Available online at
http://journal.uitm.edu.my/ojs/index.php/BEJ

e-ISSN: 2637-0395

Built Environment Journal 22(2) 2025, 295 – 317.

Built Environment Journal

A Study About the Economic Activities of Orang Seletar in Johor Bahru: Addressing Challenges in Fishing Practises Through Architectural Solutions

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ARTICLE INFO

Article history:
Received 06 February 2025
Revised 08 June 2025
Accepted 19 June 2025
Online first
Published 01 July 2025

Keywords:
Orang Seletar
Economic activities
Fishing practises
Architectural spaces

DOI:
10.24191/bej.v22i2.5017

ABSTRACT

This research investigates the economic activities of the Orang Seletar, also known as Orang Laut, an indigenous community in Johor Bahru, Malaysia, focusing on their fishing practises and proposing architectural interventions to address the challenges faced by Seletar fishermen in the fishing ecosystem. As urbanisation and industrialisation reshape their environment, the Orang Seletar face increasing challenges in sustaining their traditional livelihoods. Despite the centrality of fishing to their economy, limited research addresses the spatial and architectural needs required to support these practises. The research objectives are to explore their fishing routines, understand the fishing ecosystem, and propose architectural solutions to address the challenges they face. Using a qualitative approach, the research involves document analysis, observations, and interviews with Seletar fishermen. Research findings include a comprehensive Orang Seletar socio-cultural context, a detailed understanding of their linear fishing ecosystem, the identification of key challenges such as inadequate facilities or disrupted access to resources, and the development of architectural solutions that align with their cultural and economic needs based on the benchmarks from global indigenous community strategy. This research is significant for bridging the gap between indigenous economic practises and architectural design, offering insights and practical recommendations for cultural sensitivity and sustainable spatial interventions that can improve the livelihoods of the Orang Seletar.

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https://doi.org/10.24191/bej.v22i2.5017

INTRODUCTION

The Orang Seletar is an indigenous group within the greater Orang Laut community and has a long history attached to the coast and marine environments of southern Malaysia along the Tebrau Straits. Traditionally known as sea nomads, they relied on the sea for their livelihood, transportation, and economic activities such as fishing. Their traditional settlements along coastlines and riverbanks were established to maximise resource harvesting while maintaining harmony with nature.

As part of the Orang Laut, the Orang Seletar have a long record of playing crucial roles both in the seas of the Malay sultans and in that polity and economy themselves, serving alternately as navigators, fishermen, and boatmen. Because of their superior knowledge of the seas, they contributed to trade and territorial defence, including in Johor. Their mobile lifestyle allowed them to sustain social systems on very small patches of shoreline, balancing resource use with cultural practises deeply tied to the sea.

This development has highly disrupted the old, traditional ways of life within Johor Bahru due to rapid urbanisation and industrialisation. The developmental activities along the coasts have dislocated many from their ancestral lands, making their access to traditional fishing areas more limited and resulting in drastic declines in marine resources. The challenges faced by the Orang Seletar due to rapid urbanisation and development in Johor Bahru, leading to displacement and disruption of traditional fishing areas, are reflected in the study by Ramli (2014), which highlights socio-economic impacts on the Seletar community due to Danga Waterfront development.

Relocation to inland areas has been one (1) means of pushing the Orang Seletar into land-based activities. This has presented them with socioeconomic challenges in the form of unemployment, poverty, and erosion of cultural practises. The economic and cultural challenges faced by indigenous communities during urbanisation, including the Orang Seletar, have been further explored in studies examining the impact of modernisation on their livelihood and land rights (Yusoff & Rashid, 2023). Economic problems are manifest in their fishing activities, for example, prawn fishermen need at least one (1) kilogram per catch to make up for fuel expenses, while mussel farmers see shortened breeding seasons. More of their younger population is moving away from fishing into urban jobs.

Environmental degradation is another crucial issue. Not only has the destruction of mangroves and alteration in the pattern of water flow destroyed biodiversity, but it has also reduced the access of the Orang Seletar to essential resources, despite all these hardships, traditional fishing continues, reflecting their resilience and commitment to maintaining their cultural heritage.

Cultural identity preservation amidst development is a pressing issue for the Orang Seletar, as highlighted by Toorabally (2017), who underscores the negative impact of poorly adapted living schemes on their lifestyle. This research investigates the spatial implications of these challenges and probes for architectural solutions responsive to both traditional and contemporary needs. This research attempts to address various socio-economic and environmental issues affecting the Orang Seletar by incorporating sustainable fishing infrastructure and culturally sensitive design, hence preserving their identity while promoting economic sustainability.

https://doi.org/10.24191/10.24191/bej.v22i2.5017

Fig. 1. Photo of Orang Seletar in Sampan Kajang circa 1950

Source: Polunin (1950)

Problem Statement

The Orang Seletar, one (1) of Malaysia's indigenous Orang Asli groups, have historically relied on fishing and marine resources in the Tebrau Strait of Johor as their primary livelihood. However, rapid urbanisation, environmental degradation, and socio-economic pressures have disrupted their traditional way of life. Coastal developments have caused pollution and restricted water flow, leading to reduced marine biodiversity and declining seafood yields that often fail to cover basic expenses such as fuel. Climate change has further introduced unpredictable weather, making fishing increasingly risky and less viable (Rashid & Ara, 2015).

Traditionally, the Orang Seletar lived in stilted houses near mangroves or jetties, reflecting their close relationship with water. Urban development has displaced many from these environments, and modern housing schemes often lack the spatial features necessary to support fishing-related activities, such as catch storage or tool maintenance (Ibrahim, 2019). This disconnection has weakened their economic resilience and eroded cultural practises tied to the sea.

Given these challenges, there is a pressing need for architectural solutions that respond to the functional requirements of their fishing activities while preserving cultural identity. This research aims to explore the Orang Seletar's fishing routines, understand their fishing ecosystem, and propose design strategies to address these challenges. It contributes to bridging the gap between indigenous economic practises and architectural design by offering insights and practical recommendations for culturally sensitive and sustainable spatial interventions (Ibrahim, 2019; Rashid & Ara, 2015). These findings may also serve as a model for supporting other coastal indigenous communities facing similar socio-economic and environmental pressures.

https://doi.org/10.24191/10.24191/bej.v22i2.5017

Fig. 2. Photo of Seletar Family Harvesting Mussel Farming Yields in The Tebrau Strait

Source: Salim (2022)

Ethical Consideration

Research involving the Orang Seletar must be conducted with the highest regard for ethical principles, respecting their cultural identity, autonomy, and historical background. Informed consent plays a crucial role, requiring clear and transparent communication about the purpose, methods, and expected outcomes of the research. Consent should be obtained collectively to align with the community's traditional decision-making practises. Cultural sensitivity is equally important, involving the use of language and methods that reflect the worldview of the Orang Seletar. Emphasising collaboration and maintaining transparency throughout the research process fosters trust, ensures equity, and makes the research culturally relevant and beneficial to the community.

LITERATURE REVIEW

Definition of Orang Asli

The Orang Asli, as defined by Jabatan Kemajuan Orang Asli (JKOA), are the Indigenous peoples of Peninsular Malaysia who have traditionally inhabited the region and are recognised for their distinct cultural heritage, languages, and connection to the land. They are classified into three (3) main groups which are Negrito, Senoi, and Proto-Malay, each with its unique languages, traditions, and ways of life (Masron, et al., 2013).

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Types of Orang Asli in Malaysia

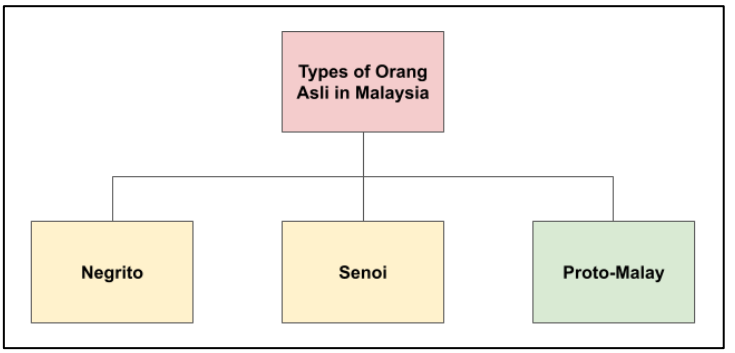

Fig. 3. Types of Orang Asli in Peninsular Malaysia

Source: Authors (2025)

The Orang Asli in Malaysia are divided into three (3) main groups which are Negrito, Senoi, and Proto-Malay. The Negrito, believed to be the earliest settlers, inhabit the northern regions of Malaysia and are distinguished by their unique physical features and cultural heritage. The Senoi, the largest group, primarily live in central Malaysia, sustaining themselves through agricultural activities. The Proto-Malay, found in southern and coastal areas, often integrate with Malay communities and engage in fishing and other maritime-based livelihoods (Khor & Zalilah, 2008).

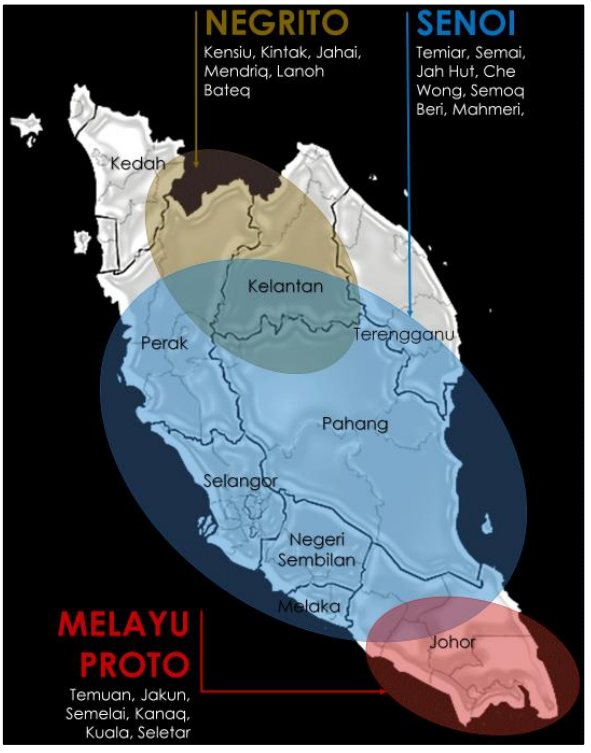

Fig. 4. Demography of Orang Asli in Peninsular Malaysia

Source: Jabatan Kemajuan Orang Asli (2016)

Orang Seletar: Historical Context

The Orang Seletar, a Proto-Malay subgroup of the Orang Laut and part of Malaysia's Orang Asli community, have historically lived along the Straits of Johor, relying on fishing and foraging as core economic activities shaped by maritime traditions (Benjamin, 2002). Their origins are linked to Austronesian migration and their early role in Southeast Asia's pre-colonial trade networks (Cai, 2017).

Colonialism and modern nation-building disrupted their coastal livelihoods, leading to displacement and socio-economic marginalisation (Toorabally, 2017). Urbanisation in Johor Bahru further impacted their fishing grounds through land reclamation and pollution (Tan, 2022). While government resettlement policies have challenged their cultural continuity, the Orang Seletar have shown resilience by adapting their housing and community structures (Shah et al., 2018).

Fig. 5. Photo of Orang Seletar circa 1950

Source: Polunin (1950)

Orang Seletar: Socio-cultural Context

The Sampan Kajang is a traditional canoe-shaped vessel central to the Orang Seletar's marine culture, functioning as both transport and shelter. Constructed from hardwood and pandanus leaves, it reflects sustainable practises and adaptability to coastal environments (Benjamin, 2002; Shah et al., 2018). It symbolises their resilience and creative indigenous architecture suited to a nomadic maritime lifestyle.

The Orang Seletar language, part of the Malayic subgroup of Austronesian languages, is rich in nautical vocabulary reflecting their seafaring heritage (Benjamin, 2002; Shah et al., 2018). It carries cultural knowledge and identity but is increasingly endangered due to urbanisation and integration with broader Malaysian society (Toorabally, 2017).

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The Batin serves as a traditional leader and mediator, maintaining social order, cultural practises, and representing the community in external engagements (Zal et al., 2013). Leadership is based on lineage and wisdom, playing a vital role in community decision-making and cultural preservation (Kunasekaran, 2014).

The Orang Seletar's animistic beliefs emphasise harmony with nature, particularly marine environments. Rituals tied to fishing and seasonal cycles reflect their deep spiritual connection with the sea (Benjamin, 2002; Jegatesen, 2019). These practises reinforce their identity and sustainable interaction with nature.

Mangroves are essential for the Orang Seletar's livelihood, supporting fishing, gathering, and cultural rituals. They also serve as symbols of the community's ecological knowledge and dependence on biodiverse coastal ecosystems (Benjamin, 2002; Ramli, 2014; Ramli, 2014).

Cultural expressions such as dance, music, and handicrafts play a central role in preserving oral history and community identity (Benjamin, 2002; Cai, 2017). Items crafted from natural materials and traditional clothing reflect adaptation to their coastal environment while embodying cultural symbolism (Ramli, 2014).

Access to education remains a challenge due to the Orang Seletar's traditional lifestyle, economic priorities, and language barriers (Benjamin, 2002; Ramli, 2014). Government subsidies and NGO efforts aim to integrate indigenous knowledge into culturally responsive education, improving participation and outcomes (Ramli, 2014; Zal et al., 2013).

Fig. 6. Photo of Sampan Kajang Orang Seletar circa 1950

Source: Polunin (1950)

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Orang Seletar: Socio-Economy Context

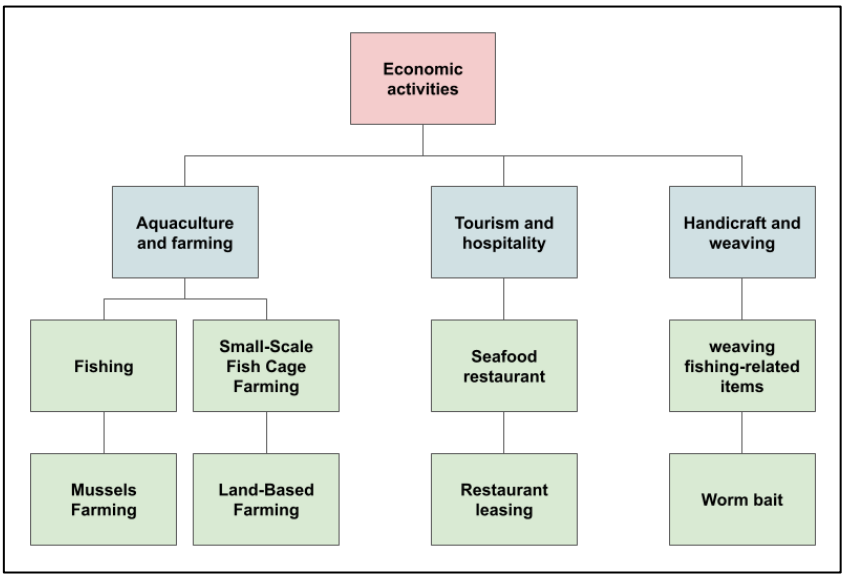

Fig. 7. Orang Seletar Economic Activities

Source: Authors (2025)

Aquaculture and Farming

The Orang Seletar, traditionally sea-oriented people, rely heavily on fishing and marine resources as a primary source of income and sustenance. Their practises, rooted in traditional ecological knowledge, include sustainable methods such as handlines, traps, and nets, and are closely linked to their cultural identity and environmental understanding (Ahmad et al., 2018; Endicott, 2016; Masron et al., 2013).

In addition to fishing, mussel farming has become a common secondary activity, particularly in Sungai Temon. This low-cost aquaculture practise benefits from the region's calm, nutrient-rich waters but faces challenges like pollution and limited access to modern techniques, which reduce its productivity (Yap et al., 2018).

Fish cage farming, focused on species like groupers and sea bass, is also practised using floating cages. While it offers income potential and reflects traditional knowledge, it demands significant initial investment and is limited by insufficient training and weak market access (Ahmed & Troell, 2010).

Although mainly engaged in aquatic livelihoods, the Orang Seletar have expressed interest in land-based farming to enhance food security. However, access to arable land remains limited due to urbanisation and development pressures, a common issue for many Orang Asli communities (Masron et al., 2013). Addressing this challenge requires coordinated policy and community-based land management efforts.

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Tourism and Hospitality

The Orang Seletar have developed small seafood eateries within their fishing communities, offering traditional dishes made from freshly caught seafood. These restaurants serve both as income sources and as platforms to promote their fishing heritage and cultural identity in the local tourism sector (Ruhanen & Whitford, 2019; Thompson et al., 2014).

In some cases, restaurant spaces are leased to outsiders, providing passive income without the need for daily involvement. While financially beneficial, this practise raises concerns about cultural dilution, as non-indigenous operators may influence the community's identity. This highlights the need to balance tourism-driven economic gains with cultural preservation (Chang et al., 2018).

Handicraft and Weaving

The Orang Seletar maintains traditional skills such as weaving fishing tools—baskets, traps, and nets—using natural materials like rattan and bamboo. These crafts are essential to their fishing practises and serve as a source of supplementary income, while also preserving cultural heritage (Endicott, 2016).

Another important activity is worm bait preparation, involving the collection of mangrove worms for personal use and trade. This practise supports local fishing operations and provides a modest, steady income, demonstrating their deep environmental knowledge and economic adaptability (Choo, 2004).

Coastal Indigenous Communities Globally

Economy Activities

Fishing is the cornerstone of economic activity for most coastal indigenous communities. Traditional fishing practises are frequently sustainable, using tools and techniques passed down through generations. These include small-scale netting, line fishing, and the usage of traps. For instance, in the Pacific Islands, local fishers exploit knowledge of marine biodiversity and tidal patterns to improve harvests while maintaining ecological balance (Cinner et al., 2012). Overfishing and marine degradation, however, provide important problems, pushing some communities to adapt or reduce their reliance on marine resources (Nicholls, 2004).

Aquaculture is increasingly being utilised by coastal indigenous groups as a solution to dwindling fish populations. Communities in Southeast Asia and Latin America, for instance, participate in seaweed farming, shellfish aquaculture, and fish cage farming. These activities give alternate revenue sources while aligning with their traditional ecological knowledge. However, aquaculture's expansion can lead to conflicts over land usage and water resources, particularly when commercial organisations approach indigenous lands (Barbier et al., 2011).

Fishing Ecosystem

The fishing ecosystems of coastal indigenous groups are tightly intertwined with their cultural practises, economic systems, and environmental management measures. These ecosystems frequently represent a balance between resource usage and conservation, created by centuries of traditional ecological knowledge (TEK) (Thornton & Scheer, 2012). TEK is characterised as the information and practises transmitted between generations, shaped by cultural memories, adaptability to change, and ideals

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encompassing reciprocity. Fishing is the cornerstone of many coastal indigenous economies, with methods and systems suited to specific maritime conditions.

Traditional fishing practises are diverse and region-specific, often based on a profound awareness of marine biodiversity, migratory patterns, and seasonal fluctuations. Indigenous groups adopt sustainable tactics such as fish traps, spearfishing, and tidal harvesting, limiting environmental consequences while guaranteeing food security (Pitcher, 2001). For example, the Hawaiian fishpond system demonstrates how traditional engineering can connect with biological processes to boost fish populations sustainably (Erlandson & Rick, 2010).

Fishing is not only an economic activity but also a cultural pillar for many indigenous cultures. Practises often involve rituals, taboos, and communal activities that strengthen social bonds and cultural identity. In addition, the sale of fish and seafood supports local economies, with women usually playing crucial roles in processing and selling products (Lau et al., 2019).

Challenges in the Ecosystem

One (1) of the most significant concerns is the degradation of marine and coastal ecosystems owing to pollution, coastal development, and climate change. For example, mangrove deforestation and coral reef degradation greatly impair the richness and productivity of fishing grounds (Islam & Tanaka, 2004). Pollution from agriculture, industry, and urban runoff further lowers water quality, reducing fish populations and increasing the vulnerability of indigenous communities (Beck et al., 2009).

Rising sea levels, ocean acidity, and warming sea temperatures disturb marine ecosystems, altering fish migration patterns and diminishing fish stocks. Coral reefs, which are vital to many indigenous fishing ecosystems, are particularly vulnerable to climate change. Their loss impacts not only marine biodiversity but also the cultural and economic activities of indigenous groups who rely on them (Jackson et al., 2001; Weatherdon et al., 2016).

The global demand for seafood has escalated to overfishing, often by large-scale industrial fisheries. This rivalry depletes resources that small-scale indigenous fishers rely on, compelling them to go farther or move to alternate livelihoods. The introduction of modern fishing technologies by commercial organisations undermines traditional practises and exacerbates imbalances in resource access (Cinner et al., 2012).

Adaptation Strategies

Globally, Traditional Ecological Knowledge (TEK) plays a major role in tackling environmental and climatic concerns. Indigenous groups often employ observational knowledge to monitor changes in marine ecosystems, such as variations in fish migration patterns or coral health. For example, American Samoa tribes of the Pacific Island apply TEK to manage their fisheries by establishing seasonal no-take zones to allow fish stocks to recover (Beck et al., 2009). Such techniques have shown efficacy in balancing resource use and conservation aims.

Ecosystem-based adaptation (EbA) merges TEK with scientific approaches to enhance the resilience of coastal systems. These techniques involve restoring and protecting important habitats like mangroves and coral reefs, which provide natural buffers against climate impacts. In Southeast Asia, mangrove restoration has been essential in lowering coastal erosion and supporting fish nurseries, directly helping indigenous fisheries (Hale et al., 2009).

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To lessen dependency on dwindling fish populations, many coastal communities diversify their economic pursuits. Examples include integrating small-scale aquaculture, seaweed farming, and eco-tourism into conventional fishing economies. In Bangladesh, community-based aquaculture initiatives have provided an alternative income for indigenous fishers while protecting ecological integrity (Ahmed et al., 2014). Similarly, eco-tourism programmes in the Arctic sustain indigenous fishing traditions while attracting global visitors, and fostering cultural exchange (Galappaththi et al., 2019).

Community-based fisheries management (CBFM) strategies empower local populations to take ownership of marine resource governance. These systems frequently entail participatory decision-making, co-management with governmental agencies, and the formation of maritime protected areas (MPAs). For instance, the Andaman coast in Thailand has experienced successful implementation of CBFM, integrating community-led activities with scientific inputs to prevent overfishing (Bennett et al., 2014).

Indigenous communities are increasingly utilising modern technologies to address critical concerns. Low-cost solar-powered fish-drying units and smartphone apps for market access show how technology can enhance traditional techniques. Such improvements reduce post-harvest losses and increase economic outcomes (Chong, 2014).

Table 1. Benchmark from Global Coastal Communities Adaptation Strategies

Adaptation strategy	Description	Community	Application
Traditional Ecological Knowledge (TEK)	Knowledge and practises passed from generation to generation are informed by cultural memories, sensitivity to change, and values that include reciprocity.	Pacific Island tribe	They manage their fisheries by establishing seasonal no-take zones to allow fish stocks to recover.
Ecosystem-based Adaptation (EbA)	A strategy that uses nature to help people adapt to climate change.	Vietnam coastal community	Mangrove restoration has been essential in lowering coastal erosion and supporting fish nurseries.
Community-based Fisheries Management (CBFM)	Empower local populations to take ownership of marine resource governance.	Thailand coastal community	Ensuring access to credit for attaining independence from the middlemen, introducing potential changes in occupations as alternatives to capture fisheries, and introducing special income-generating projects for women in the community.

Source: Authors (2025)

RESEARCH METHODOLOGY

Introduction

This research employs a qualitative research methodology to investigate the economic activities focusing on fishing practises of the Orang Seletar in Johor Bahru, by emphasising their historical, socio-cultural, and socio-economic contexts, as well as the challenges they face. The methods used include document analysis to explore their historical and socio-economic background, observation to gain insights into their fishing ecosystem and processes, and interviews to understand their experiences, challenges, and needs. This qualitative approach enables a comprehensive and nuanced understanding of the community's practises, ensuring that proposed architectural solutions are grounded in their lived realities and cultural identity.

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Data Collection Methods

Document Analysis

Document analysis was employed to gain a comprehensive understanding of the historical, socio-cultural, and economic context of the Orang Seletar community. This involved a detailed review of various secondary sources, including government reports, ethnographic studies, journal articles, and academic publications. These documents were selected based on their relevance to indigenous coastal livelihoods and the Orang Seletar's adaptation to urbanisation and environmental pressures. As Bowen (2009) notes, document analysis is an effective qualitative tool for gathering contextual data that supports and enriches primary research findings. In this study, document analysis provided the foundation for identifying patterns in traditional fishing practises and the socio-economic transformations experienced by the Orang Seletar.

Observational Method

Observational research was conducted through participant observation, allowing for direct immersion in the Orang Seletar's fishing ecosystem. Fieldwork was carried out in Orang Seletar villages in Johor Bahru, where the researcher followed the fishermen throughout their daily routines—from early morning preparation of equipment, to fishing at sea, and later processing the catch in the evening. The method followed Spradley's (1980) ethnographic approach, enabling a deeper understanding of tangible and intangible aspects of daily practises. Observations were structured around specific categories, including the condition and usage of fishing tools, docking and unloading processes, spatial layouts, storage limitations, and informal interactions. These detailed observations helped identify spatial inefficiencies and areas where architectural intervention could support their fishing activities more effectively.

Semi-structured Interview

Thirdly, semi-structured interviews were conducted with five (5) Orang Seletar individuals actively involved in fishing, selected through purposive sampling to ensure the inclusion of experienced voices, both elder and younger. Interviews took place in familiar settings such as homes and fishing sites to promote open and comfortable dialogue. Interview questions were initially developed based on themes identified in the document analysis and further refined following the observational phase to ensure contextual relevance. The questions explored various aspects of the fishing ecosystem, including daily routines, community roles, environmental and economic challenges, and perspectives on infrastructure and cultural change. The semi-structured format allowed the flexibility to explore emergent themes in-depth, in line with the qualitative interviewing approach described by Kvale and Brinkmann (2015).

Data Analysis

The data gathered from observations and interviews were analysed using thematic analysis, as outlined by Braun and Clarke (2006). The researcher began by thoroughly reading all field notes and interview transcripts to become familiar with the data. Initial coding was used to highlight important concepts and recurring patterns. These codes were then grouped into broader themes that captured significant issues relevant to the research, such as environmental degradation, spatial challenges, and market dependency. The themes were refined and interpreted to draw connections between the Orang Seletar's fishing practises and the architectural needs that could address their socio-economic and environmental challenges.

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RESULTS AND FINDINGS

Introduction

This chapter summarises the conclusions and findings of the research, which explores the economic activities of the Orang Seletar in Johor Bahru, with a specific focus on their fishing habits. By integrating data obtained through document analysis, observations, and semi-structured interviews, the chapter investigates the socio-economic difficulties encountered by the community and suggests architectural solutions customised to their particular cultural and environmental setting. The findings are divided into thematic groups developed from the data analysis. These categories highlight essential characteristics of the Orang Seletar's economic activities, including their reliance on fishing, the dynamics of their fishing ecology, and the challenges they confront owing to urbanisation, environmental deterioration, and socio-economic marginalisation. Through these findings, this chapter intends to contribute to a deeper knowledge of the Orang Seletar's economic activities and offer actionable suggestions for addressing their difficulties through architectural design.

Identification of Challenges in The Ecosystem

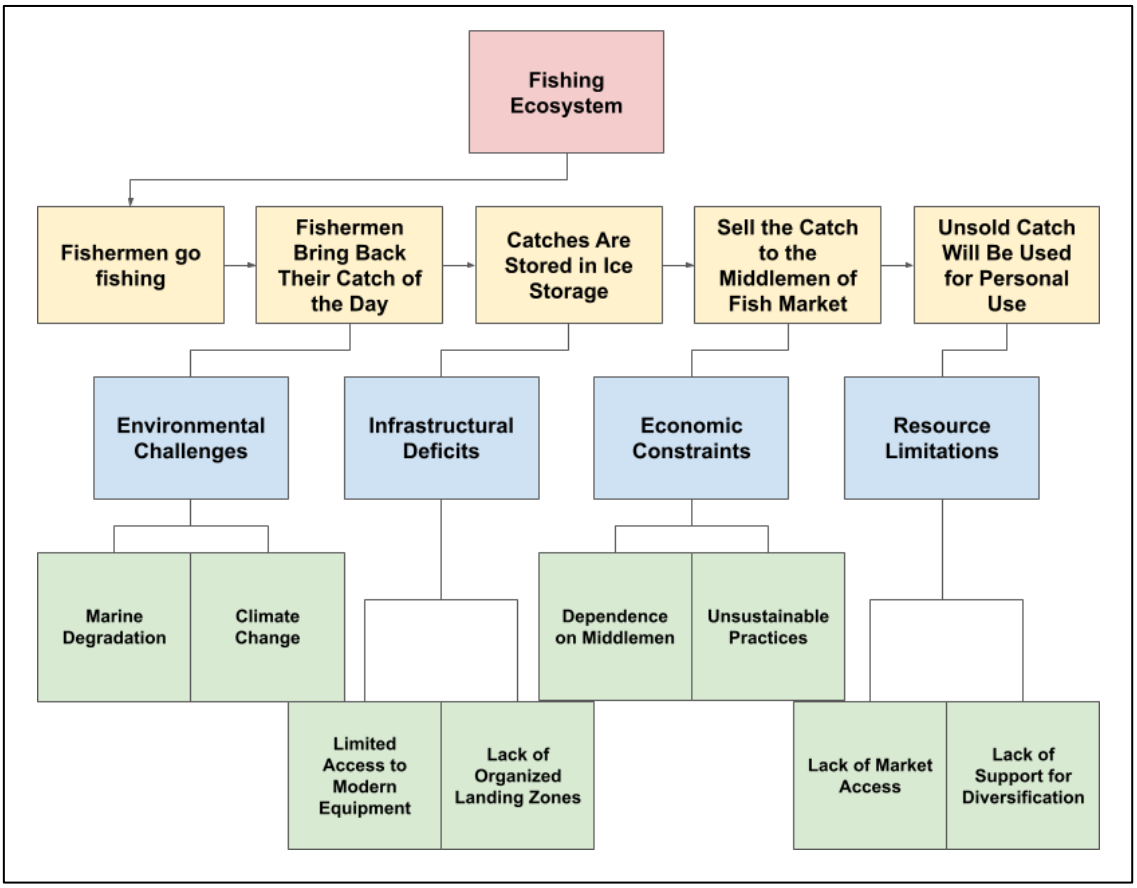

Fig. 8. Identification of Challenges in The Ecosystem

Source: Authors (2025)

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Environmental Challenges

Marine Degradation

Land reclamation initiatives in Johor Bahru have dramatically impacted coastal and marine habitats. These projects, which involve the conversion of mangroves and shallow seas into urban land, have devastated crucial habitats that serve as breeding and rearing grounds for fish and other marine species. Observations highlighted the loss of mangrove forests, which once provided shelter for juvenile fish and contributed to the general health of the maritime ecosystem.

Interviews revealed that the loss of mangroves has also had cultural and emotional consequences on the Orang Seletar. Mangroves are not only vital for their fishing production but also contain spiritual value, indicating their deep connection to the environment (Masron et al., 2013). The community raised concerns that prolonged reclamation initiatives will further marginalise their traditional way of life.

Climate Change

Unpredictable weather patterns have become a serious concern for the Orang Seletar fishermen. Interviews revealed that frequent storms, rapid rainfalls, and strong gusts had made fishing expeditions exceedingly risky. The community underlined that they often must postpone fishing expeditions owing to safety concerns, resulting in fewer fishing days and poorer income. These findings coincide with studies by Allison et al. (2009), which demonstrate the heightened sensitivity of small-scale fishing groups to climate variability. The Orang Seletar also emphasised the difficulty in predicting tides and fish movement patterns owing to weather fluctuations, which affects their capacity to plan effective fishing techniques. Traditional knowledge that has guided their actions for generations is now less trustworthy under changing climatic conditions.

Infrastructural Deficits

Limited Access to Modern Equipment

The Orang Seletar generally uses traditional tools such as handlines, traps, and small motorised fishing boats, which, while culturally significant, are less efficient compared to current fishing technology. Interviews indicated that these approaches are labour-intensive and limit the scale of their operations. The fishermen expressed a wish to adopt more contemporary equipment, such as improved motorised boats and advanced nets, but highlighted that budgetary restrictions and lack of institutional backing prevent such changes.

Observations found that the Orang Seletar rely on simple ice storage to preserve their daily catch. However, the restricted capacity and inefficiency of these storage systems result in a decreased shelf life for their fish, leading to deterioration and a loss of market value. During interviews, fishermen noted that they typically sell their catch at lower prices due to the risk of rotting, especially when there are delays in transit or selling to middlemen.

Lack of Organised Landing Zones

Currently, the Orang Seletar rely on improvised landing places along the shore or near their settlements to discharge their daily catch. Observations found that these temporary platforms are generally uneven, poorly constructed, and lack shelter from environmental elements such as direct sunshine and rain.

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Interviews with fishermen indicated that this condition causes substantial logistical issues, especially during high tides or stormy weather, when handling the catch becomes unsafe and time-consuming.

Interviews with fishermen revealed that the lack of a specialised landing site increases their reliance on middlemen. Without access to suitable unloading and handling infrastructure, fishermen find it difficult to offer their catch directly to consumers or traders, restricting their negotiating power. This difficulty correlates with results by Ahmed and Troell (2010), who emphasise that structured landing facilities play a vital role in decreasing operational inefficiencies and facilitating greater market access for small-scale fishermen.

Economic Constraints

Dependence on Middlemen

In the existing fishing ecosystem, middlemen operate as intermediaries between the Orang Seletar fishermen and the broader market. Observations found that fishermen carry their haul to preset gathering areas, where middlemen inspect, weigh, and purchase the fish at predetermined prices. Interviews with fishermen showed that these rates are generally imposed by the middlemen, leaving them with little room to negotiate or oppose unjust practises.

The reliance on middlemen resulted in diminished profits for the Orang Seletar fishermen. Interviews revealed that the rates supplied by middlemen are often lower than what the fishermen could earn through direct sales in local markets. This issue is aggravated by the unavailability of alternate selling channels, such as cooperatives or community-owned marketplaces, which would allow fishermen to retain a higher share of their revenues.

Unsustainable Practises

The Orang Seletar fishing ecosystem maintains a predictable linear flow in which fishermen capture fish, store them in simple ice storage, sell them to middlemen, and use any unsold fish for personal consumption. While this system provides a normal livelihood, it lacks mechanisms for value addition or long-term resource sustainability. Observations indicated inefficiencies at each stage of this cycle, particularly in storage and market access, which limit the community's capacity to optimise revenues.

The repetitive nature of the Orang Seletar's fishing activities, coupled with external problems like price exploitation by middlemen and environmental degradation, results in low financial returns. Fishermen claimed that their revenues barely cover the costs of gasoline, bait, and ice storage, leaving little to invest in improved equipment or alternative employment. This financial instability compels the community to remain caught in a cycle of subsistence rather than progress.

Resource Limitations

Lack of Market Access

Interviews revealed that unsold fish are often consumed within the community or abandoned owing to a lack of storage or processing facilities. Observations revealed the absence of facilities for freezing, drying, or packaging fish, which limits the fishermen's ability to add value to their catch or extend its shelf life. This issue is aggravated by the inadequacies of basic cold storage systems, which are insufficient for preserving increasing amounts of unsold fish.

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The Orang Seletar confronts severe challenges to growing its market reach. Interviews found that fishers lack the financial means, transportation infrastructure, and market expertise essential to seek prospects beyond their immediate vicinity. Additionally, the absence of cooperative organisations or community-based marketing campaigns further inhibits their capacity to pool resources and negotiate collectively with purchasers.

Lack of Support for Diversification

The Orang Seletar population displayed a significant interest in diversifying their income through aquaculture operations, such as fish cage farming and mussel cultivation, as well as land-based farming practises. Interviews indicated that these activities are considered potential alternatives to complement their fishing income and reduce overreliance on depleting marine resources. Observations revealed that small-scale aquaculture activities, such as mussel farming in Sungai Temon, have been informally explored but remain limited in scale and impact due to resource restrictions.

The inability to diversify economic activity exacerbates the Orang Seletar's financial vulnerability and dependence on fishing. This linear reliance on marine resources is becoming increasingly unsustainable owing to environmental degradation and market constraints. Additionally, the absence of diversification opportunities limits their potential to adjust to changing ecological and economic situations, further marginalising the group.

DISCUSSION

Introduction

The architectural solutions proposed in this chapter are developed based on the global indigenous coastal community adaptation strategies which are Traditional Ecological Knowledge (TEK), Ecosystem-based Adaptation (EbA), and Community-based Fisheries Management (CbFM), along with insights from the history and socio-cultural practises of the Orang Seletar. These elements from the literature review provide a comprehensive framework to design sustainable and culturally relevant solutions that address the challenges in fishing practises and livelihoods of the Orang Seletar.

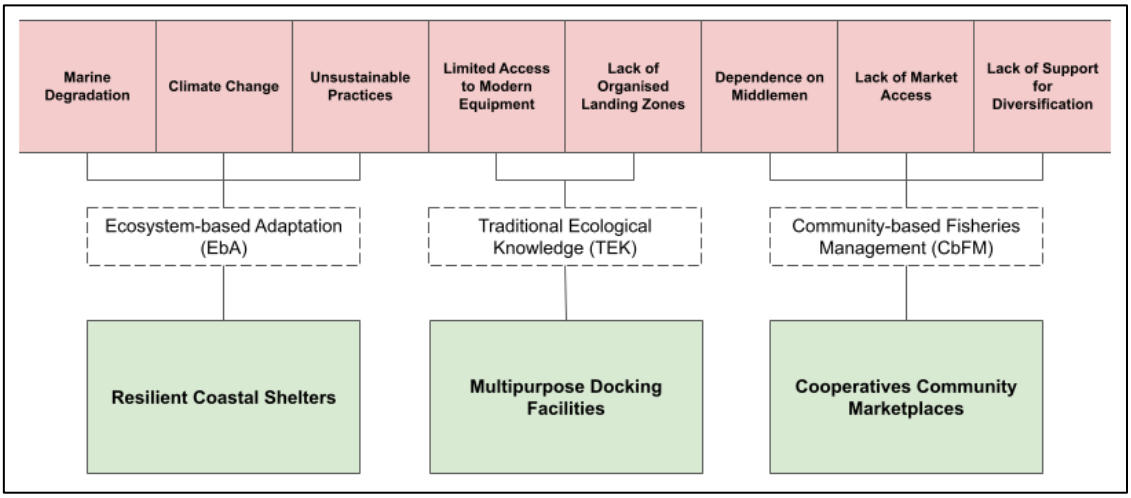

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Fig. 9. Architectural Solutions for Orang Seletar Challenges in Their Fishing Ecosystem

Source: Authors (2025)

Resilient Coastal Shelters

Mangrove-inspired breakwaters emulate the natural qualities of mangroves to disperse wave energy and protect coastal settlements from erosion. These structures provide dual benefits which secure infrastructure while nurturing marine life. Studies indicate that restoring mangrove ecosystems might decrease the impacts of storm surges and maintain fisheries, which are vital for indigenous livelihoods (Barbier et al., 2011). For example, in Indonesia, mangrove buffer zones have been integrated into community planning to improve coastal resilience (Thornton & Scheer, 2012).

Stormwater harvesting systems lessen dependency on external water sources by gathering and purifying rainfall for community usage. Such systems are particularly crucial for coastal populations who lack access to fresh water. Solar energy systems, when integrated into floating or stilted structures, provide reliable and sustainable power for lighting, refrigeration, and community services. These systems promote self-sufficiency while minimising environmental consequences (Chong, 2014).

Multipurpose Docking Facilities

Centralised hubs provide secure and efficient docking sites, boosting the management and safety of fishing activities. These facilities are designed to handle small boats with modular docks that can grow dependent on community needs. Secure storage for conventional fishing gear, nets, and small motors helps fishers protect their tools from environmental damage, theft, or degradation (Ismail et al., 2015). For example, The Sanya Fishing Port in Hainan, China, integrates landing sites and storage facilities to accommodate small-scale fishermen, maintaining operational efficiency and lowering logistical loads (Ou & Ma, 2017).

The modular architecture of docking facilities provides flexibility to changing community needs and environmental circumstances. These docks can accommodate additional boats or associated facilities as fishing activities develop, avoiding the need for costly infrastructure overhauls (Ou & Ma, 2017). For example, modular docking systems installed in Norway's tiny fishing towns demonstrate cost-effectiveness and adaptability in changeable coastal environments (Thornton & Scheer, 2012).

Cooperatives Community Marketplaces

Community-managed fish markets aim to strengthen fishing communities by minimising dependence on the middlemen. By situating these markets near residential areas, they cut transportation expenses and allow fishers immediate access to clients. This approach correlates with successful cooperative programs like the Island Lake Opakitawek Cooperative, which increased fishers' livelihoods through localised management and fair-trade systems (Thompson et al., 2014).

The diversification of fresh seafood into processed products can enhance economic resilience and create value-added opportunities for small-scale fisheries. Processing seafood, such as turning fish into dried or snack goods, stabilises incomes and opens new doors in the seafood markets. Research demonstrates that value-added strategies not only improve financial outcomes but also bolster food security and reduce waste in fisheries (Purcell et al., 2021).

https://doi.org/10.24191/10.24191/bej.v22i2.5017

Table 2. Summary of The Architectural Solutions for Orang Seletar Challenges in Their Fishing Ecosystem

Challenges		Benchmarks	Solutions
Environmental challenges	Marine degradation	Ecosystem-based Adaptation (EbA)	Resilient coastal shelter
	Climate change		
Economic constraint	Unsustainable practises	Ecosystem-based Adaptation (EbA)	Resilient coastal shelter
	Dependence on middlemen	Community-based Fisheries Management (CbFM)	Cooperative community marketplace
Resource limitation	Lack of market access	Community-based Fisheries Management (CbFM)	Cooperative community marketplace
	Lack of support for diversification		
Infrastructural deficit	Limited access to modern equipment	Traditional Ecological Knowledge (TEK)	Multipurpose docking facilities
	Lack of organised landing zone		

Source: Authors (2025)

CONCLUSION

The Orang Seletar's transformation from sea nomadic to settled coastal settlements has exposed them to serious socio-economic and environmental concerns. Their traditional fishing traditions, profoundly founded in ecological knowledge, have been interrupted by urbanisation, marine degradation, and socio-economic pressures, including dependency on middlemen and limited access to modern equipment. These issues have contributed to declining profits and economic fragility.

The proposed architectural solutions, resilient coastal shelters, multipurpose docking facilities, and cooperative community marketplaces, offer culturally sensitive and sustainable remedies to these difficulties. Resilient coastal shelters address marine degradation and climate change, providing adaptive housing while fostering sustainable aquaponics systems (Chakravartty et al., 2017). Multipurpose docking facilities minimise infrastructural limitations by centralising docking and storage facilities, boosting operating efficiency, and decreasing logistical constraints (Ou & Ma, 2017). Cooperative community marketplaces promote economic diversification, improve market access, and lessen dependency on exploitative intermediaries (Thompson et al., 2014).

By incorporating these ideas, this research emphasises the possibility of architectural interventions to restore economic stability, develop community resilience, and protect the cultural heritage of the Orang Seletar. These findings contribute to broader conversations on indigenous architecture and sustainable design, giving a reproducible framework for tackling the issues encountered by coastal indigenous people globally.

Finally, researchers, architects, and policymakers should cooperate closely with the Orang Seletar to co-create solutions matched with their cultural values and practical demands. This participatory approach guarantees that interventions stay equitable, durable, and community driven (Kunasekaran, 2014).

https://doi.org/10.24191/10.24191/bej.v22i2.5017

ACKNOWLEDGEMENTS

The author sincerely thanks the Orang Seletar community in Kampung Sungai Temon, Johor Bahru for their generosity in sharing their knowledge. Special appreciation goes to Jefree Salim, a Seletar fisherman and photographer, for his invaluable insights and visual documentation. Gratitude is also extended to Jumaat Misman for his scholarly work on the Orang Seletar, which provided essential knowledge for this study. Their contributions have greatly enriched this research.

CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

AUTHORS' CONTRIBUTIONS

Muhammad Zahiruddin Mohd Salleh conceptualised the research idea, wrote, and analysed study data, designed the methodology, and investigated and collected the data. Liyana Mahfuzah Mohd For and Zalina Samadi supervised the research progress and revisions and approved the article submission. Fatmah Adhilah Mustapha Kamal and Siti Hajar Mohd Shahrain was involved in carrying out the research's critical review, commentary, and revisions.

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