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FRESHWATER FISHERIES RESEARCH AND DISCOVERY CENTRE: REJUVENATION OF NATIVE SPECIES

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ABSTRACT

Malaysia's rivers, such as the Pahang River, harbour a rich diversity of native freshwater fish species crucial for ecological stability and the well-being of local communities. However, the increasing presence of invasive species poses a significant threat to these native populations, reducing biodiversity and disrupting the river ecosystems. This research explores the challenges faced by native freshwater fish in Malaysia's rivers due to invasive species. It outlines the establishment of the Freshwater Fisheries Research and Discovery Centre as a vital initiative to address these issues. The proposed centre will focus on increasing the populations of native fish species through dedicated research, scientific breeding programs, habitat restoration, and strategic reintroduction efforts. By conducting advanced research, the centre aims to develop effective methods for the propagation and conservation of native species. Additionally, the centre will implement systems for early detection and management of invasive species, thereby protecting the native fish populations from further decline.

Keywords: Natives Species, Invasive Species, Ecology stability, Research and Discovery Centre

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INTRODUCTION

Malaysia's freshwater ecosystems are home to a diverse array of native fish species, many of which are integral to the ecological balance and cultural heritage of the region. However, the proliferation of invasive species poses a significant threat to these native populations. Invasive species can outcompete, prey upon, and introduce diseases to native fishes, leading to a decline in biodiversity and disruption of ecosystem functions (Moyle & Light, 1996).

In response to this growing concern, the establishment of the Freshwater Fisheries Research and Discovery Centre represents a pivotal step towards safeguarding Malaysia's native freshwater fish species. This state-of-the-art facility aims to increase the population of native species through advanced research and conservation strategies. By fostering scientific research and public engagement, the Centre seeks to address the challenges posed by invasive species and promote the importance of preserving native biodiversity.

The Centre's research initiatives focus on breeding programs, habitat restoration, and the development of management practices to enhance the resilience of native fish populations. Additionally, it serves as an educational hub, raising public awareness about the critical role of native species in maintaining healthy ecosystems and the threats posed by invasive species. Through community outreach and educational programs, the Centre endeavors to cultivate a sense of stewardship and encourage conservation efforts among the public.

BACKGROUND

This thesis examines how architectural interventions that combine innovative engineering solutions, habitat restoration, and ecologically conscious design can mitigate the impact of invasive species, restore equilibrium to freshwater ecosystems, and encourage the coexistence of native species for sustained river health and resilience.

ISSUE

Environment

The invasive species introduction disturbs the established ecological relationships and food chains in the river ecosystem. Both native and invading species' eating, breeding, and predation patterns are affected. This imbalance has an impact on the entire ecosystem and may have cascading consequences on our local fish such as :

- 1) Patin Muncung
- 2) Kelah Merah
- 3) Jelawat Putih
- 4) Temalan or Temoleh
- 5) Pari Sungai

Economic

As a result of this invasion, the local aquaculture sector, which has long relied on the naturally occurring species in Sungai Pahang, is currently dealing with negative effects. The future of traditional methods, which were formerly ecological and economically feasible, is uncertain. Native species are becoming less common, which is threatening the ability of many local fishermen and aquaculturists to make a living.

Social

Empowering communities with knowledge about invasive species, their impacts, and potential mitigation strategies is critical. Education campaigns and community engagement initiatives can play a pivotal role in building awareness and fostering a sense of collective responsibility towards managing the invasive species issue in Sungai Pahang.

ISSUE

To propose a Freshwater Fisheries Research and Discovery Center with architectural interventions that combine innovative engineering solutions, habitat restoration, and ecologically conscious design with interactive experiential programs in collaboration with the local community.

QUESTIONS

1. What is the method to decrease the number of invasive fish species and to increase the number of freshwater native fish species in the Pahang River?
2. What are the potential solutions for freshwater invasive fish in aquaculture sectors?
3. What are the initiatives to increase the knowledge and information about freshwater invasive fish species and their impact on our river?

OBJECTIVES

1. To identify the potential to reduce the number of freshwater invasive fish species and the possible methods to increase the numbers of the native fishes in the Pahang River
2. To recognise the species and the opportunities of freshwater invasive fish and local species that roam the Pahang River.
3. To provide information and education to the community about freshwater invasive fish species and their impact on our river

RESEARCH STRUCTURE

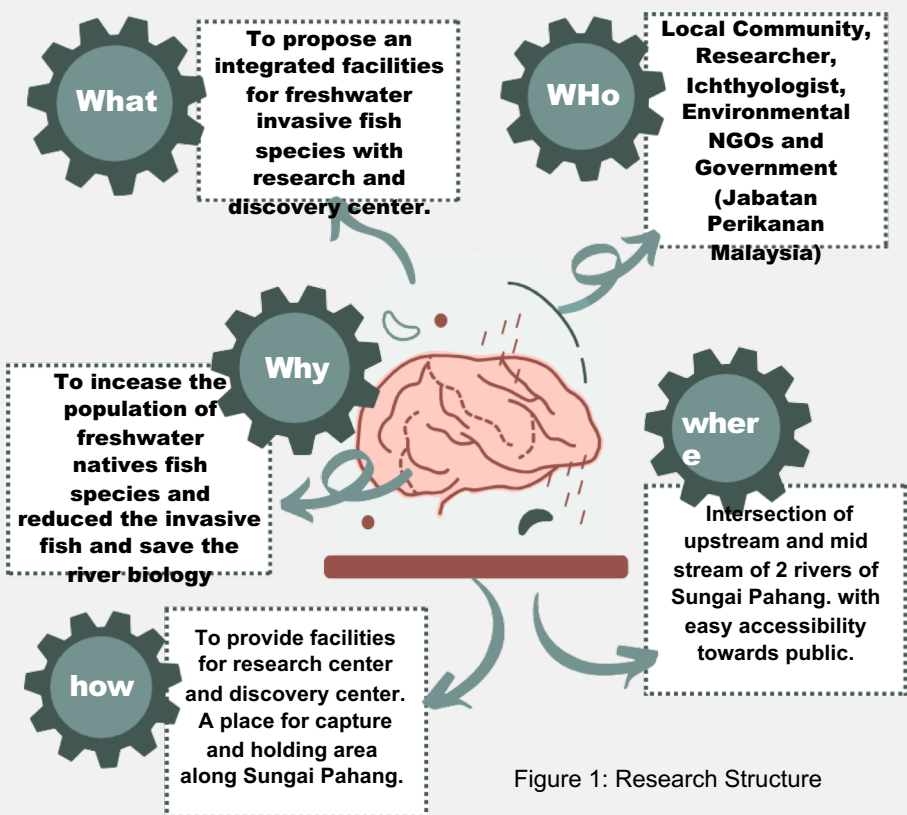


Figure 1: Research Structure

METHODOLOGY

To fulfil the aims and objectives of the study, the research methodology was divided into three phases: literature review, field research and interview with Jabatan Perikanan Malaysia to collect the data.

LITERATURE REVIEW

Native Species of Malaysia

Malaysia is home to approximately 300 species of freshwater fish, with significant endemism noted in several taxa (Ng & Tan, 1999). Notable native species include the Malaysian (Tor tambroides), the river catfish (Mystus nemurus), and various species of rasboras and gouramis. These species play vital roles in their ecosystems, contributing to nutrient cycling, maintaining food web dynamics, and supporting the livelihoods of local communities through fisheries and ecotourism (Zakaria-Ismail, 1994).

Invasive species

Invasive fish species have been introduced to Malaysia through various means, including aquaculture, the aquarium trade, and accidental releases. Notable invasive species include the tilapia (*Oreochromis* spp.), the African catfish (*Clarias gariepinus*), and the common carp (*Cyprinus carpio*). These species have established substantial populations in Malaysian waters, often at the expense of native biodiversity (Canonico et al., 2005).

Ecological Impacts of Invasive Species

The introduction of invasive fish species has had profound ecological consequences. Invasive species often outcompete native species for resources such as food and habitat, leading to declines in native populations. For example, the aggressive nature and high reproductive rate of tilapia have allowed it to dominate many freshwater habitats, resulting in reduced diversity and abundance of native fish species (Zambrano et al., 2006). The African catfish, known for its voracious appetite, preys on a wide range of native fish, further exacerbating the decline of indigenous species (Vitule et al., 2009).

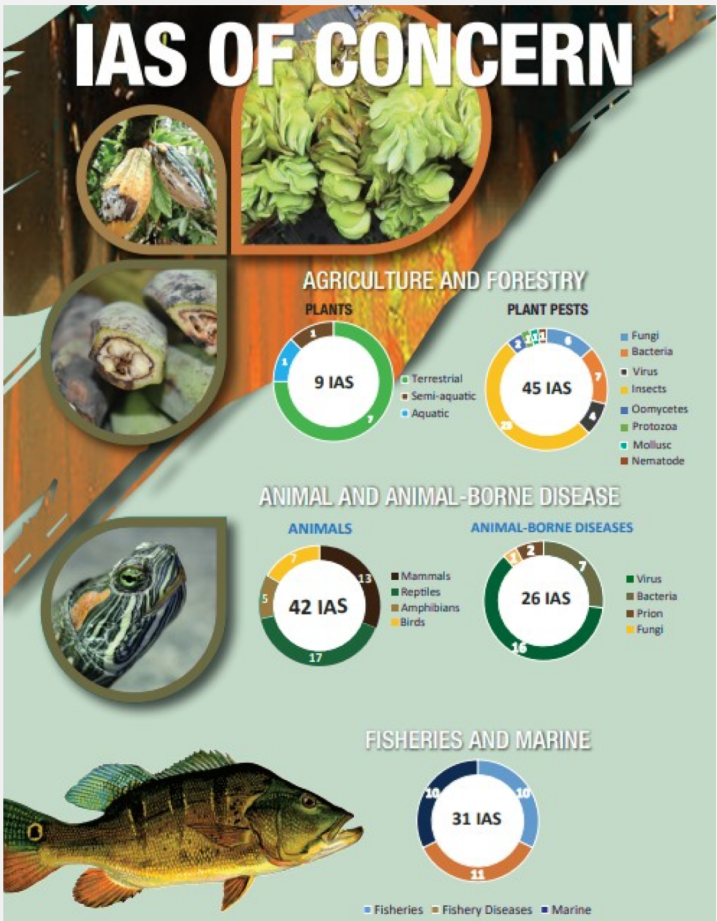


Figure 2: Invasive species of concern (National Action Plan on Invasive Alien Species 2021-2025)

Conservation Status and Threats in Malaysia

The conservation status of many native freshwater fish species in Malaysia is increasingly precarious. A significant emerging threat is the introduction of invasive species, which can outcompete native species for resources, introduce new diseases, and alter habitat structures. Species such as the tilapia (*Oreochromis* spp.) and the African catfish (*Clarias gariepinus*) have been particularly problematic, leading to declines in native fish populations (Canonico et al., 2005).

Conservation efforts in Malaysia have increasingly focused on habitat restoration, the establishment of protected areas, and the implementation of sustainable fishing practices. Recent studies have emphasized the importance of community-based management approaches that involve local communities in conservation activities (Chong et al., 2010).

NAME / ITEM	IMAGES
Malaysian Mahseer (kelah)	
White Edge Freshwater Whip Ray (pari sungai)	
Tamalian (temoleh)	
Golden Arowana (kelisa)	
Fresh Water Dorab (parang sungai)	
pengasius hypophthalmus (Patin Muncung)	
Bala Shark (ekor hangus)	
Betta Persephone (Pelaga liar)	

Figure 3: Some endangered freshwater fish in Pahang River, Malaysia

Ecology of Upstream River Ecosystems

Upstream rivers in Malaysia, often originating from mountainous regions, are typified by fast-flowing, clear waters with high oxygen levels and low nutrient concentrations. These rivers flow through diverse habitats, including rainforests and peat swamps, contributing to their rich biodiversity (Dudgeon, 2000). The physical structure of these rivers, with their riffles, pools, and varying substrate types, provides critical habitats for many aquatic species (Allan & Castillo, 2007).

The upstream rivers of Malaysia are home to a diverse array of native fish species, many of which are endemic and specialized to thrive in these environments. Notable native species include:

1. Malaysian Mahseer (*Tor tambroides*): Known locally as "kelah," this species is highly valued both ecologically and economically. It prefers the fast-flowing, oxygen-rich waters of upstream rivers and is considered an indicator of healthy river systems (Ng, 2004).
2. River Catfish (*Hemibagrus nemurus*): This species is commonly found in the slower-moving sections of upstream rivers and is an important food source for local communities (Zakaria-Ismail, 1994).
3. Suckermouth Catfish (*Glyptothorax major*): Adapted to fast-flowing waters, this species has specialized morphological features that allow it to cling to rocks in strong currents (Ng & Tan, 1999).
4. Various Rasboras (*Rasbora* spp.): These small, schooling fish are abundant in upstream habitats and play a crucial role in the riverine food web (Kottelat et al., 1993).

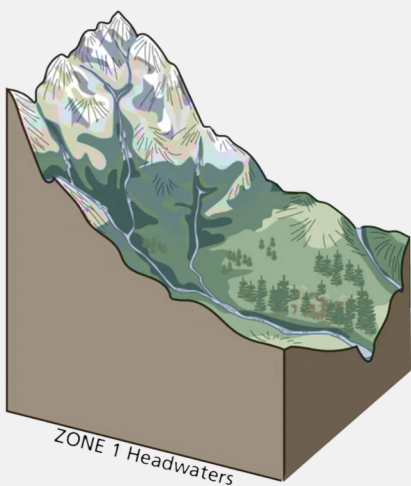


Figure 4: Headwaters/Upstream river



Figure 5: Natives species that live in upstream river corridor

FIELD RESEARCH IN KUALA TAHAN

The methodology for this thesis focuses on conducting field research in the Kuala Tahan, Pahang, to collect data from the locals on native fish species and assess the impacts of invasive species. The following sections outline the detailed approach to data collection, including site selection, data analysis, and ethical considerations.



Figure 6: Interview with the Batik people (Locals)



Figure 7: Crossing Tembeling River, Pahang to collect data



Figure 8: Meeting with Special unit of Jabatan Perikanan Malaysia



Figure 9 : Mahseer (Kelah) natives species for in-situ conservation by Jabatan Perikanan Malaysia

INTERVIEW SESSION WITH JABATAN PERIKANAN MALAYSIA

The methodology for this thesis required data collection from the government sector which is Jabatan Perikanan Malaysia, the data was recorded and put into design consideration for the Freshwater Fisheries Research and Discovery Centre.

SITE LOCATION

The Kuala Tahan River, located within the Taman Negara National Park, is chosen for its relatively undisturbed natural environment and its rich biodiversity, including numerous native fish species (Zakaria-Ismail, 1994). The river's upstream sections provide an ideal setting for studying the ecological interactions between native and invasive fish species in a pristine habitat.



Figure 10: Site location in Kuala Tahan in Jerantut District, Pahang

SITE SELECTION

The Taman Negara National Park, where Kuala Tahan is located, is a protected area with minimal anthropogenic disturbances. This allows for the study of native fish populations in a relatively undisturbed environment, providing baseline data for comparison with more impacted areas (Ng et al., 2006). Kuala Tahan also has many endangered fish species native to Malaysia. In addition, the upstream sections of the Tahan River represent pristine riverine habitats that are crucial for understanding the natural state of Malaysia’s freshwater ecosystems and the species they support. In Rancangan Khas Kawasan (Kuala Tahan) there is one site that is marked as an Aquarium Zone and Angler’s Point. This makes Kuala Tahan a suitable site for the Malaysian Freshwater Fisheries Research and Discovery Centre.

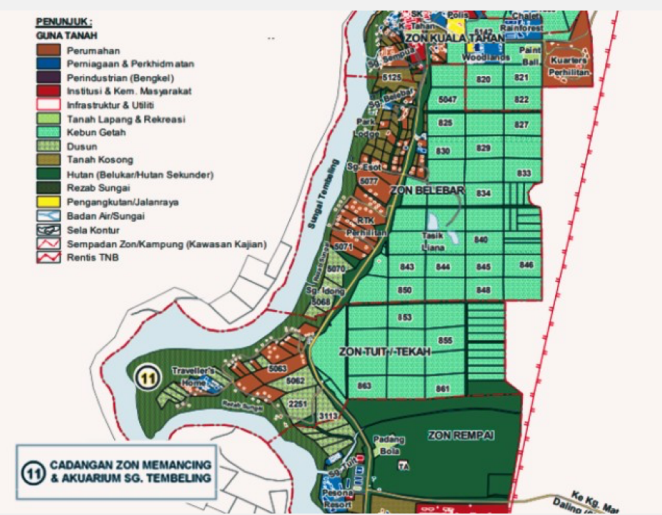


Figure 11: Site location (NO. 11) is marked as Aquarium Zone and Angler's Point in Rancangan Khas Kawasan (Kuala tahan)

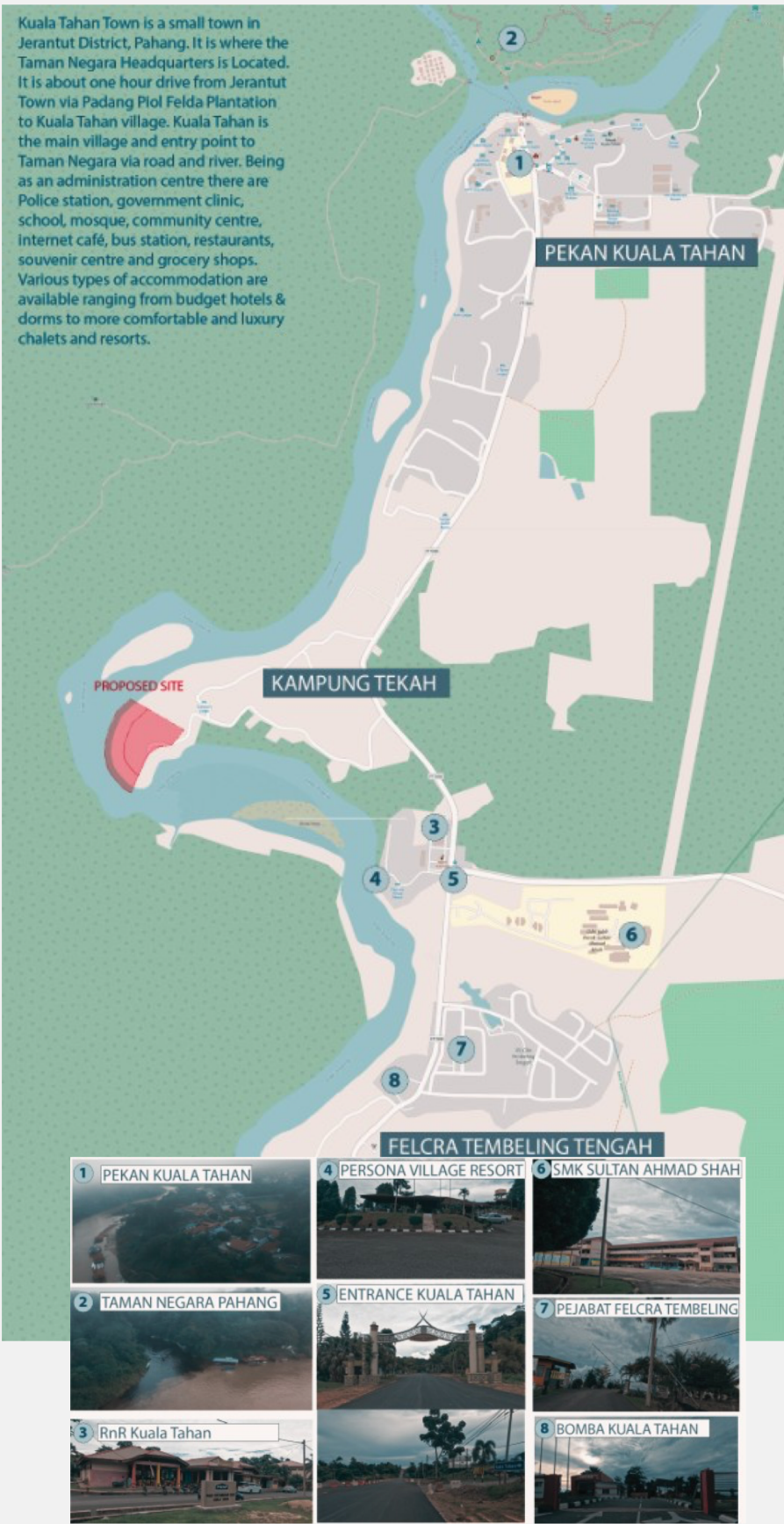


Figure 12: Neighbourhood Context of the site

SITE PLAN AND PROFILE

The site is located at the end of Kampung Tekah and surrounded by a river in the west part and a commercial area in the east part. The main Access by land is from Jalan Tuit-Tekah from the main road Jalan Kuala Tahan - Jalan Jerantut. The main access is by the Tembeling River and the ticket can be bought by Kuala Tembeling Jetty and Kuala Tahan Jetty to the site.

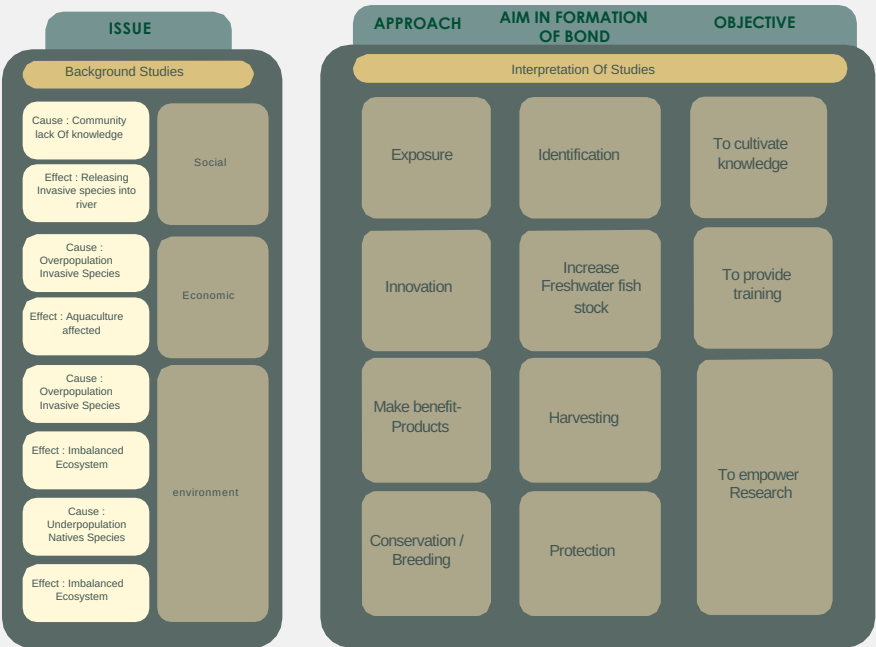


Figure 13: Aerial view of the site that is surrounded by Tembeling River



Figure 14: Top view of the site

RESEARCH FRAMEWORK



BUILDING COMPONENTS	PROGRAM	ACTIVITY	SPACE
Synthesis of Case Studies and Precedent Studies			
Discovery	Participation and discovery	Exhibition	learning tank i interactive tan monstration ta k
Training	Academy	Learning	seminar room briefing room multipurpose area
Research	Production	Capture and harvest	Processing area Laboratories quarantine tank
	In-situ Conservation ation	In-situ Conserv	conservation tank breeding tank nursery tank

Table 1: Research framework

PRECEDENT STUDY

	ONE OCEAN THEMATIC PAVILION	KARLOVAC FRESHWATER AQUARIUM AND RIVER MUSEUM
LOCATION	YEosu-SI JEDLLANAM-DO SOUTH KOREA	KARLOVAC CROATIA
PROGRAM	RESEARCH AND SCIENCE	CULTURAL AQUARIUM & MUSEUM
AREA	8900M2	8327M2
CONCEPT	THE LIVING OCEAN AND COAST	'KARLOVAC STAR' SURROUNDED BY 'SANCJ' - DEFENSIVE 'EARTHEN' WALLS AND MOUNDS
DESCRIPTION	MAIN CONCEPT WAS TO EXPERIENCE THE OCEAN IN TWO WAYS, AS AN ENDLESS SURFACE AND FROM A SUBMERGED PERSPECTIVE AS DEPTH	THE MAIN TARGET WAS TO FORM A NEW CITY FOCAL POINT AND TO VALIDATE THE PROMENADE BY THE RIVER TO MAKE A NEW TOURIST ATTRACTION
URBAN CONTEXT	BUILT ALONG A NEW PROMENADE IN A FORMER INDUSTRIAL HARBOUR BASIN. THE PROMENADE WILL SERVE AS AN URBAN BEACH OFFERING LEISURE ACTIVITIES FOR TOURISTS AND LOCALS	THE FARLOVAC FRESHWATER AQUARIUM IS SITUATED BY THE RIVER KORANA. THE BUILDING VOLUME IS SLIGHTLY DUG INTO THE GROUND AND COVERED WITH EARTHEN DAMS FROM EXTERIOR EDGES. THE AQUARIUM BUILDING IS EMBEDDED IN THE NATURAL ENVIRONMENT AND COVERED WITH GRENNARY
FLOOR PLAN AND PROGRAM ANALYSIS DIAGRAM		
PROGRAM AND ACCESS	MAIN ENTRANCE SITUATED AT THE 'OCEAN PLAZA' WHICH PARTIALLY SHADED BY THE OVERHANG OF THE BUILDING. THE FOYER IS CONCEIVED AS AN OPEN, FLOWING SPACE FACING THE PROMENADE. THE ROOF LANDSCAPE FUNCTIONS AS THIRD EXHIBITION SPACE WHERE VISITORS WILL FIND GARDENS AND A 360 DEGREE VIEW	THE PEDESTRIAN COURSES INTEGRATE IN THREE PRIMARY WAYS: WESTERN TOWARDS THE DOWNTOWN AREA AND THE PROMENADE, SOUTHERN TOWARDS THE NEIGHBORING POLYVALENT TERRITORY UTILIZED FOR SHOWS AND EASTERN TOWARDS THE FUNDAMENTAL STREET APPROACH AND THE STADIUM
CLIMATE CONCEPT		
INTERIOR		
EXTERIOR		

ISLAMIC PERSPECTIVES

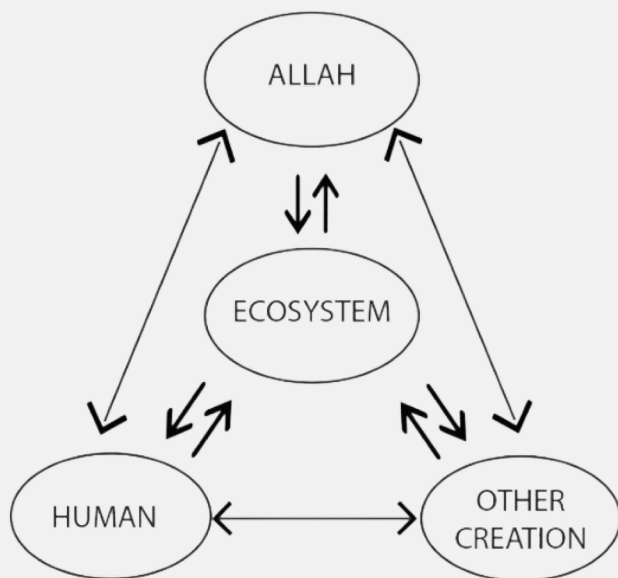


Figure 15: Relationship between God and The Creation

The Qur'an also states that the earth is a living entity which should be treated with respect and caution in line with the concept of justice. Allah S.W.T ordered that the results of the earth's resources should be well managed, distributed and utilised by the people of a country. For example, agricultural products, livestock, logging, petroleum, minerals, gold and many more[8]. This includes human actions towards the environment by not causing damage. We need to realise that the various disasters and environmental damage that occur around the world are caused by the greed and carelessness of humans themselves. The Word of Allah SWT.

(يَذُلُّاْ ضَاعِدِمَ قَيْدِيْ لِسَانُلَا يَدِيْ اَب سَكَا لِمَ بِرَحْمَلَا اَوْ سَدَا يَفْذِلَا سَفَلَا اَرْحَطْ
[9] نَّ وَعَجَرِيْمَ هَلَعَلَا اَوْلِيْعَ

Mischief has appeared on land and sea because of (the meed) that the hands of men have earned that (Allah) may give them a taste of some of their deeds so that they may turn back (from Evil).

FRESHWATER FISHERIES RESEARCH AND DISCOVERY CENTRE

The Centre's research initiatives focus on breeding programs, habitat restoration, and the development of management practices to enhance the resilience of native fish populations. Additionally, it serves as an educational hub, raising public awareness about the critical role of native species in maintaining healthy ecosystems and the threats posed by invasive species.



Figure 16: Site Plan showing entrance from Tembeling River and the land via Jalan Kuala Tahan - Jerantut

CENTRAL AQUA VORTEX

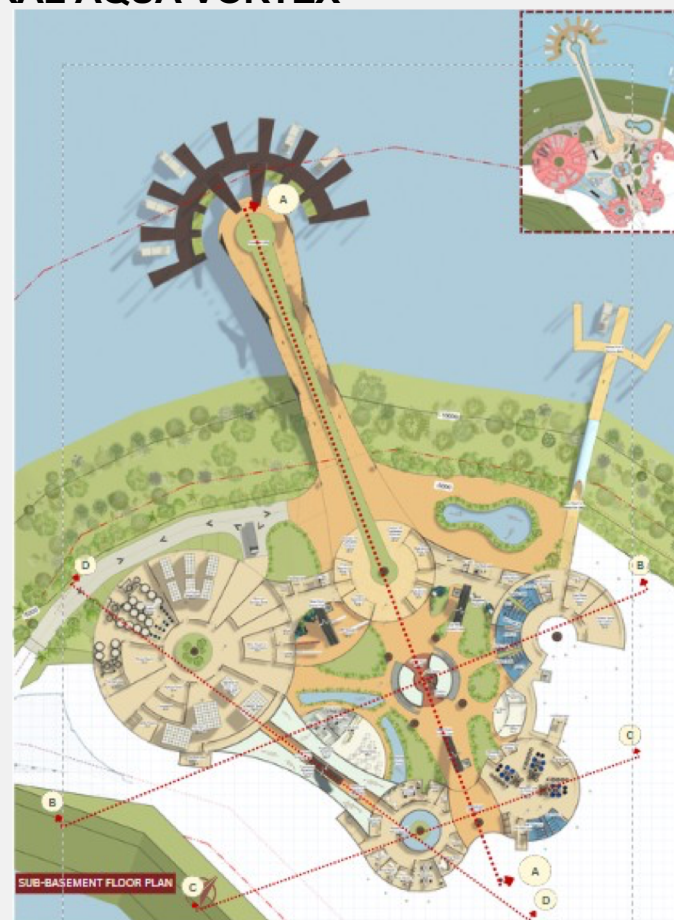


Figure 17: Sub-basement Plan showing Central Aqua Vortex as meeting point of both building entrances

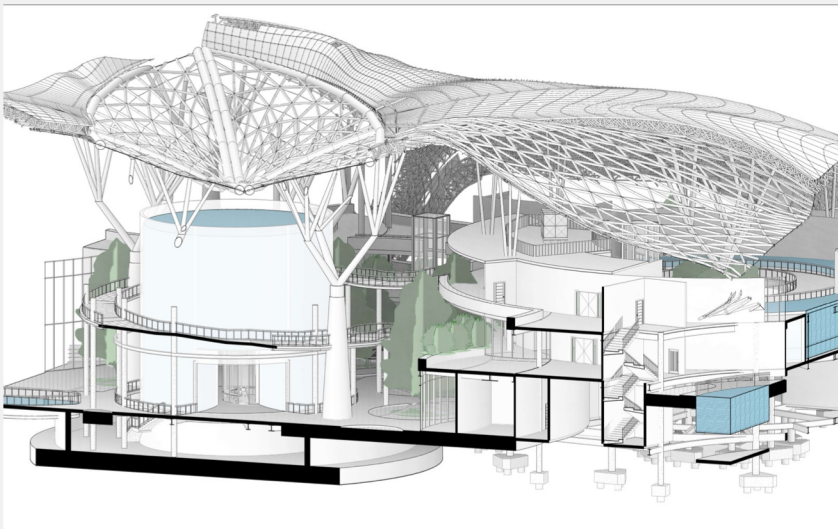


Figure 18: Sectional Axonometric of central Aqua Vortex

The Freshwater Fisheries Research and Discovery Centre, designed to enhance the conservation and awareness of native fish species in Malaysia, features a distinctive architectural element: the Central Aqua Vortex. This innovative structure serves as the focal point and meeting area within the centre, symbolizing the convergence of scientific research and public engagement. The Central Aqua Vortex is an architecturally striking feature located at the heart of the research centre. Its design is inspired by the natural whirlpools and vortexes found in river systems, embodying the dynamic and interconnected nature of aquatic ecosystems. The vortex is constructed with a 200 mm Acrylic panel, allowing visitors to observe the swirling water and the fish within, creating a visually captivating and educational experience.

PRESERVING MICRO CLIMATE WITHIN BUILDING

The Freshwater Fisheries Research and Discovery Centre is designed with a strong emphasis on sustainability and environmental conservation. The building is oriented to maximize natural light while minimizing direct solar gain, reducing the need for artificial lighting and cooling. Strategic placement of windows and skylights allows for abundant daylighting without excessive heat buildup. The design incorporates cross-ventilation strategies, including operable windows and vents that allow fresh air to flow through the building, maintaining a comfortable indoor environment and reducing reliance on mechanical ventilation systems. Indoor water features, such as the Central Aqua Vortex, are carefully managed to avoid excessive humidity while still providing aesthetic and educational benefits.

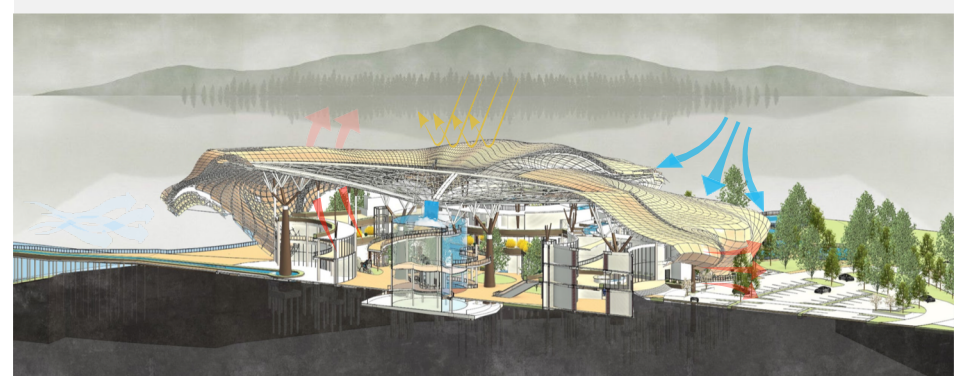


Figure 19: Sectional Perspective of the Freshwater Fisheries Research and Discovery Centre showing cold wind enter the building from large opening and hot air going out the building

OXYGENATED LIFE SUPPORT SYSTEM

The Freshwater Fisheries Research and Discovery Centre employs a state-of-the-art oxygenated water supply system, integrated into the building's architectural and functional design. This system is crucial for maintaining the health and vitality of the aquatic life housed within the centre and enhancing the overall educational and visitor experience. The system uses advanced aeration techniques to infuse water with oxygen. This process involves passing water through fine diffusers or aerators that create tiny bubbles, significantly increasing the surface area for oxygen exchange. Central to this system are vertical columns designed to enhance the oxygenation of water. As water is pumped through these columns, it is vigorously mixed with air or pure oxygen, boosting its oxygen content before being distributed throughout the centre's aquatic exhibits. High-efficiency pumps circulate the oxygenated water from the columns to various tanks, ponds, and water features within the building. This ensures a consistent supply of oxygen-rich water to all aquatic environments.

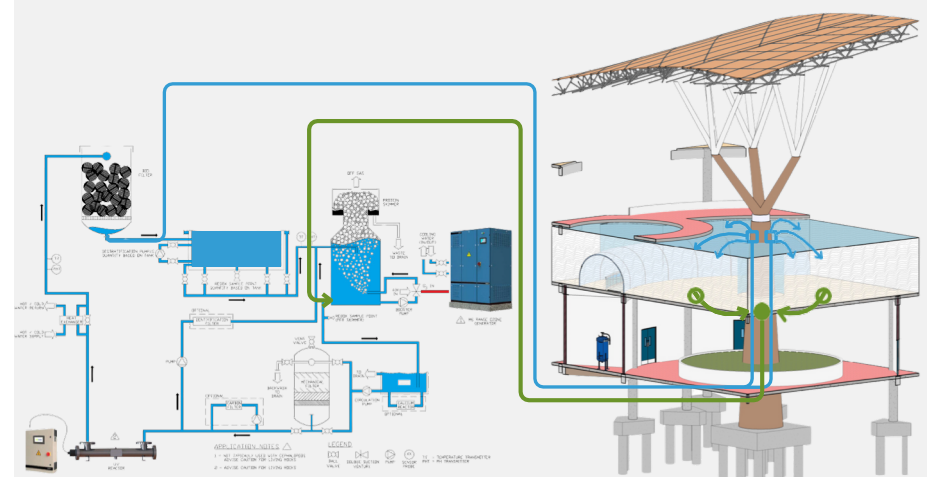


Figure 20: Schematic of Oxygenated Life Support System

THE PERSPECTIVES



Figure 21: Interior Perspectives of Central Aqua Vortex

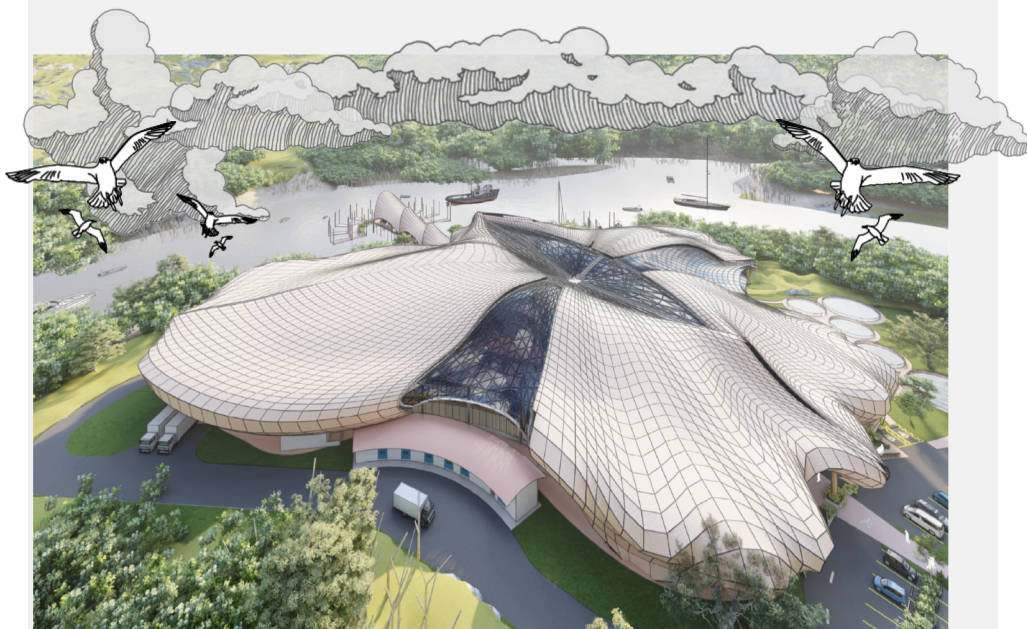


Figure 22: Exterior Perspectives of The Freshwater Fisheries Research and Discovery Centre

CONCLUSION

The Freshwater Fisheries Research and Discovery Centre in Kuala Tahan, Pahang, represents a pioneering effort in the conservation of Malaysia's native freshwater fish species and the management of invasive species. This thesis has detailed the multifaceted approach taken by the centre to achieve its goals, highlighting its innovative design, research methodologies, and community engagement strategies.

The centre's architectural design is a testament to sustainable and functional innovation. The inclusion of the Central Aqua Vortex as a symbolic and practical focal point underscores the integration of scientific research with public engagement. The building's design incorporates passive solar principles, natural ventilation, and eco-friendly materials, all of which contribute to a stable and energy-efficient microclimate. Green roofs, walls, and rainwater harvesting systems further enhance the building's environmental sustainability, supporting both biodiversity and resource efficiency. Equipped with state-of-the-art research facilities, the centre is well-positioned to conduct cutting-edge studies on native fish species and the impacts of invasive species. The strategically chosen site of Kuala Tahan offers a pristine and biodiverse environment, crucial for collecting baseline data and understanding ecological dynamics. The research methodologies employed, including field studies, laboratory analyses, and community engagement, provide comprehensive insights into freshwater ecosystems. The centre's commitment to community engagement and education is evident through its interactive displays, workshops, and guided tours. This collaborative approach is essential for long-term conservation success.

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