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Potential Use of Floating Architecture for Flood Mitigation in *Bulungan* Regency

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Abstract

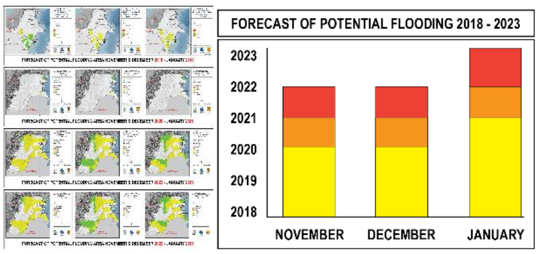
Flooding is a natural phenomenon in *Bulungan* that can affect the discomfort of people's living conditions. Floating house technology has the potential to be a flood mitigation strategy in *Bulungan* Regency, North Kalimantan. Through the study of Floating Architecture technology, including floating houses, raft houses with plastic drums and houses made of EPS (Expanded Polystyrene) material. This research explores the use of this technology in the context of flood mitigation in the *Bulungan* district. Analyzing various sources of information, this research identified 3 (three) potential technologies. This research is limited in being able to identify technologies that have the potential to be applied. Each of these technologies has similarities that have the potential to be applied as flood mitigation in *Bulungan* Regency, looking at aspects such as the *Bulungan* floating house concept, security and sustainability efforts.

Keywords: *bulungan; floating house; flood house; flood mitigation; mitigation house.*

Introduction

The flood phenomenon is a problem that often occurs in various regions. Floods can cause problems in society, infrastructure, and ecosystems. *Bulungan* Regency, located in North Kalimantan Province, is one of the areas that experiences repeated flooding, which causes inconvenience to the local community. Floods can occur with various characteristics, such as floods with repeated periods, increased water discharge, floods with debris, floods accompanied by other hazards, bad weather conditions, and flood behavior. Floods in this area often occur because they are triggered by increased water discharge caused by high rainfall yearly.

Figure 1. *Forecast of potential flooding Bulungan 2018 - 2023*
Source: Author



This condition also triggers repeated flooding in specific periods. It is known from the forecast data for potential flood areas from 2018 to 2023 (figure 1) by BMKG in *Bulungan* Regency that this area is classified as having medium flood-prone potential (Badan Meterologi, 2024). These areas include *Tanjung Selor* District.

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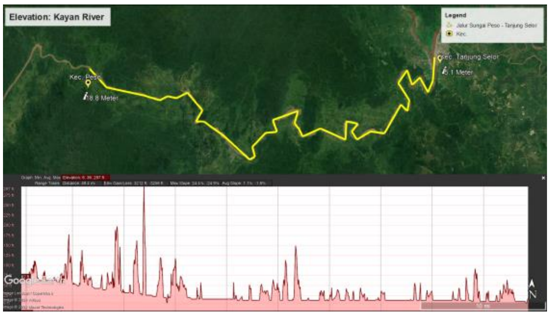
Figure 2. Contour Elevation Kayan River from sub-district Peso to Tanjung Selor
Source: Author

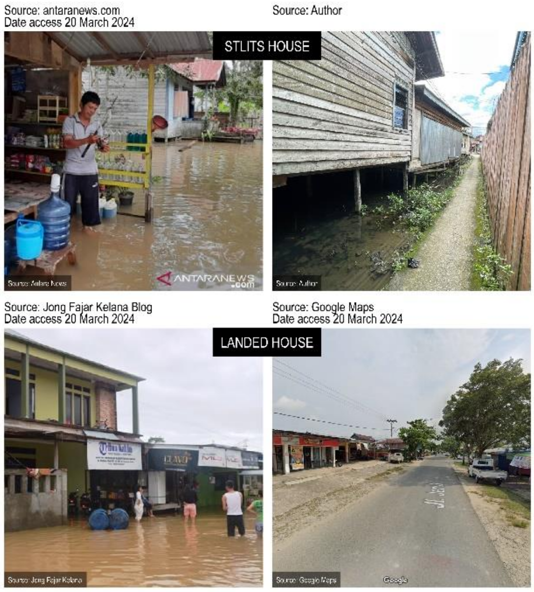


Tanjung Selor District is now a regional municipality in North Kalimantan Province. This area has a relatively high population density compared to other sub-districts. Flood conditions in this area, according to information from BPBD *Bulungan* regency (BNPB, 2024), generally occur because high rainfall around the Peso District area results in an increase in river water discharge towards the *Tanjung Selor* area and inundates the surrounding area via the Kayan River.

The geographical location of Peso District and *Tanjung Selor* District is known to be traversed by the Kayan River. This route (figure 2), starting from the Peso area, has a contour height of 18.8 meters, and the *Tanjung Selor* area is 5.1 meters above sea level. So, there is a difference in contour height of around 13.7 meters towards the *Tanjung Selor* area. This condition can trigger flooding in the *Tanjung Selor* area and its surroundings.

Figure 3. Flood (left) & non-flood (right) in *Tanjung Selor*

Figure 4. Flood (left) & non-flood (right) stilts / landed house



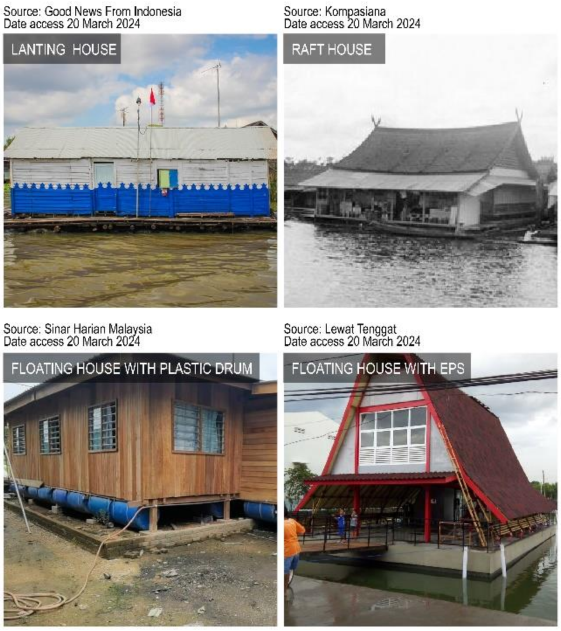
One of how the flood conditions influence the settlement culture of the people of *Bulungan* Regency is that they tend to build houses on stilts or landed houses. Houses on stilts built using tall poles and wood are often an option for people living in areas prone to flooding (figure 3). Meanwhile, landed houses are built directly on the ground without supporting wooden poles. However, this residential culture is still relatively vulnerable to responding to flood mitigation in the face of conditions where the level of increase in water discharge is minimal to predict during floods (figures 3, 4). People are often prepared with minimal materials and equipment to prevent floods from entering their homes.

Figure 5. Stilts (left) & landed (right) House in Tanjung Selor
Source: Author

The stilt house (figure 5) is considered to have a response to increasing water discharge during floods, but its effectiveness is only at certain water discharge levels. It will also affect home accessibility for specific users, such as the elderly and disabled. Meanwhile, landed houses (figure 5), considered in an area minimally subject to flooding, can sometimes be uncertain because the increase in water discharge tends to be unpredictable in each area. This condition can damage the house, both structural and non-structural (Moya et al., 2024). Affected communities do not just move houses immediately because of several influencing factors, such as comfortable conditions and togetherness in certain settlements (Wani et al., 2022). Several people who live in landed houses have prepared barriers in case an increase in floodwater discharge inundates their houses. When anticipating when you want to fill your home with furniture, you must consider materials that can survive flood conditions. This dynamic encourages the development of more effective and sustainable solutions for overcoming flood risk in *Bulungan* Regency.

Floating architecture is an architectural approach that can adapt to these conditions. This approach could be a solution in flood mitigation in *Bulungan* Regency and has the potential to know its role. The flood phenomenon is handled in *Bulungan* Regency, which aligns with the rapid growth of urbanization and increasingly evident climate change.

Figure 6. Flood (left) & non-flood (right) stilts / landed house



Floating architecture is one of the principles that has the potential to be utilized (Moon, 2011). This development (figure 6) can be seen in the presence of floating houses using various traditional and conventional technologies, such as floating houses, raft houses, floating houses with plastic drums, and EPS (Expanded Polystyrene). Makoko Floating School is an example of a sustainable effort implemented by floating technology (Riise & Adeyemi, 2015). This use can be identified in the context of *Bulungan* Regency to determine its significance in responding as a flood mitigation effort. So, it is also necessary to know the culture of housing and flood mitigation in *Bulungan* Regency and the development of Floating Architecture (Abriandi et al., 2012). This knowledge contributes to previous research and expands the understanding of floating architecture, which can be used as part of a flood mitigation strategy in settlements in *Bulungan* Regency.
This research aims to study the potential of 3 floating house technologies (*lanting* houses, floating houses using used drums, and EPS) against flood conditions in *Bulungan* Regency. This can contribute as a flood mitigation solution for houses in residential areas and understanding floating architecture in certain areas.

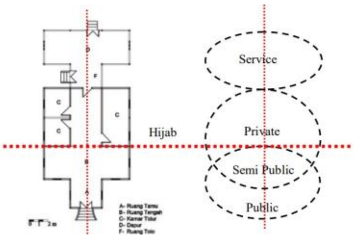
Literature Review

Inhabit culture of Bulungan house.

Bulungan Regency, precisely in *Tanjung Selor* District, is a developing area with a high population density. The population in this sub-district is quite significant compared to the other nine sub-districts (Badan Pusat Statistik Kabupaten Bulungan, 2021). *Tanjung Selor* is currently a planned Municipality of North Kalimantan Province. This city has lowland and hilly geographical conditions. This makes the community's residential culture to build houses according to conditions. However, it is known that there are other factors to consider (Utami, 2012), such as flood conditions that often occur; people need to be alert to these conditions. District area *Bulungan,* according to Indonesian Disaster Information data, has been flooded repeatedly every year from 2015 to 2022. (BNPB, 2024). It is known that most of the settlements in this area are houses with stilt and tread construction. A house on stilts is a house that has a construction raised from the ground with supporting pillars, generally in this area using wood material. Meanwhile, a landed house is a house whose construction is placed directly on the ground.

It is known that people who use stilt and tread houses use it as a residence with an average of around 1 to 2 families, namely between 4 - 8 residents. The facilities and functions of stilt and site houses do not have significant differences. Its spatial system can know this. According to Habraken (1988), spatial systems are the basis for knowing space based on human behavior patterns (Annisa et al., 2023). The spatial space of stilt houses and community sites generally consists of the following zoning

Figure 7. Spatial & zoning
Source: Samra, 2017



Bulungan community houses generally have relevance to the typology of Malay houses and the surrounding area (figure 7) (Agustin, M, Nabila, & Z, 2021) because it is close to a river which adapts to geography (Angkasa, 2017). The zoning is known to the public for service, from the front room to the back. If you look at the designation, it is known as follows:

Table 1. Zoning and function of stilt and grounded house

Zoning	Function
Public	• Terrace • Garage/*carport*
Semi-public	• Living Room
Private	• Family room • Bedroom
Service	• Kitchen • Toilet

Source: Author

The zoning and function of the space (table 1) are generally organized in a linear plan form, starting from the front, middle, and back rooms. The description (figures 8, 9) regarding the zoning and typology of houses in *Bulungan* can be seen as follows:

Figure 8. Zoning space
Source: Author

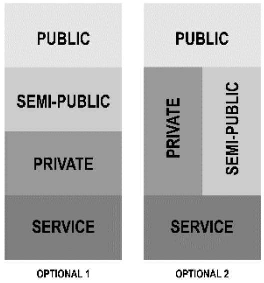
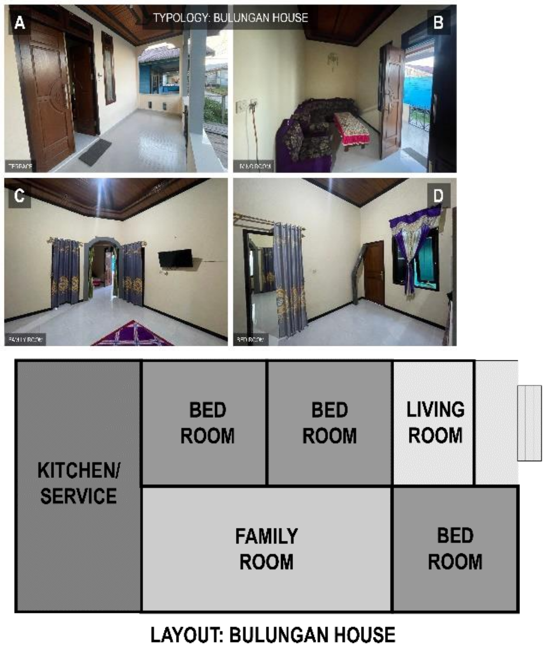


Figure 9. Typology bulungan house
Source: Author



Flood Mitigation

This phenomenon of increasing water volume tends to be caused by natural and human factors. Therefore, mitigation in this case needs to be done. Regarding mitigation in Government Regulation Number 21 of 2008 concerning the Implementation of Disaster Management, it is intended as a series of efforts to reduce the risk of a disaster, both in physical development and awareness, as well as increasing the ability to face the threat of disaster. (Rofiqoh, Siswanto, & Teddy, 2020). Mitigation for facing floods in the resilient agile response pocketbook for disasters by BNPB (National Disaster Management Agency) provides essential actions in the form of structuring river basins so that they are integrated and by the function of the land, not building buildings on riverbanks, installing pumps for lower areas and greening efforts (Badan Nasional Penanggulangan Bencana, 2006). Mitigation can also be carried out with the role of the community, such as in residential areas (Khaidir, 2019). This role can include controlling the environment and utilities. Neighborhood or residential road space so that access can be known. This room is a means of mobilization if an emergency occurs. Utilities in electricity networks and sanitation must be managed well so they are not polluted, causing discomfort and endangering the environment. The application of floating architecture needs to be paid attention to because it is one of the elements achieved, such as utility access, fire safety, and water maintenance (Joseph & Rohith, 2023). Floating architecture with various technological applications can be seen in its latest developments.

Development of Floating Architecture

Floating Architecture in a house is a residential building built on water by applying floating structures, materials, and shapes that adapt to the conditions of the location where the floating house is built. (Endangsih & Ikaputra, 2020). In its construction, this house needs to consider several things related to the floating house concept relating to the regional context, namely *Bulungan* Regency, foundation specifications, parking, utility access, security, sustainable elements, and routine repairs (M.V. & Philip, 2022). This element also needs to consider the construction's resistance to flooding (Nilubon et al., 2016), specification (Daryanto, 2016), and performance (Mohamad et al., 2012). An essential component of a floating house is floating criteria (Wang et al., 2022), floating house sustainable approach (Thu Trang, 2016), buoyancy adaptation (Anwar et al., 2022), mitigation strategy (Novalinda et al., 2022), floating platform (Cahyono et al., 2022), buoyant flexibility (J D Putro & Zain, 2022), floating requirements (Joseph & Rohith, 2023), use of technology (Endangsih & Ikaputra, 2020), influence of environmental conditions (Cottura et al., 2021), floating mass (D. Manlutac et al., 2023) floating house supporting construction system (Prihatmaji & Nugraha, 2019) (Jawas et al., 2021) (G. Hema & Vidya, 2022; Ishaque et al., 2014; Pillai, Gordelier, Thies, Cuthill, & Johanning, 2022)

Lanting bamboo house

The *lanting* house is one of the traditional houses in South Kalimantan. This house generally floats on water and is used as a trader to support community activities (Afdholy, 2017). This house is floating in nature, and the primary material is constructed using wood (Afdholy, 2017). Lanting houses tend to adapt due to changes in environmental conditions, which require the active role of the occupants to control the house well (Jawas et al., 2021).

Plastic Drum House

Raft houses generally developed in society are assembled using bamboo to float on water. However, raft houses now have other options that adapt to the materials in the area. One of the materials used is plastic drums as the foundation of a rafted house (Rofiqoh et al., 2020). This material is used as an alternative for providing raft house materials, which are considered to have reasonably good material durability (Novalinda et al., 2022). A raft house certainly needs suitable quality materials, even if it uses optional materials, because this determines the length of use and improvement in the house's condition.

EPS House (Expanded Polystyrene)

Floating houses use EPS or Styrofoam as the structure's foundation (Adi & Wahyudi, 2021). This material has low thermal conductivity, is strong under pressure, and is light (Cahyono et al., 2022). Using this material is much cheaper than using PVC. However, each material has advantages and disadvantages, among which EPS can last up to 15 – 20 years. Meanwhile, the use of PVC can last up to 50 years (G. Hema & Vidya, 2022).

Methodology

This research will examine several objects of floating architecture technology used in houses, including *lanting* bamboo house, plastic drum house and EPS house (Expanded Polystyrene). This study will explore the use of this technology relevant to the regional context, namely flood mitigation efforts in homes in *Bulungan* Regency. The intensity of flooding in the last ten years in this region has provided various forms of flood mitigation that have developed in the community. Floating architecture can contribute to flood mitigation efforts in residential areas.

The research instrument was carried out by collecting and studying information about floating architecture and flood mitigation in *Bulungan* Regency through journal papers, books, data reports, news, and events. Relevant information is needed to formulate a comprehensive analysis, results, and conclusions.

Data analysis was descriptively and tabulated to convey findings well and organized. The potential for using floating architecture as flood mitigation in *Bulungan* Regency will be known by assessing the following research object.

Table 2. Benchmarks and technological objects to be assessed

Parameter	Lanting bamboo house	Plastic drum house	EPS house	Ref
Bulungan house concept	descriptive	~	~	~
Foundation specifications	~	descriptive	~	~
Parking requirements	~	~	descriptive	~
Utility access	~	descriptive	~	~
Fire & safety	descriptive	~	~	~
Incorporation of sustainable elements	~	descriptive	~	~
Underwater maintenance options	~	~	descriptive	~

Source: Author

The assessment results (table 2) will be able to formulate floating architecture technology that can be applied in the context of flood mitigation in *Bulungan* Regency. The results can also provide descriptive advantages and disadvantages of this potential technology so that conclusions can be drawn.

Result and Discussion

The use of Floating Houses as flood mitigation in *Bulungan* Regency was discovered by observing 3 (three) developing floating house technology objects, namely *lanting* bamboo houses, plastic drum houses, and EPS houses. This technology will be observed by observing several floating house technology parameters. These parameters were obtained from various written references related to floating house characteristics, which will be known in *Bulungan* Regency—regional context in flood characteristics and settlement conditions.

Table 3. Bulungan context parameters with floating house

Parameter	Lanting Bamboo House	Plastic Drum House	EPS House	Reference
Construction of Amphibious Houses				
Bulungan house concept	Context modular, flexibility, synchronize, adaptation	Modular flexibility, replication	Modular flexibility, replication	(M.V. & Philip, 2022)
foundation specifications	Adaptation flexibility	Movement setting	Adaptation flexibility	
parking requirements	Limited space	Limited space	Limited space	
utility access	Integrated system	Integrated system	Integrated system	
fire and safety	Evacuation strategy	Evacuation strategy	Evacuation strategy	
incorporation of sustainable elements	Strength and durability	Durability	Strength and durability	
underwater maintenance options	Easy	Medium	Hard	
Construction Durability				
Flood hazard	Strong condition	Strong condition	Weak condition, need anticipation	(Nilubon et al., 2016)
sensitivity	Resistant	Resistant control	Resistant control	
House Specifications				
Building function	Context adaptation	Context adaptation	Context adaptation	(Daryanto, 2016)
Building material	Easy to get	Indirect to get	Indirect to get	
Roof form	Center mass distribution	Center mass distribution	Center mass distribution	
House Performance				
Cost efficiency	Material acquisition & quality	Material acquisition & quality	Material Acquisition & Quality	(Mohamad et al., 2012)
Enviromental friendly	Strength and durability	Durability	Strength and durability	
Easy to construct	Worker quality	Worker quality	Worker quality	
Durability	5-10 years	15-20 years	50 years	
Suitable mooring and movement system	Rope & mooring system	Rope & mooring system	Rope & mooring system	

Parameter	Lanting Bamboo House	Plastic Drum House	EPS House	Reference
House Element				
Foundation/floating platform	Adaptation flexibility	Movement setting	Adaptation flexibility	(Wang et al., 2022)
Floor	Additional flooring option	Floor stabilization	Floor stabilization	
Roof	Center mass distribution	Center mass distribution	Center mass distribution	
Staircase	Entering access	Entering access	Entering access	
External wall	Buoyancy material	Buoyancy material	Buoyancy material	
Internal wall	Buoyancy material	Buoyancy material	Buoyancy material	
Finishes	Buoyancy material	Buoyancy material	Buoyancy material	
External works/drainage	Integrated system	Integrated system	Integrated system	
House Design				
Organization of space	Context adaptation	Context adaptation	Context adaptation	(Thu Trang, 2016)
Structure and Joining System	Integrated construction	Integrated construction	Integrated construction	
Unique features; facades; water;sloping roofs	Buoyancy material	Buoyancy material	Buoyancy material	
Architectural features: door, window, roof	Buoyancy material	Buoyancy material	Buoyancy material	
Energy usage	Energy efficiency	Energy efficiency	Energy efficiency	
Sanitation	Integrated system	Integrated system	Integrated system	
House adaptation				
Temporary houses	Context adaptation	Context adaptation	Context adaptation	(Anwar et al., 2022)
Maintaining	Easy	Medium	Hard	
House Component				
Foundation	Adaptation flexibility	Movement setting	Adaptation flexibility	(Novalinda et al., 2022)
Floating media	Adaptation flexibility	Movement setting	Adaptation flexibility	
Roof building	Center mass distribution	Center mass distribution	Center mass distribution	
House Mass				
Strength	Medium endurance	Long durability	Medium endurance	(Cahyono et al., 2022)
Weight	Heavy	Heavier	Light-weight	
Floating occupation				
Adaptability	Bulungan context	Bulungan context	Bulungan context	(J D Putro & Zain, 2022)
Flexibility	Integrated system	Integrated system	Integrated; attention	
Building element				
Building facade	Material adaptation; buoyancy	Material adaptation; buoyancy	Material adaptation; buoyancy	(Afdholy, 2017)
Building distance	1-2 meter (exact distance)	2-3 meter (need more distance)	1-2 meter (need more distance)	
Interior building	Material buoyancy	Material buoyancy	Material buoyancy	
Roof building	Center-buoyancy	Center-buoyancy	Center-buoyancy	
Bodybuilding	Material buoyancy	Material buoyancy	Material buoyancy	
Foundation building	Adaptation flexibility	Movement setting	Adaptation flexibility	
Floating requirements				
Capability of floating	capable	capable	capable	(Joseph & Rohith, 2023)
Foundation	Adaptation Flexibility	Movement setting	Adaptation flexibility	
Float line	Rope & mooring system	Rope & mooring system	Rope & mooring system	
Structure type	Produce & rafting system	Rafting system	Fabrication structure	
Road and parking condition	Limited space	Limited space	Limited space	
Utility access	Integrated system	Integrated system	Integrated system	
Fire safety	Evacuation strategy	Evacuation strategy	Evacuation strategy	
Water maintenance	Easy	Medium	Hard	
Prevention floating technology				
Stable condition; waves & wind forces	controlled	controlled	controlled	(Endangsih & Ikaputra, 2020)
low prices	Material acquisition & quality	Material acquisition & quality	Material acquisition & quality	
high durability/low maintenance	Low	High	Low	

Parameter	Lanting Bamboo House	Plastic Drum House	EPS House	Reference
low weight	Need estimation	Need estimation	Need estimation	
high buoyancy	Need estimation	Need estimation	Need estimation	
building shape	Bulungan house context	Bulungan house context	Bulungan house context	
House modeling				
Waves	Need calculations	Need calculations	Need calculations	(Cottura et al., 2021)
Wind	Need calculations	Need calculations	Need calculations	
Wind turbine	Need calculations	Need calculations	Need calculations	
Moorings	Need calculations	Need calculations	Need calculations	
Hull	Need calculations	Need calculations	Need calculations	
House Character				
Structural security	Need calculations	Need calculations	Need calculations	(Prihatmaji & Nugraha, 2019)
Resistance and security to the structure	Need calculations	Need calculations	Need calculations	
Ease of Implementation	Worker quality	Worker quality	Worker quality	
Structural durability	Long time	enough	Short time	
Dimension scale	Bulungan house context	medium	large	
Material availability	Material acquisition & quality	Material acquisition & quality	Material acquisition & quality	
Function integration	Integrated-function	Integrated-function	Integrated-function	
Structural strength	Need calculations	Need calculations	Need calculations	
Economic and budget	Easy to get, cost efficiency	it takes time to get the materials, and it is not cost-efficient	it takes time to get the materials, and it is not cost-efficient	
Building durability	5-10 years	15-20 years	50 years	
Design & Cost Estimation				
Buoyancy	Need calculations	Need calculations	Need calculations	(Ishaque et al., 2014)
Stability	Need calculations	Need calculations	Need calculations	
Wind force	Need calculations	Need calculations	Need calculations	
Sanitation	Need integrated technology	Need integrated technology	Need integrated technology	
Estimation of cost	Need calculations	Need calculations	Need calculations	

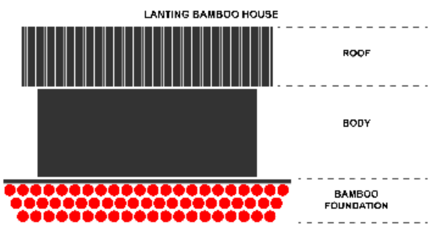
Source: Author

This parameter assessment provides knowledge that using floating houses by observing three floating technologies has various characteristics that support their implementation. However, for several parameters, certain technologies need to be readjusted and applied because they are related to the regional context of *Bulungan* district, as well as both settlements and flood characteristics. This can be known as follows.

Lanting bamboo house

Several parameters must be considered if bamboo-*lanting* floating houses (figure 10) are used as flood mitigation in *Bulungan* Regency.

Figure 10. Lanting bamboo house
Source: Author

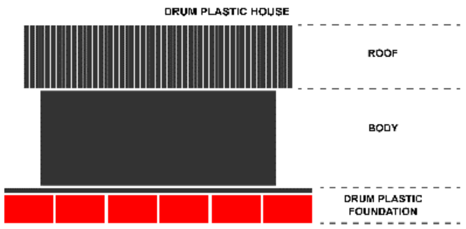


The culture of living in Bulungan Regency is one of the influences, as is the building typology where the mass of the building is rectangular with the same modular space. (M.V. & Philip, 2022). This typology allows it to be adapted to the application of the floating bamboo lanting house in terms of space and function (Afdholy, 2017). The entire building construction uses wood materials; in the context of the area, generally, the wood used is meranti wood (Jawas et al., 2021). This material can be constructed to make the body and roof of the house. However, the foundation of the house will use bamboo material. It is known that obtaining bamboo in Bulungan is not that difficult to obtain, but the next consideration is the limited workforce. Floating construction requires special handling to be realized, both when conditions are not flooded and during flood conditions (Nilubon et al., 2016). Building utilities (Joseph & Rohith, 2023), such as electricity and sanitation networks, need to be supported by additional technology, which allows them to be integrated with the home. Sustainability elements and routine repairs to bamboo-lanting houses will likely be carried out quickly because the bamboo material used is moderately durable.

Plastic drum house

Floating technology, which uses plastic drums (figure 11) that are assembled into floating houses, has been developed in various scientific discussions.

Figure 11. Drum plastic house
Source: Author

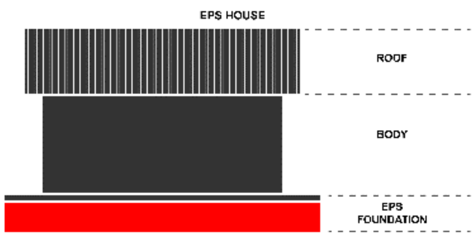


This technology uses existing materials, which are then assembled to respond to flood conditions, one of which is. Implementing flood mitigation in Bulungan Regency is possible using floating plastic drums. However, several parameters need to be considered and adjusted. This use is classified as a medium for construction. Plastic drum material can be obtained, but this is related to costs and time because it is generally unavailable directly (Ishaque et al., 2014). Assembly also requires qualified labor to be able to construct and test surface and floating conditions (Wang et al., 2022). Technology for handling utilities such as electricity networks and sanitation makes it possible to integrate this technology because the shape and material are in harmony with the assembly construction. Sustainability and routine improvements to this technology are classified as moderate because the assembly process uses materials of fairly good durability (Thu Trang, 2016).

EPS house

Utilizing EPS material (figure 12) as a floating house is one solution for developing floating houses in various regions.

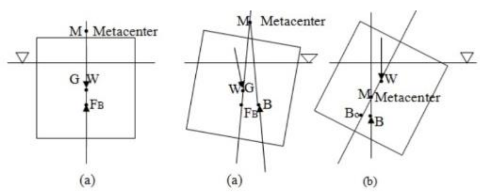
Figure 12. Drum plastic house
Source: Author



Flood mitigation in Bulungan Regency can be achieved using floating houses with EPS material. In this utilization, there are several parameters that need to be adjusted, such as obtaining materials that are pretty difficult to reach due to limited regional conditions, so it is necessary to provide materials first. Apart from that, this material is not familiar to the public; this will also affect the acquisition of qualified workers to construct EPS floating houses. However, technology is significant in a floating house because it is durable. However, a significant quantity of cost consideration is required. In terms of shape and typology, the house will be well integrated, along with the utility technology that will be applied to handle the electricity and sanitation networks in the floating house. This condition regarding sustainability efforts and routine repairs is also influenced by the acquisition of materials that are not easy to obtain.

The potential use of floating houses as a flood mitigation effort in Bulungan Regency is known from the three floating technologies, each of which can be applied in the context of this region. However, the considerations regarding its implementation are related to the cost and efficiency of implementation. This is because the condition of the Bulungan Regency area is limited by human resources and the use of certain materials that are not easy to obtain. If sorted, the significant ones that have the potential to be applied are from traditional to conventional technology. The technologies in order are the application of bamboo lanting floating houses, floating houses using plastic drum material and floating houses using EPS material. Each technology needs adjustments in several parameters to achieve a floating house that adapts to the regional context, such as the concept of the house, utilities, security, sustainability efforts, and routine repairs (M.V. & Philip, 2022).

Figure 13. Stable equilibrium and unstable equilibrium of a floating body
Source: Ishaque et al., 2014



It is also relevant that the balance of the building (figure 13) in approaching the Bulungan house typology will be disturbed. So, efforts are needed to stabilize this condition, such as using rope tethers to support the foundation (Ishaque et al., 2014).

Conclusion

Knowledge of the potential use of Floating Architecture as a flood mitigation effort in Bulungan Regency by looking at the three developing floating technologies, namely bamboo lanting floating houses, floating houses using plastic drum material, and floating houses using EPS material, which have various characteristics. Every technology has something in common.

Knowledge of the potential use of Floating Architecture as a flood mitigation effort in Bulungan Regency by looking at the three developing floating technologies, namely bamboo lanting floating houses, floating houses using plastic drum material, and floating houses using EPS material, which have various characteristics. This is influenced by the application of technology, which has experienced significant developments, so traditional to conventional technology has various applications. Each of these technologies has similarities that have the potential to be applied, looking at aspects such as the Bulungan floating house concept, security, and sustainability efforts (M.V. & Philip, 2022). Bamboo lanting house technology has the disadvantage of being able to be applied with supporting conventional technology, such as utility innovation and routine repairs. Adaptations can only be made to similar construction materials, such as wooden materials constructed to fulfill the aspects of bamboo-lanting houses. This differs from plastic drum houses, which have been adapted to supporting technology to be assembled into one aspect of a plastic drum house. This house can be planned using local materials, and the supporting technology can be adapted. It is known that this house is adaptable and flexible. However, it has drawbacks when applied to settlements with a distance between housing units of 1-2 meters. Other technologies, such as EPS housings, are similar to plastic drum housings. However, the drawback of applying this technology is that it is not easy to use and construct EPS material. This is because EPS is unavailable in Bulungan, so bringing this material takes time and money. On the other hand, special workers are also needed to construct this material. If we sort the durability of the floating material, which can last well, it is known that EPS material lasts around 50 years, plastic drums around 15-20 years, and bamboo lanting around 5-10 years. Residential areas are classified as quite dense, with distances between buildings ranging from 1-2 meters. Applying these three technologies requires modification to be adapted to the regional context. These modifications include tethering ropes, which minimize horizontal and vertical movement. This is necessary because, looking at the floating house technology in Bulungan, which aims to mitigate floods, it should be stable when floating during floods or non-flood conditions. This situation also needs to be adjusted to the characteristics of the flood; of course, things like Adaptability and flexibility are taken into consideration (J D Putro & Zain, 2022), construction durability (Nilubon et al., 2016), and cost estimates (Ishaque et al., 2014).

The potential use of floating house technology in Bulungan Regency, if listed in order of those that have the potential to be implemented, are bamboo lanting floating houses, floating houses using plastic drum material, and floating houses using EPS material. The limitation of this research is that it can only provide predictions and identification of floating technology that has the potential to be applied in the context of the Bulungan Regency area. Further contributions to this knowledge must be made to study Floating Architecture in certain areas comprehensively. Hopefully, this contribution will aid flood mitigation efforts in Bulungan Regency.

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