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Transformation Of Fishermen's Settlements in Manado City
Case Study of Coastal Reclamation Boulevard Dua

Claudia Talita Dariwu[1]*, Kindly Anugerah Imanuel Pangauw[1], Fiska Chintya Ezra Pangalila[2]

[1] Department of Architecture, Sam Ratulangi University, Manado, Indonesia
[2] Department of Civil Engineering, Sam Ratulangi University, Manado, Indonesia

Correspondence*:
E-mail: claudiatalitadariwu@yahoo.co.id

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Abstract

Research explores the Transformation of Fishing Settlements in the Boulevard Dua coastal reclamation area of Manado City, focusing on how communities adapt to ecological changes and coastal urbanization. The reclamation initiative, intended to expand urban land, has resulted in shifts in spatial layouts, housing designs, and fishermen's income sources. Utilizing a mixed-methods approach that combines GIS-based spatial analysis, direct field surveys, and in-depth interviews, the study uncovers that settlements now face inland rather than the sea, and traditional homes have transitioned into permanent multifunction residences. Livelihoods have moved from exclusive fishing to services and small-scale commerce. These observations demonstrate social and architectural adaptations to urban development pressures, while emphasizing the importance of fair, environmentally friendly coastal planning centered on local communities. Building on this context, the research explicitly targets three core issues in post-reclamation settlement transformation: spatial patterns of settlement, shifts in housing functions, and alterations in the architectural identity of local communities. The problem scope encompasses changes in spatial orientation from sea to land, reconfiguration of settlements from linear to grid or cluster forms, modifications of house roles from single-purpose to productive dwellings, and the effects on the continuity of coastal architectural identity deeply rooted in maritime culture. The anticipated results will not only chart physical and functional changes but also elucidate how fishing communities formulate adaptation strategies to uphold their architectural and social identities amid challenges posed by urbanization and reclamation policies.

Keywords: *coastal reclamation; transformation of fishing settlements; urban sustainability*

Introduction

Manado City is one of the primary coastal cities in eastern Indonesia, with a coastline spanning approximately 18.7 km, and has a long history as a center of maritime activity. Since the 1990s, the city's development direction has adopted the Waterfront City concept, focusing on waterfront development for economic, tourism, and modern residential purposes. One major project reflecting this policy is the Boulevard Dua Coastal Reclamation, which created new land covering about 90 hectares in Manado Bay. (Oehlers, J. D, 2024) This reclamation aims to enhance the city's land capacity and economic activities. However, it has also had significant impacts on the coastal environment and the socioeconomic lives of traditional fishing communities that have inhabited the area for several generations.

Before reclamation, the fishing settlements along the Boulevard Dua coast featured distinctive tropical coastal architecture, with stilt houses oriented toward the sea and arranged in a linear line along the shoreline. (Wahyudi et al., 2023) The ecological relationships among dwellings, the sea, and economic activities were deeply intertwined. The sea was not only a source of livelihood but also an integral part of the coastal community's culture and identity. However, post-reclamation, these characteristics changed drastically. Access to the sea became restricted, settlements became denser, and land use shifted from single-function dwellings to mixed-use residences. This phenomenon indicates a complex transformation in spatial, social, and architectural aspects within the Manado coastal fishing community.

Furthermore, ecological changes resulting from reclamation have led to the loss of boat mooring areas, reduced brackish water sources, and increased risks of tidal flooding and coastal erosion. Socially, the fishing community has experienced shifts in livelihoods, from full-time fishing to informal economic activities and service provision. These changes create a paradox between macro-economic development and the socio-ecological sustainability of micro-communities (Faradilla, 2023). This situation underscores the importance of research on post-reclamation transformations in fishing settlements to understand the spatial, social, and cultural dynamics of coastal communities facing urbanization pressures.

Previous studies in Manado (Rondonuwu, 2019) have primarily focused on the environmental impacts of reclamation and the loss of coastal public spaces. Still, few have deeply examined spatial changes and the architectural transformations of fishermen's houses as adaptive responses to reclamation. Studies on the relationship between transformations in housing space and shifts in the socioeconomic identity of fishermen remain limited. Therefore, this research aims to fill these gaps through a multidisciplinary approach integrating GIS-based spatial analysis, architectural studies, and socioeconomic examinations of the fishing community.

Research Objectives

- Identify changes in spatial layout and physical conditions of fishing settlements in the Boulevard Dua coastal reclamation area before and after reclamation.
- Analyze the forms of architectural transformation in fishermen's houses and adaptations in space functions to the new environmental conditions.
- Examine the socioeconomic dynamics of the fishing community in responding to changes in sea access and livelihood orientations.
- Formulate conceptual models and policy recommendations for managing fishing settlements oriented toward social, ecological, and architectural sustainability.

This research (Hantono & Sitanggang ,2022) contributes to the advancement of coastal architecture and tropical urban planning by offering new insights into the dynamics of spatial transformation in fishing settlements resulting from reclamation. Theoretically, it extends the application of the built environment transformation concept to Indonesian coastal architecture. In practice, (Nurcahyo & Sari, 2025) the findings produce thematic maps of spatial transformations, floor plans of changes to fishermen's houses, and community-based coastal zoning policy recommendations. These outcomes are expected to support Manado's sustainable development vision while strengthening the implementation of Universitas Sam Ratulangi's Renstra (Rencana Strategis) in the field of outstanding research on coastal resources.

Literature Review

Theory of Settlement Transformation

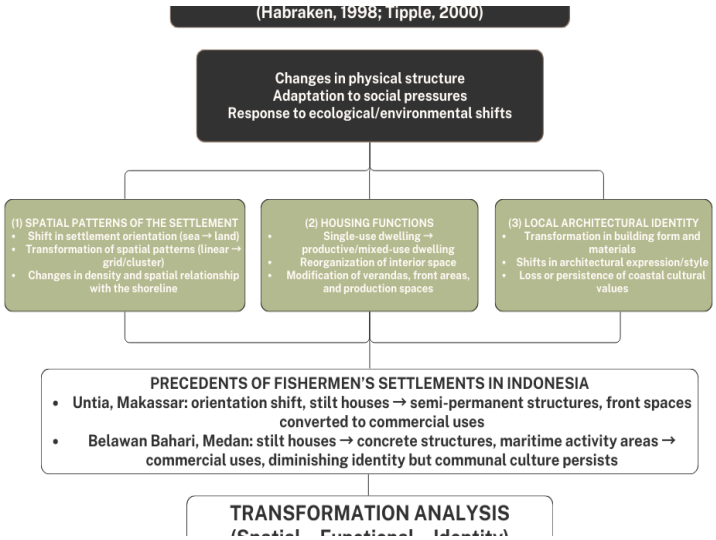


Figure 1. Theory of Settlement Transformation
Source: Habraken, 1998; Tipple, 2000

The concept of settlement transformation refers to the gradual changes in the physical, social, and cultural structures of a built environment driven by internal or external community dynamics. Transformation is a continuous process of change in the physical and social systems of a settlement that reflects the interaction between humans, space, and cultural values (Habraken, 1998). These changes can manifest as additions, reductions, or relocations of physical and social elements that shape the living environment.

The phenomenon of transformation in fishing settlements is often triggered by external factors, such as urbanization pressure, coastal reclamation, or urban development policies that fail to consider socio-ecological sustainability. Housing transformation represents an adaptation to changes in spatial and household economic needs (Tripple, 2000). In the context of coastal settlements, transformation not only affects architectural forms but also values, social relations, and the community's cultural identity (Habraken, 1998).

The transformation of fishing settlements in Manado can be understood as a multidimensional phenomenon that integrates three aspects: Spatial transformation, namely the change in spatial layout patterns from linear, following the coastline, to a grid pattern following post-reclamation road structures. Architectural transformation, namely the change in form from traditional stilt houses to permanent multifunction dwellings (mixed-use dwellings). Socioeconomic transformation, namely the shift in livelihood orientation from a marine-based economy to a land-based economy. The theory of built environment transformation serves as an important framework for understanding how fishing communities adapt to ecological changes and urban development pressures Concept of Fishing Settlements.

Fishing settlements are a distinctive form of settlement in coastal areas that have historically developed as a response to the livelihood needs of communities dependent on marine resources. According to the Directorate General of Human Settlements in Guidelines for Urban Settlement Environment, fishing housing is a residential area inhabited by communities whose majority are fishermen, equipped with infrastructure and facilities supporting fishing activities, such as boat moorings, docks, fish-drying areas, and production spaces (Habraken, 1998).

Morphologically, fishing settlements in Indonesia generally develop organically along the coastline and have a strong orientation toward the sea (Supriharyono, 2007). Their characteristics include linear patterns, stilt houses with natural ventilation, and open spaces that serve social and economic functions simultaneously (Doxiadis, 1968; Yatmo & Atmodiwirjo, 2019). In a cultural context, fishing settlements not only reflect the economic system but also a system of high values and social solidarity, that the living space of fishermen is an expression of maritime community identity (Rusdiana et al., 2020).

However, the development of modern coastal cities has altered this order. Reclamation and urbanization shift the function of fishing areas from sea-based productive spaces to dense residential areas integrated with land-based economies. This phenomenon triggers the emergence of new adaptive housing forms to spatial and economic pressures. These changes are not merely physical degradation but a process of social-spatial transformation that demonstrates the fishing community's ability to adapt to structural changes in their environment.

Coastal Reclamation and Spatial Planning Policies

Reclamation is an activity that creates new land by filling water areas to enhance economic benefits and urban spatial layout. Based on the Manado City Spatial Plan 2023–2042, reclamation is defined as an effort to improve land functions from social, economic, and environmental aspects through landfilling or drying methods (Nurcahyo & Sari, 2025). In the national context, reclamation policies are regulated by Presidential Regulation No. 122 of 2012 on Reclamation in Coastal and Small Island Areas, which emphasizes the need to balance ecological, social, and economic functions (Kementrian PUPR, 2007).

However, in practice, reclamation projects often cause severe socio-ecological impacts, including the loss of fishing grounds, changes in sea currents, and the displacement of fishing settlements (Ulung et al., 2018). In Manado, the Boulevard Satu and Dua Coastal Reclamation Project serves as a concrete example of how urban development policies can create disparities between investment interests and the sustainability of local communities (Doxiadis, 1968).

In this context, a sustainable coastal planning approach based on community participation is required. This approach aligns with the principles of Integrated Coastal Zone Management (ICZM), which emphasize integrating environmental, social, and economic aspects (Kay & Alder, 2017). Therefore, reclamation policies should not only expand economic space but also guarantee the rights of coastal communities to their living spaces and cultural identities.

Conceptual Synthesis

From the literature review above, the post-reclamation transformation of fishing settlements results from complex interactions among ecological, social, and architectural factors. The theory of built environment transformation (Faradillah, 2023). provides a conceptual foundation for understanding spatial change as a continuous social adaptation process. Meanwhile, the concept of fishing settlements emphasizes the importance of ecological and cultural relations between humans and the sea.

In the context of Manado's coastal reclamation, these three perspectives, spatial transformation, architectural adaptation, and spatial planning policies, converge in one central issue: how coastal communities maintain their identity and livelihood sustainability amidst urban development pressures (Nugroho & Astuti, 2023). With this theoretical framework, the subsequent research focuses on empirically analyzing the processes of physical, social, and architectural changes in fishing settlements in the Boulevard Dua reclamation area through spatial, qualitative, and quantitative approaches.

In this study, the discussion focuses on three core aspects essential to understanding the transformation of fishermen's settlements following coastal reclamation: the spatial patterns of settlement, the functional characteristics of housing, and the architectural identity of the coastal community. The analysis is grounded in several key theoretical foundations. First, the theory of settlement transformation and the built environment explains how spatial and architectural changes emerge as adaptive responses to environmental pressures and social dynamics (Habraken,1998; Tipple, 2000). Second, empirical studies and precedents of fishermen's settlements in Indonesia reveal distinctive spatial characteristics, such as seaward-oriented dwellings, the use of stilt-house structures, and the functional integration between the house and maritime economic activities (Supriharyono, 2007; Yatmo & Atmodiwirjo, 2019). Third, the concept of local architectural identity within coastal communities, which emphasizes the role of cultural values, ecological relationships with the sea, and everyday spatial practices in shaping the architectural expression of fishermen's communities (Rusdiana et al., 2020).

Building upon this theoretical foundation, the study develops three principal analytical variables:

(a) **The spatial pattern variable**, which includes changes in settlement orientation, the evolution of road networks, building density, and the spatial relationship between the settlement and the shoreline before and after reclamation;

(b) **The housing function variable**, which examines the shift from single-use residential functions toward more productive or mixed-use configurations, the reorganization of interior spaces, and the utilization of additional areas to support household economic activities; and

(c) **The local architectural identity variable**, which encompasses transformations in building form, material use, architectural style, and the shifting coastal cultural values expressed in spatial arrangements and built forms.

Methodology

Research is an activity closely associated with the field of science, typically conducted to uncover, verify, or evaluate the accuracy of something. The phenomenon of transformation in fishing settlements in Manado, particularly in the Boulevard Dua coastal reclamation area, demonstrates social, economic, and environmental dynamics influenced by changes in coastal spatial planning through the reclamation process.

Based on the research flow diagram, the method to be applied is a case study with a mixed-methods approach (qualitative, quantitative, and spatial) (Nugroho & Astuti, 2023; Rusdiana et al, 2020). Data collection is conducted through field observations, surveys, interviews, map analysis, and policy studies. Data analysis involves spatial techniques (GIS), qualitative (thematic analysis), quantitative (descriptive statistics), and policy analysis (Peraturan Presiden No. 122 Tahun, 2012). The research results include thematic maps of fishing settlements, floor plans of fishermen's houses before and after changes, and policy recommendations to be submitted to the Manado City Government.

1. Research Approach

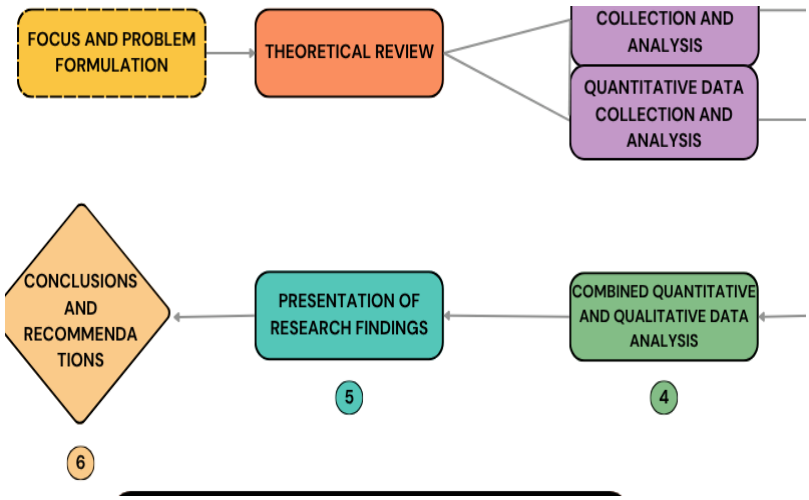


Figure 2. Mixed Methods
Source: Creswell & Plano Clark, 2018

This research employs a mixed-methods approach, combining qualitative, quantitative, and spatial methods, to achieve a comprehensive understanding of the transformation phenomenon in fishing settlements in the Boulevard Dua coastal reclamation area, Manado. This approach is selected because the changes under study involve ecological, social, economic, and architectural aspects that are intricately interconnected. Overall, this research is descriptive-comparative, comparing the conditions of fishing settlements before and after reclamation to evaluate the forms, functions, and patterns of community adaptation to physical and social environmental changes.

2. Research Location and Time

The research location is in Bitung Karangria Village and Maasing Village, Tuminting District, Manado. Both areas are coastal regions directly affected by the Boulevard Dua Reclamation Project, with communities predominantly engaged in traditional fishing. Encompassing field surveys, collection of primary and secondary data, spatial analysis, and result interpretation through a socio-architectural perspective.

3. Types and Sources of Data

This research utilizes two main types of data:

- Primary data, obtained through field observations, in-depth interviews with fishing communities, photo documentation, and spatial measurements of houses and settlements.
- Secondary data, sourced from Google Earth and Landsat satellite imagery, spatial planning maps (Manado City Spatial Plan 2023–2042), and data from the Public Works Department and local fishing communities.

Both types of data are integrated to provide a complete picture of spatial and social changes in the study area.

4. Research Stages

a. Preliminary Study

The initial stage includes collecting literature and policy documents related to:

- Theory of settlement transformation (Habraken, 1998);
- Concepts of fishing settlements and coastal reclamation;
- Manado City spatial planning policies.

The results of this study are used to formulate indicators for analyzing spatial, architectural, and social transformations.

b. Field Data Collection

Conducted through several methods: direct observation of the existing conditions of fishing settlements in two study locations. In-depth interviews with community leaders, fishing group heads, and representatives of fishing families to understand socioeconomic changes. Visual documentation in the form of photos of house conditions, environment, and public facilities (Sitorus & Hutabarat, 2021). Spatial surveys with mapping of coordinate points of fishermen's houses using GPS for GIS analysis purposes.

c. Spatial Analysis (Geographic Information System / GIS)

Spatial analysis is conducted to identify and compare changes in settlement patterns over three time periods: 2005 (pre-reclamation), 2015 (transition period), and 2025 (post-reclamation). The steps include: Processing Google Earth and Landsat satellite imagery for settlement boundary delineation; Creating thematic maps of spatial transformation using ArcGIS software; overlaying spatial analysis to observe shifts in fishermen's house locations and changes in residential area sizes; Buffering analysis up to 200 meters from the old and new coastlines to map spatial orientation shifts. The results of spatial analysis provide a quantitative basis for assessing changes in housing density, settlement patterns, and spatial orientation toward the sea.

d. Qualitative Analysis

This analysis focuses on understanding the meanings and experiences of communities facing environmental changes. The qualitative analysis steps include: Transcription of interviews with fishermen and stakeholders; Thematic analysis to identify main themes, such as social adaptation strategies, changes in household functions, and perceptions of reclamation; and Triangulation between interview results, observations, and spatial data to ensure the validity of the findings.

e. Quantitative Analysis

Quantitative analysis is conducted to assess measurable changes, including: Calculation of the number of fishermen's houses, settlement land area, and housing density per hectare; Analysis of density change trends (2005–2025); Tabulation of socioeconomic data (types of employment, income, house ownership, and business diversification); Presentation of results in the form of descriptive tables and graphs to strengthen spatial and qualitative analysis results.

f. Synthesis and Interpretation

The final stage is integrating all results from spatial, qualitative, and quantitative analyses to build a conceptual model of fishing settlement transformation in the Boulevard Dua coastal reclamation area. This synthesis provides an understanding of the relationships among ecological, architectural, and socioeconomic factors in the transformation of the fishing settlement.

5. Comparative Analysis Design

This research also uses a comparative-narrative approach to compare the two study locations (Bitung Karangria Village and Maasing Village). The analysis is conducted by evaluating: Differences in physical environmental characteristics, such as ecosystem degradation levels, spatial patterns, and sea access, Differences in housing typologies, including building materials, spatial orientation, and house functions, Differences in socioeconomic adaptation strategies of communities in maintaining livelihoods. The comparison results are presented in spatial and social analysis tables that show variations in adaptive responses of fishing communities to reclamation pressures.

6. Data Validation and Result Reliability

To ensure the validity of research results, source and method triangulation techniques are used, namely: comparing field observation results with GIS spatial data and interviews; verifying findings with information from government agencies and fishing communities; and validating thematic maps and house plans through participatory consultations with residents. These techniques ensure that the interpretation of research results is objective, credible, and representative of actual field conditions.

7. Research Analysis Framework

Conceptually, the research flow illustrates the relationships among ecological changes resulting from reclamation, spatial and architectural transformations, and socioeconomic adaptations of fishing communities. The analysis results from each stage are used to formulate a conceptual model that can serve as a basis for future sustainable coastal area planning.

Result

A. EXISTING CONDITIONS OF FISHERMEN'S SETTLEMENTS

1. General Overview of the Research Location

This study was conducted in two coastal sub-districts directly affected by the Boulevard Dua reclamation project, namely Bitung Karangria Sub-district and Maasing Sub-district, located in Tuminting District, Manado City. Both areas have a rich historical background as traditional fishing settlement zones that developed organically along the shores of Manado Bay.

Geographically, Bitung Karangria Sub-district is situated in the northern part of the reclamation area. At the same time, Maasing Sub-district lies on the southern side, which now forms the new land boundary resulting from the reclamation. Prior to the reclamation project, both sub-districts faced directly towards the sea, with a linear settlement pattern following the original coastline. However, following the

reclamation, most of the coastal area has been transformed into artificial land, significantly diminishing the ecological and functional linkages between the local community and the marine environment.

Figure 3. Satellite Imagery Map
Source: Google Earth, 2025

2. The Condition of Fishermen's Settlements along the Boulevard Dua Coastal Area: Bitung Karangria Village

a. Physical Environmental Changes

Based on field survey findings, prior to the reclamation activities, the coastal area of Bitung Karangria exhibited the characteristics of a natural shoreline with open sea waters, a clearly defined coastline, and coral reef ecosystems at several coastal points. However, following the reclamation process, most of the shoreline has been filled and transformed into reclaimed land, leaving the natural coastline near complete. Currently, only a small section in the northern part of the village remains in its original condition.

This transformation has disrupted the ecological balance of the coastal environment. The natural flow of seawater is now obstructed by reclaimed soil and concrete structures, leading to seawater intrusion into inland areas and increasing the risk of tidal flooding during the rainy season. These ecological impacts are also felt by the local community, which has lost its traditional boat mooring areas and access to brackish water sources used for daily needs.

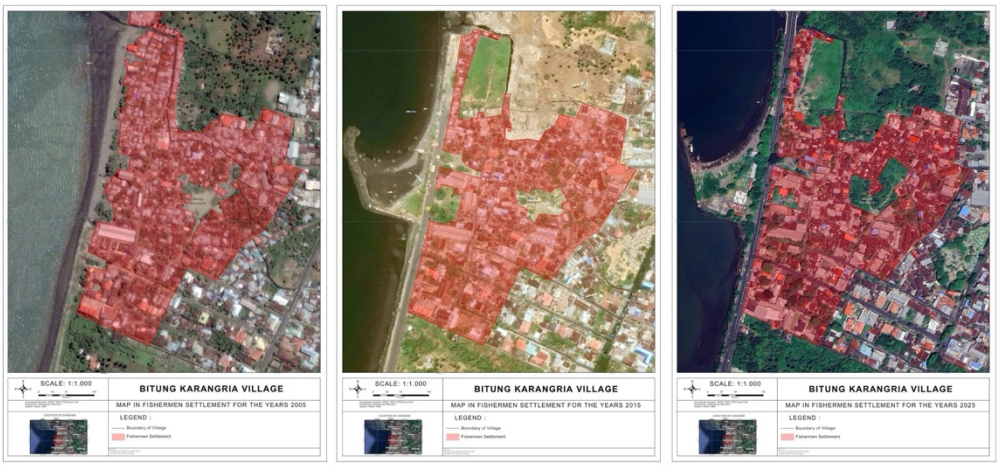


Figure 4. Satellite Imagery Map
Source: Google Earth, 2025

b. Settlement Pattern

Before the reclamation project, the settlement pattern of fishermen in Karangria developed naturally along the coastline in a linear arrangement, without formal spatial planning. The houses were built close to one another and faced the sea, reflecting the community's dependence on and orientation toward fishing activities. After the reclamation, residential areas shifted as parts of the coastal zone were converted into reclaimed land. Several fishermen's houses were relocated or rearranged further inland as new road patterns were formed. At present, the original linear settlement pattern has evolved into a mixed form combining clustered and grid arrangements. Some residents have established new residential clusters near the reclamation area, while others have chosen to remain in the original settlement zone despite the increasing distance from the sea. This spatial shift has not only altered the physical structure of the settlement but has also affected the social dynamics and patterns of interaction among members of the fishing community.

c. Housing Pattern

Prior to the reclamation, fishermen's houses in Karangria were generally stilt houses constructed from wood or bamboo, roofed with palm leaves or corrugated metal sheets, and floored with compacted earth or wooden planks. Following the reclamation, significant changes occurred in the materials and structure of the buildings. Many houses have now been reconstructed as semi-permanent or permanent dwellings, featuring concrete walls, metal roofing, and tiled floors. These changes illustrate the community's adaptation to a drier, denser environment. The houses are no longer built on sandy coastal soil but on the solid reclaimed land. The transformation of building materials also represents an adaptive response to increasingly frequent extreme weather conditions and higher rainfall intensity resulting from changes in the coastal ecosystem.

d. Livelihoods

Before the reclamation process, most residents worked as full-time fishermen, going to sea almost daily depending on weather conditions. However, after reclamation, fishing activities declined as the distance to boat mooring sites increased and fish catches decreased. Consequently, some community members turned to alternative occupations such as construction laborers, daily workers, or small-scale traders. Although fishing remains central to their collective identity, the community has adopted a mixed economic system to sustain their livelihoods. This phenomenon reflects a socioeconomic transition from traditional fishing communities to urban coastal societies, driven by spatial restructuring and the loss of direct access to marine resources.

3. The Condition of Fishermen’s Settlements along Boulevard Dua Coastal Area: Maasing Village

a. Physical Environmental Changes

Before the reclamation project, the Maasing coastal area directly bordered the sea and exhibited natural beach characteristics, with clear seawater and stretches of sandy shoreline. However, following the reclamation process and the construction of Boulevard Dua Road, the area transformed into a developed urban zone featuring a road approximately 20 meters wide, equipped with pedestrian pathways and concrete barriers separating the land from the sea. As a result of this development, the ground elevation around the road has risen by approximately three meters above the original coastline level. This transformation eliminated the natural transition zone between the sea and the settlement, although it also introduced specific positive effects. Areas that were once vulnerable to tidal waves are now relatively protected due to the presence of concrete wave-breaking structures. On the other hand, this change has significantly restricted fishermen's access to the sea, forcing them to find alternative launch and mooring sites.

Figure 5. Satellite Imagery Map
Source: Google Earth, 2025

b. Settlement Pattern

Prior to reclamation, fishermen's settlements in Maasing developed in a linear pattern along the coastline, with direct access to the sea located behind their homes. After the reclamation and the construction of Boulevard Dua Road, this pattern changed drastically. The residential area has now shifted inland, away from the shoreline, and no longer faces the sea. Houses that once opened toward the beach now face directly onto the main road. This spatial reorientation indicates a shift in community focus from maritime-based activities toward terrestrial life. Fishermen's houses are now more closely connected to land-based economic activities, such as small-scale roadside trade, replacing the earlier orientation centered on fishing practices.

c. *Housing Pattern*

Before reclamation, fishermen's houses in Maasing were generally traditional stilt houses, with open spaces beneath them functioning as protective areas during high tides. The house layout was simple, featuring natural partitions and open front yards. Today, however, most houses have been transformed into permanent landed houses with concrete walls and metal roofing. This transformation has also led to the disappearance of open front yards and the emergence of additional spaces serving economic purposes, such as small shops or rental units. Consequently, fishermen's houses no longer serve solely as living spaces but have evolved into mixed-use dwellings combining residential and commercial functions. This phenomenon reflects the community's architectural adaptation to economic pressures and the increasing spatial demands of an increasingly urbanized environment.

d. *Livelihoods*

Field observations indicate that the Maasing coastal community is no longer entirely dependent on the fishing sector. Although traditional fishing remains present, the number of full-time fishermen has declined. Most residents now engage in supplementary occupations, such as motorcycle taxi drivers, small-scale traders, or home-based entrepreneurs. This diversification of livelihoods reflects an adaptive strategy in response to social, economic, and climatic pressures. The fishing community demonstrates a high degree of flexibility in adjusting to new urban-oriented conditions by transitioning toward land-based economic activities, marking a socioeconomic shift from traditional fishing communities to coastal urban societies with non-maritime livelihoods.

Table 1. Comparative Analysis of the Two Research Locations

ASPECT	BITUNG KARANGRIA URBAN VILLAGE	MAASING URBAN VILLAGE	COMPARATIVE ANALYSIS
ENVIRONMENTAL CONDITIONS	Drastic changes; coastal ecosystems have disappeared, and the risk of tidal flooding has increased.	More stable environment with physical protection such as roads and wave-retaining concrete structures.	Karangria experiences more severe ecological impacts, while Maasing is relatively more protected physically but has lost direct access to the sea.
SETTLEMENT PATTERN	Shifted from a linear to a clustered form, with partial relocation to areas behind the reclaimed land.	Transformed from a linear pattern to a grid system following the alignment of Boulevard Dua Street.	Both areas exhibit a spatial orientation shift from sea-based to land-based settlement patterns.
HOUSING PATTERN	Transition in building materials from wood to concrete, with some traditional forms still remaining.	Almost all houses are permanent and densely built.	Maasing demonstrates a faster urbanization process in terms of housing transformation.
LIFELIHOODS	Fishermen with secondary occupations such as laborers or construction workers.	Fishermen with alternative jobs such as drivers or small traders.	Both communities show economic diversification as a result of declining access to the sea.

Source: Field Observation Data, 2025

The analysis of these two locations reveals that coastal reclamation has triggered fundamental changes in the ecological, spatial, architectural, and socioeconomic dimensions for the fishing community. This phenomenon can be summarized in three crucial aspects:

First, ecological and spatial shifts have prompted the community to reorient itself from the sea to the land, with settlements that were previously directly open to the sea now separated by new infrastructure.

Second, architectural transformations demonstrate adaptations to altered environmental conditions, with traditional stilt houses being replaced by multifunctional permanent structures.

Third, socioeconomic changes reflect efforts at adaptation through livelihood diversification, though this may diminish maritime identity and coastal culture.

These findings affirm that fishermen in Bitung Karangria and Maasing are not merely passive recipients of change, but active agents devising resilience strategies amid the environmental impacts of reclamation.

B. SPATIAL ANALYSIS

Thematic Map of Fishermen's Settlements (GIS-Based)

In this study, the Geographic Information System (GIS) approach is employed to examine the spatial transformation of fishermen's settlements along the Boulevard Dua coast in Manado City, taking into account three temporal phases: 2005 (before reclamation), 2015 (during the transition period), and 2025 (after reclamation). The primary data sources are Landsat satellite imagery and Google Earth, which are subsequently integrated with mapping survey results for fishermen's houses and field documentation from Maasing and Bitung Karangria Villages.

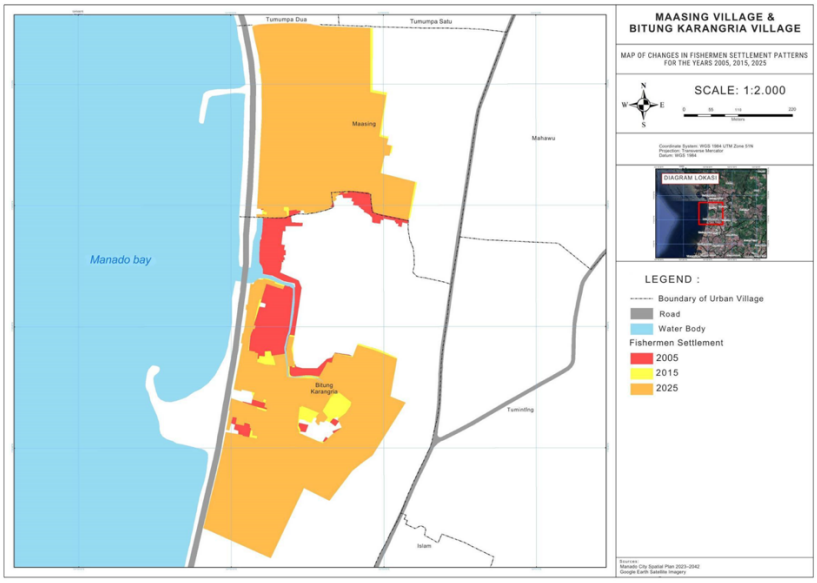


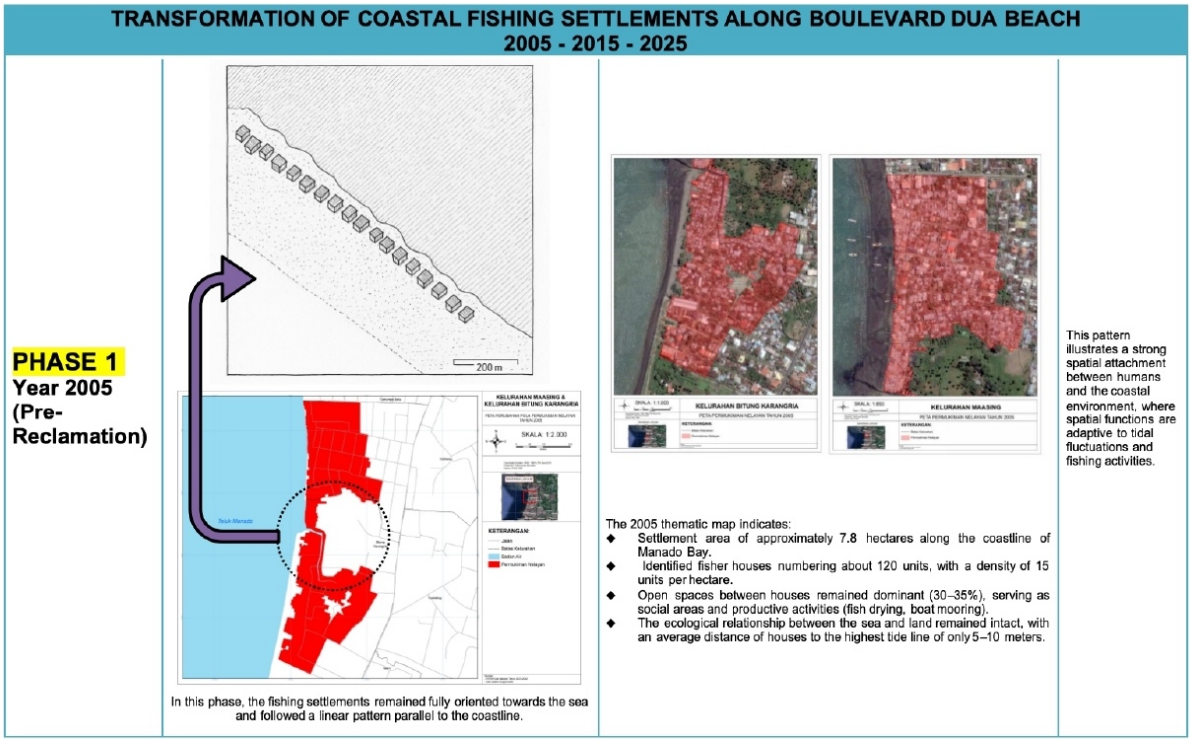
Figure 6. Thematic Map (GIS-Based)
Source: Google Earth, 2025

Analysis based on GIS data and field observations indicates that the evolution of fishermen's settlements in the Boulevard Dua area undergoes gradual spatial changes, which can be detailed as follows:

1. Ecological displacement (2005-2015) : where spatial shifts occur due to initial reclamation that erases the original coastline;

2. Densification and reorientation (2015-2025) : with increased housing density and a shift in house orientation from the sea to the land;

3. Adaptive urbanization (2025) : marked by the emergence of grid-patterned settlements with new household-based economic activities.



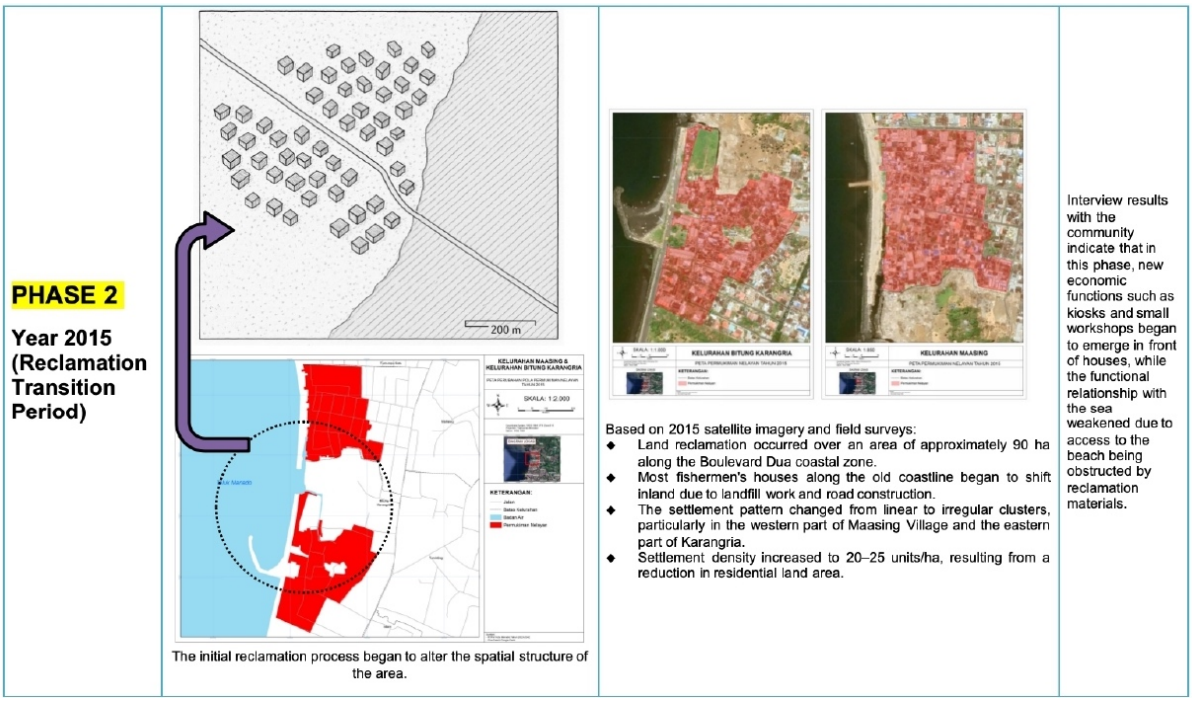


Figure 7. Tranformation Of Coastal Fishing Settlements 2005-2015
Source : Researcher Analysis based on GIS data and field observation, 2025

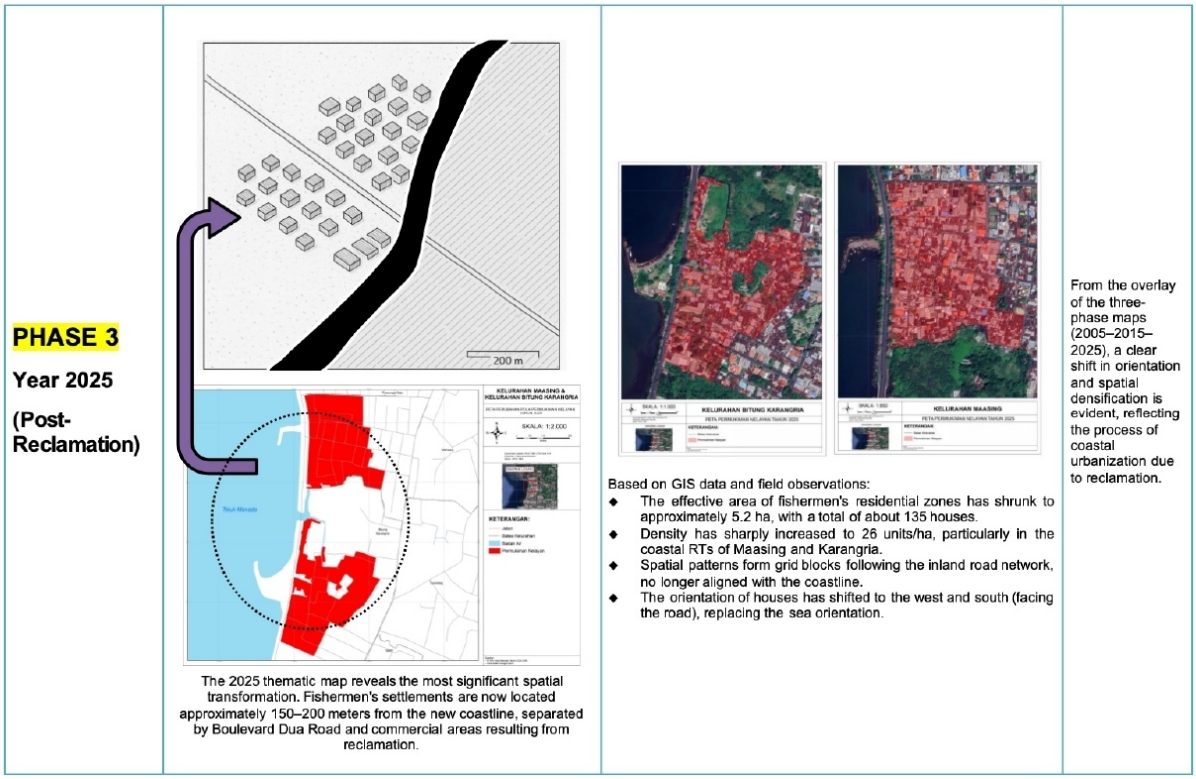


Figure 8. Tranformation Of Coastal Fishing Settlements 2025
Source: Researcher Analysis based on GIS data and field observation, 2025

This phenomenon illustrates the capability of spatial technologies such as GIS to capture the dynamics of fishermen's settlements both quantitatively and qualitatively, while reinforcing that architectural and social changes in the Boulevard Dua coastal community are direct consequences of man-made environmental interventions through reclamation and urban growth pressures. Therefore, the thematic maps from 2005 to 2025 serve not only as visual records but also as socio-ecological spatial documents that reflect processes of adaptation, resistance, and transformation experienced by the fishermen community on the Manado coast over the past two decades.

C. EXISTING CONDITION OF FISHERMEN'S HOUSING

Analysis of Housing Distribution Patterns and Changes in Residential Density

Spatial analysis was carried out using the *point density mapping* technique combined with a *buffering analysis* within a 200-meter radius from both the old and new shorelines. The purpose of this analysis is to identify the spatial dynamics of fishermen's housing distribution and the shifts in residential density following the reclamation process.

a. Distribution Pattern of Fishermen's Houses

- **2005 :** The distribution of fishermen's houses was dense along the coastline, forming a continuous linear belt with a high concentration of dwellings, particularly in the eastern part of Karangria.
- **2015 :** The distribution pattern began to extend southward toward Maasing as a result of relocation driven by land reclamation projects. This period was marked by spatial fragmentation and the loss of continuity between housing clusters.
- **2025 :** The concentration of residential points shifted inland by approximately 150 meters from the original shoreline, forming a grid-like pattern that runs parallel to Boulevard Dua. The settlement now exhibits a semi-urban character, interspersed with new commercial buildings.

GIS visualization reveals an apparent spatial displacement, indicating a shift in settlement orientation from a coastal, sea-oriented fishing village to a road-oriented urban coastal settlement. This transition reflects not only changes in physical layout but also the evolving function of the coastal zone.

b. Changes in Residential Density

The results of the spatial analysis demonstrate a consistent trend of increasing residential density over time, indicating progressive urbanization within the coastal fishing communities.

Table 2. Trends in Residential Density

Year	Area of Residential Zone (ha)	Number of Fishermen's Houses	Density (units/ha)	Spatial Description
2005	7.8	±120	15	Linear pattern parallel to the coastline
2015	6.1	±125	20	Irregular clustered pattern (transitional phase)
2025	5.2	±135	26	Dense grid pattern parallel to the reclamation road

Source: Field Observation Data, 2025

c. General Characteristics and Typology of Fishermen's Houses

Fishermen's settlements along the Boulevard Dua coastal area, particularly in Bitung Karangria and Maasing sub-districts, reflect a distinctive typology of coastal vernacular architecture. Prior to the reclamation activities, fishermen's dwellings were generally simple wooden stilt houses built on sandy ground and directly facing the sea. This architectural form demonstrated a high level of adaptability to tidal fluctuations while illustrating a strong ecological interconnection between living spaces, fishing activities, and the marine environment as the primary source of livelihood.

The reclamation period between 2015 and 2025 marked a significant transformation in both the physical form and spatial function of these houses. Most fishermen's dwellings now stand on compacted reclaimed land and have evolved into permanent or semi-permanent structures predominantly made of concrete. The orientation of the houses has also shifted from facing the sea to facing Boulevard Dua Road. This transformation signifies a typological change from traditional maritime-oriented coastal houses to more adaptive and multifunctional urban dwellings that integrate residential use with economic activities.

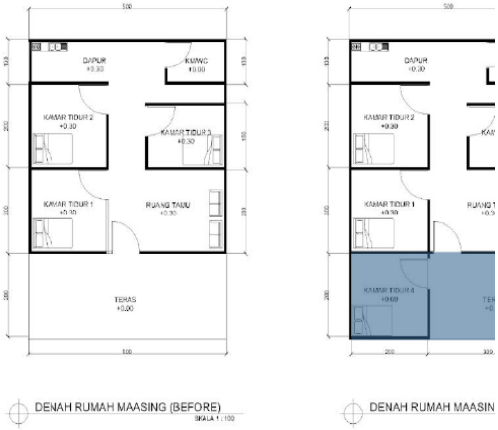
PONDENT	PROFILE	HOUSING PATTERN	HOUSE PLAN SKECTH
n, 54 years old, Fishermen's 	Owner-occupied house. Background: Moved to the current location in 1982 due to the family's main occupation as fishermen. The current site used to border directly with the coastline before the construction of Boulevard II Road in 2010. Before the development of the main road, Mr. Hasan's house was frequently affected by tidal waves, causing repeated damage. The original house type was a stilt house (rumah panggung).	Form and Type: Permanent structure. Building Materials: Reinforced concrete, cement floor, zinc roof. Spatial Layout: Complete transformation of the house's interior after the reclamation project. Initially a wooden stilt house, it was later reconstructed with concrete materials and an added terrace. By 2025, a non-permanent kiosk (warung) was added on the terrace area as a new economic adaptation.	
68 years old, of Fishermen's 	Owner-occupied house. Has been a fisherman since youth, following his parents' occupation. Originally from Manado Tua Island, he relocated to the city in search of better livelihood opportunities. Currently, he is no	Form and Type: Permanent structure. Building Materials: Reinforced concrete, cement floor, zinc roof. Spatial Layout: Additions have been made to the terrace area, along with the	
 	Owner-occupied house. Has been working as a fisherman since youth, following his parents' occupation. Previously lived in the back area of Maasing near the river, but relocated in 2005 to the coastal zone after eviction from the previous site. The former house directly bordered the coastline and was at the same elevation as the beach.	Form and Type of House: Permanent structure Building Materials: Reinforced concrete, cement floor, zinc roof Spatial Layout Pattern: The spatial layout changed after the construction of the coastal road. The house is now situated below road level and no longer directly connected to the shoreline.	
Samel, 60 years er of Fishermen's 	Mr. Zakaria has lived in Karangria for 60 years (since birth). The house is occupied only by him and his wife. It is an owner-occupied property, and together they operate a small kiosk (warung) in front of their house.	Form and Type of House: Semi-permanent structure Building Materials: Zinc roof, concrete and plywood walls Spatial Layout Pattern: Before reclamation, the house consisted of a terrace, living room, one bedroom, kitchen, and bathroom. After the reclamation, several changes occurred, including the addition	

Figure 9. Transformation of spatial pattern and function of fishermen's houses Maasing Village
Source: Researcher Analysis based on GIS data and field observation, 2025

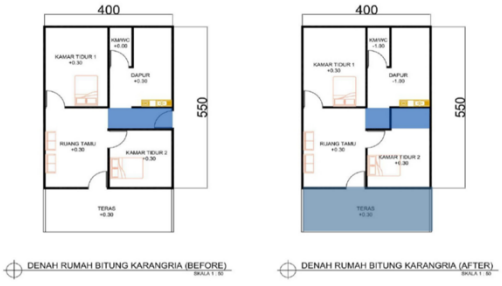
Mr. J. Haydemans, 68 years old, Treasurer of the Fishermen's Group 	Owner-occupied house. Background: Moved to the current location in 2008. His primary occupation is as a fisherman; however, since 2018, he has developed an additional source of income by establishing a boarding house (kost) consisting of six rooms and managing a small family business.	Form and Type of House: Permanent structure Building Materials: Reinforced concrete, cement floor, zinc roof Spatial Layout Pattern: The spatial configuration of the house has changed following the addition of new functional areas, including rental rooms (kost) and a parking area, extending the use of the residence beyond its original domestic function.	
Mr. J. Adrian, 49 years old, Vice Chairman of the Fishermen's Group 	Owner-occupied house. Has worked as a fisherman since youth, following his parents' occupation. He has lived in the same house since birth, as it originally belonged to his parents. As the head of a family with three children, Mr. Adrian has diversified his livelihood beyond fishing, running a sound system rental business and a small food stall (warung makanan jadi).	Form and Type of House: Permanent structure Building Materials: Reinforced concrete, cement floor, zinc roof Spatial Layout Pattern: The overall building size remains unchanged, but functional adjustments have occurred. In 2019, a former storage room for fishing equipment was converted into a food stall, and the terrace area is now also used for storing sound system equipment.	
Mr. Natal Adrian, 66 years old, Member of Fishermen's Group 	Owner-occupied house. Semi-permanent dwelling, located in Karangria, where he has lived since birth in his family's home. His main occupations are fishing and construction work, and since around 2020, he and his family have operated a small kiosk (warung) in front of the house.	Form and Type of House: Permanent structure Building Materials: Reinforced concrete, cement floor, zinc roof Spatial Layout Pattern: There have been no major changes to the interior spaces, apart from renovations in building materials and a bedroom extension. The kitchen and bathroom areas are located approximately one meter below the road level due to changes in ground elevation after reclamation.	
Mr. Muhammad L., 46 years old, Member of Fishermen's Group 	Owner-occupied house. Semi-permanent structure. Mr. Muhammad has lived in Karangria since birth (1981, approximately 44 years). His primary occupation is as a traditional fisherman, with an additional job as a construction worker. He lives with his wife and three children. His father was also a fisherman, continuing the family livelihood tradition.	Form and Type of House: Semi-permanent structure Building Materials: Concrete, plywood, cement floor, zinc roof Spatial Layout Pattern: No significant changes have occurred in the interior layout, except for renovations to building materials. However, the exterior layout has changed — the terrace and storage area that previously existed have been removed.	

Figure 10. Transformation of spatial pattern and function of fishermen's houses Bitung Karangria Village
Source: Field Observation Data, 2025

Based on field documentation and surveys conducted on ten representative fishermen's houses, this study identifies three main typological categories of post-reclamation fishermen's dwellings. The classification is determined by the buildings' physical form, the materials used, and the spatial functions within them. In general,

spatial transformation within fishermen's settlements along the Boulevard Dua coastal area of Manado reveals a gradual process of change, encompassing shifts in building orientation, adaptation of spatial functions, and alterations in the relationship between houses and their surrounding environment. Field observations, photographic documentation, and plan sketches indicate that the architectural evolution of fishermen's houses can be divided into three major phases, namely:

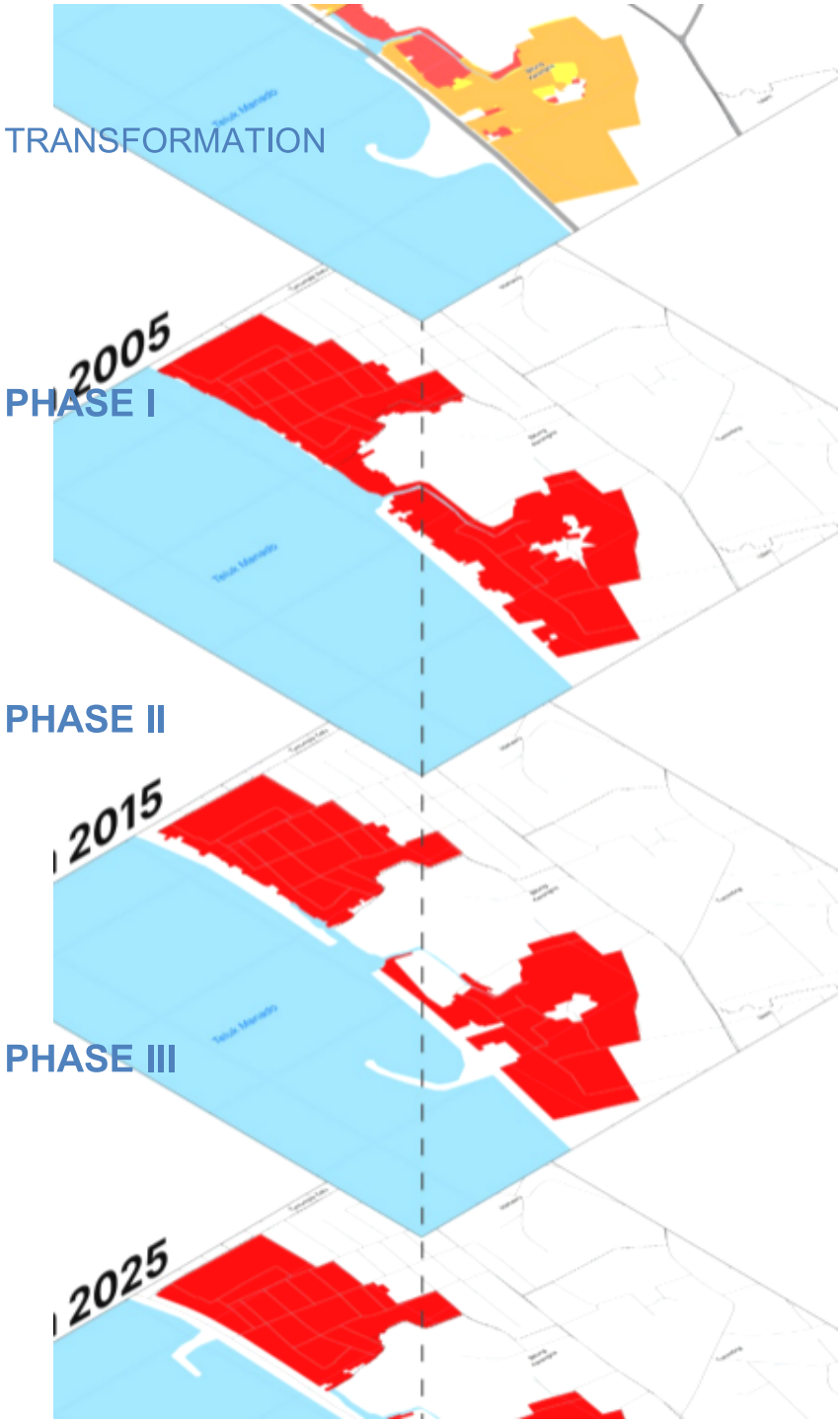


Figure 11. Transformation Phase (GIS-Based)
Source: Google Earth, 2025

Phase I – Pre-Reclamation (Before 2005)

In the initial period, fishermen's houses still retained their traditional tropical coastal vernacular characteristics, featuring wooden stilt structures and an orientation facing directly toward the sea. The floor plans were typically arranged linearly from front to back, with a simple yet functional spatial organization.

- The front veranda faced the sea and served multiple purposes, such as repairing fishing nets, drying fish, and receiving guests.
- The central area functioned as a family room and children's sleeping area, forming the social core of the dwelling.
- The kitchen and main bedroom were located at the rear, with natural ventilation directed toward the inland side.
- The space beneath the house was utilized for storing fishing gear, small boats, and as a shaded workspace.

At this stage, the relationship between the house and the sea was direct and inseparable; the sea acted as the house's front yard, and fishing activities formed an integral part of the residents' daily lives.

Phase II – Reclamation Transition (2005–2015)

As the reclamation process commenced, the orientation and function of the front part of the houses began to change due to the obstruction of direct sea access by reclamation fill materials. The stilt structures were mostly altered or buried as the ground surface gradually rose and solidified. Early adaptations to the new environmental conditions were reflected in several spatial modifications:

- The once-open front veranda became partially enclosed and repurposed as a semi-economic space, such as a small shop or storage area.
- The family room continued to serve as the main activity center, although social interactions diminished following the loss of the seaward orientation.
- The rear section of the house was expanded with small storage spaces or enclosed kitchens to support household economic activities, such as processing and selling smoked fish.
- The stilt underfloor area was partially filled or covered, as it no longer served its original function.

This stage represents a transitional phase from ecologically adapted stilt architecture toward denser, more permanent land-based housing, while still demonstrating the community's adaptive resilience to environmental changes.

Phase III – Post-Reclamation (2015–2025)

After the reclamation project was completed and the reclaimed land had stabilized, fishermen's houses underwent a complete transformation into permanent land-based dwellings (landed houses). The building orientation changed entirely, now facing Boulevard Dua Street, which had developed into the central corridor of local economic activity.

- The front veranda was fully converted into a commercial space, such as a kiosk, food stall, or small workshop, featuring direct street access and visible signage.
- The central space remained a family room, while the kitchen area was expanded toward the rear to accommodate household-based economic activities.
- The back portion often included additional rooms or a second floor used for rental accommodation or storage.
- The former underfloor space completely disappeared, replaced by concrete flooring that now functions as a storage or service area.

This phase signifies a paradigm shift in both architectural form and socio-economic orientation from ecologically grounded traditional fishermen's houses to adaptive urban dwellings with productive functions. The fishermen's homes are no longer solely residential spaces but have evolved into integral units of household economy amid the growing pressures of coastal urbanization.

Discussion

1. Spatial Pattern Variable

The transformation of spatial patterns in fishing settlements in the Boulevard Dua area exhibits quite complex dynamics since the commencement of the reclamation process. Prior to reclamation, settlements developed organically along the coastline, forming a linear pattern that demonstrated functional proximity between houses, coastal economic activity routes, and boat mooring areas. However, after reclaimed land was formed and new road networks emerged, the settlement orientation shifted significantly. Houses that previously faced the sea now turn toward inland areas or follow the road structures built on the reclaimed land. This reconfiguration of the road network also influences spatial planning, as the new routes create grid and cluster patterns that differ from the previous linear arrangement. The impact is evident in increased settlement density, particularly in areas pushed away from the old coastline due to the loss of direct interaction space with the sea. The change in spatial relationship between settlements and the coastline is also strongly felt: the increasing physical distance from the sea leads to the severance of maritime activity-based spatial orientation, so the spatial patterns now formed reflect adaptation to the new urban structure created by reclamation rather than to the ecological and cultural needs of the fishing community.

2.Housing Function Variables

The transformation of housing functions in the Boulevard Dua fishing settlement has become increasingly evident after the reclamation severed the direct connection between the houses and sea-based activities. Before reclamation, fishermen's houses primarily served as single-function dwellings, with simple spatial arrangements that reflected the daily needs of coastal communities. The open-front veranda was used for repairing fishing gear, the underfloor space of the stilt houses served as storage for small boats, and the kitchen, located at the rear, served as a workspace for domestic activities. As access to the sea became increasingly restricted and fishing declined, the houses' functions shifted toward more productive uses. The front area, once intended for social interaction or for receiving guests, was converted into commercial spaces such as small kiosks, food stalls, or workshops, aligning with the new building's orientation, which now faces the roadway constructed on the reclaimed land. This shift also reorganized the internal layout of the houses: family rooms were reduced in size, kitchens were expanded to support home-based economic activities, and additional rooms or upper floors were introduced to provide rental spaces or storage areas. These functional changes indicate that the house now performs a dual role, serving not only as a place of residence but also as an economic asset that enables fishing families to adapt to declining maritime income, while simultaneously representing an architectural response to urbanization pressures and the reconfiguration of the coastal spatial structure.

3.Local Architectural Identity Variables

The architectural identity of the fishing community in the Boulevard Dua area has undergone substantial changes following the reclamation, which altered spatial orientation and reshaped the living patterns of this coastal society. Before these environmental shifts, the architectural character of fishermen's houses was strongly influenced by their physical and functional proximity to the sea. This was evident in the use of wooden stilt-house structures, simple roofing forms, and open spaces at the front of the house, which accommodated fish processing and social interaction. The choice of materials, spatial organization, and overall building form reflected coastal cultural values that emphasized ecological relationships with the marine environment, social cohesion, and daily rhythms shaped by maritime occupations. After the reclamation reconfigured the surrounding landscape, these architectural forms began to change. Houses that were once lightweight and oriented toward the shoreline were reconstructed as permanent structures with concrete walls and metal roofing, aligning with the increasingly dense pattern of urban coastal development. This shift also transformed the architectural expression: open front spaces disappeared, traditional verandas were replaced by enclosed façades or small commercial units, and rooms that formerly supported sea-related activities were converted into productive areas or additional domestic functions. These transformations represent not only physical adjustments to the built form but also a shift in cultural values, as the community's maritime identity has gradually diminished alongside reduced direct interaction with the sea. Nonetheless, some aspects of local identity remain evident, such as the continued use of family spaces as centers

of communal activity, the incorporation of wooden elements in parts of the house, and enduring patterns of social interaction that reflect the close-knit character of the fishing community.

Conclusion

Transformation of Fishermen's Settlements in Manado City (Case Study: Coastal Reclamation of Boulevard Dua) aims to examine the dynamics of physical, social, and architectural changes that have emerged in the coastal area as a consequence of reclamation activities. Based on spatial, qualitative, and quantitative analyses, the findings reveal that reclamation has triggered fundamental transformations in spatial structure, livelihood patterns, and the social identity of fishing communities in Maasing and Bitung Karangria sub-districts. Overall, the results of this research can be summarized into four key findings as follows.

AL CONDITIONS	The coastal area maintained a natural shoreline with a productive marine ecosystem, where local communities relied entirely on fishing and marine resources for their livelihoods.	Landfilling activities reduced direct access to the sea, caused sedimentation, and increased the occurrence of tidal flooding. In the post-reclamation phase	The environmental condition deteriorated further the coastline shifted approximately 200 meters inland, and the ecological relationship between humans and the sea was severed by the construction of the reclamation road.	This phenomenon indicates *displacement*, marking a fun in human–environment i
ENT PATTERNS	fishermen's settlements were arranged linearly along the coastline, with buildings oriented directly toward the sea. When reclamation began, this spatial arrangement became irregular as many houses gradually shifted in land.	This spatial arrangement became irregular as many houses gradually shifted inland.	the pattern evolved into a dense grid layout aligned with the newly reclaimed coastal road.	from a maritime oriented se land → based urban configu both the ecological and socia the area.
G TYPOLOGY	fishermen's houses were typically wooden stilt structures with open underfloor spaces used for storing fishing equipment	semi-permanent houses emerged; some underfloor spaces were closed, and front verandas were converted into small shops.	the houses transformed into permanent concrete structures, with the front areas functioning as kiosks or family-run enterprises.	This progression reflects a architectural *morphogenesis* an evolution toward more ac dwelling forms that respond functions and environmenta
. FUNCTIONS	fishermen's houses initially had a clear division of areas: the front veranda served as a social space, the middle area as a family room, and the rear part for domestic activities.	these functions began to shift the front space became a mixed-use area combining social and economic purposes (small shops), while the rear part was used as a storage area.	spatial functions became increasingly economically oriented: the front area was used for business, the middle remained as a family area, and the rear part often included additional economic spaces, such as a second floor or rental rooms.	This transformation reflects social → economic use, in emergence of *productive do* in urban coastal settle
NG DENSITY	±15 units/ha	±20 units/ha	±26 units/ha	This densification occurred limited land availability and g pressure within the narrowing
D STRUCTURE.	around 90% of residents worked as capture fishermen whose income depended on seasonal cycles.	only about 60% remained active fishermen, while 40% began to engage in trade or service activities.	this composition reversed: only 40% continued fishing, while 60% had shifted to informal sectors such as petty trade, gojek/grab/indrive,exc, and home-based enterprises.	These changes indicate the of land-based economic acti emergence of new *urba livelihoods*.
PERSPECTIVE	fishermen's communities exhibited strong solidarity rooted in shared professional identity.	social cohesion began to shift toward a neighborhood-based orientation.	social bonds became increasingly shaped by economic activities and local community networks.	This shift signifies a *reorient* structures and the emerger

Figure 12. Meaning and Impact of Transformation from Nine Aspects
Source: Data Analysis, 2025

1. Ecological and Spatial Changes in Settlements

Reclamation activities since the early 2000s have significantly altered the coastal morphology of Manado City. Fishermen's settlements that were once directly oriented toward the sea are now separated by an artificial landmass approximately 200 meters wide and the main Boulevard Dua roadway. Thematic GIS-based mapping analysis indicates a spatial shift in settlement patterns from a linear formation along the coastline in 2005 to a dense grid pattern parallel to the reclaimed road by 2025. This transformation not only modified the coastal ecological structure but also reshaped local patterns of activity, spatial relations, and social systems within the community.

2. Transformation of Fishermen's House Typologies

Environmental changes have directly influenced the architectural form and function of fishermen's dwellings. Traditional wooden stilt houses have evolved into permanent or semi-permanent concrete structures with mixed-use functions. The front areas, which once served as social spaces, have been converted into economic zones such as kiosks, small shops, or repair workshops as an adaptation to the new land-based economy. The transformation of

floor plans reflects the disappearance of ecological elements, such as the open underfloor space and sea-facing veranda, replaced by business areas oriented toward the main road. This phenomenon signifies the evolution of coastal vernacular architecture into adaptive urban housing that still strives to preserve elements of local cultural identity.

3. Socioeconomic Transformations

Social surveys indicate a significant shift in the community's economic structure. Before reclamation, approximately 90% of residents worked as capture fishermen; today, only about 40% remain active in the fishing sector. The majority have transitioned to the service, trade, and small-scale home industry sectors. Although household incomes have generally increased, ecological and cultural connections to the sea have declined considerably. Within this context, the fishing community demonstrates a high level of adaptability and social resilience in responding to urbanization pressures and environmental change in the coastal zone.

4. Adaptation and the Formation of a New Coastal Identity

Despite the rapid pace of environmental transformation, the Boulevard Dua fishing community has managed to preserve core social values such as solidarity, mutual cooperation, and communal unity, which serve as the foundation of social cohesion. Their identity as “maritime people” has gradually evolved into that of an “adaptive urban coastal community.” This shift does not merely reflect loss but rather represents an ongoing process of identity reformation and spatial adaptation, where residents actively shape new living systems that correspond with current socio-economic realities.

In general, the findings affirm that the transformation of fishermen’s settlements constitutes a multidimensional process involving simultaneous ecological, social, economic, and architectural changes. Therefore, future coastal planning and policy development should position fishing communities not as passive objects of development but as active agents endowed with local knowledge, adaptive capacity, and a vital role in sustaining the ecological and cultural continuity of coastal environments.

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