Outside-in as a domestic strategy: rethinking architectural programming in the coastal area (case study: Bedono, Morosari, Central Java-Indonesia)

De afuera hacia adentro como estrategia doméstica: repensando la programación arquitectónica en el área costera. Estudio de caso: Bedono, Morosari, Java Central, Indonesia

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Abstract

This paper explores various forms of domestic spatial strategies in response to tidal flooding. This paper will highlight the various spatialities of coastal dwellings that rising sea levels have shaped. This discussion aims to broaden the understanding of architectural programming in domestic spaces that respond to their external environment. An open understanding of domestic space is created by a response from the inside to an external environment, instead of situating the inhabitation from the outside. This study takes place in Bedono, Morosari, Central Java. This region is severely affected by climate change and tidal flooding. Data was collected by observation, interviews, and visual notes to reveal local communities' spatial strategies through mapping, cataloguing, and redrawing the observed space. This study identified dwellers' responses to changes in the settlement environment caused by tide floods by following these strategies: (1) adjusting floor levels based on alertness levels, (2) selecting materials that facilitate assembly and disassembly, and (3) optimising the top surface for storage. Adaptation to disasters is reflected in this article by the domestic strategy as an outside-in architectural program. The results of this study contribute to the understanding of the importance of adaptable and open domestic spaces in disaster mitigation measures.

Resumen

Este artículo explora diversas estrategias espaciales domésticas en respuesta a las inundaciones por mareas. Destaca las diversas espacialidades de las viviendas costeras que ha moldeado el aumento del nivel del mar. Este debate busca ampliar la comprensión de la programación arquitectónica en espacios domésticos que responden a su entorno exterior. Una comprensión más amplia del espacio doméstico se crea mediante una respuesta desde el interior al entorno exterior, en lugar de situar la vivienda desde el exterior. Este estudio se lleva a cabo en Bedono, Morosari, Java Central. Esta región se ve gravemente afectada por el cambio climático y las inundaciones por mareas. Se recopilaron datos mediante observación, entrevistas y anotaciones visuales para revelar las estrategias espaciales de las comunidades locales mediante el mapeo, la catalogación y el rediseño del espacio observado. Este estudio identificó las respuestas de los habitantes a los cambios en el entorno del asentamiento causados por las inundaciones por mareas siguiendo estas estrategias: (1) ajuste de los niveles del piso en función de los niveles de alerta, (2) selección de materiales que faciliten el montaje y desmontaje, y (3) optimización de la superficie superior para el almacenamiento. La adaptación a los desastres se refleja en este artículo en la estrategia doméstica como un programa arquitectónico de afuera hacia

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adentro. Los resultados de este estudio contribuyen a comprender la importancia de los espacios domésticos adaptables y abiertos en las medidas de mitigación de desastres.

Keywords:

outside-in, domestic strategy; adaptable; resilience; disaster tidal flood

Palabras Clave:

de afuera hacia adentro, estrategia doméstica; adaptable; resiliencia; desastre, marea e inundación

Introduction

This paper aims to expand the understanding of architectural programming in domestic spaces, especially in disaster areas. Specifically, this research will examine various domestic strategies in coastal areas affected by rising sea levels. Although discussions on domestic space arrangement have generally focused on the use of space and the arrangement of interior space (Cieraad, 2017; Imrie, 2004; Mezei and Briganti, 2012), there has been relatively little discussion regarding how changes in the external environment facilitate changes in domestic space. Studying how the strategy of changing domestic space due to changes in outdoor space may expand architectural programming based on inside-outside relationships.

Most discussions of inside-outside architecture focus on boundaries, territories, and connections (Atmodiwirjo et al., 2015; Klasto, 2019; Morrow, 2017; Plevoets, 2021). By contrast with Outside-in, which focuses on the dissolution of boundaries from within to outside, this article examines inside-outside relations as a form of community resistance to the phenomenon of rising sea levels. In the discourse of territorial expansion related to visuals and views, domesticity is discussed about depth and how it is used (Harani et al., 2023a; Verschaffel, 2012), while in the discourse of territorial expansion related to visuals and views it is discussed how it is perceived (Cetin, 2017; Klasto, 2019; Wagenfeld, 2011). However, how domestic space is arranged as part of the modification of outside space can improve our understanding of domestic architecture.

The study demonstrates that sea level rise often adversely affects domestic environments and the livelihoods of people. Coastal areas in Indonesia are often affected by sea level rise, which is a form of natural disaster (Anita and Hamzah, 2013; Harani et al., 2023c). In response to sea level rise, local communities have been forced to develop a variety of local strategies. Coastal flood adaptation has been extensively discussed (Buchanan et al., 2020; Koerth et al., 2013), including environmental infrastructure (Harani et al., 2023; Yuliastuti et al., 2023), housing adaptation (Anita and Hamzah, 2013; Buchanan et al., 2020), as well as social impacts (Brammer, 2014; Isa et al., 2018). Meanwhile, it has not been widely discussed how an area affected by sea level rise can be utilized for architectural programming.

In particular, a community affected by rising sea levels has a living strategy based on the natural phenomena that occur in that region. Exploring how coastal communities deal with rising sea levels and how they organize their living spaces is an interesting area of research. The purpose of this paper is to provide an analysis of the domestic strategies used by the community to cope with rising sea levels. In coastal areas, this strategy can contribute to the enrichment of discussions regarding architectural programs. These results will contribute to the achievement of Sustainable Development Goal 2030 point 11, namely sustainable cities and communities, especially those related to disaster mitigation. Tracing local strategies as a form of hidden knowledge can enrich adaptive and applicable architectural knowledge (Arefi, 2011; Highmore, 2002).

This study examines Bedono Village, Morosari, Demak, Central Java, which is an area vulnerable to rising sea levels. Rising sea levels severely affect this location, which has become

a part of their daily lives. This area is located on the coast, so some parts of the settlement are continually flooded or partially submerged. To survive in this location, the community carries out several strategies, including the organization of their living space in response to rising sea levels. The local strategy is implemented to ensure survival and to continue social and economic activities. The location offers the opportunity to observe how domestic strategies are reflected in the form of community resilience to rising sea levels. Initially, the paper examines various forms of domestic strategies as a means of addressing the changes in the external environment associated with rising sea levels. The next section of this paper discusses the spatial mechanisms involved in the adaptation of domestic space. Based on the findings of this study, the findings can be used to prepare sustainable and adaptive residential architecture programs in coastal areas that can help them survive changes caused by rising sea levels.

1. Coastal community adaptation strategies to sea level rise

This article focuses on the adaptation of communities in coastal areas affected by sea level rise, based on the statement of Walker & Salt (2006) that coastal environmental resilience should be considered as a sustainability strategy by emphasizing the principles of design and planning as a reference for infrastructure development. Coastal community adaptation focuses primarily on how communities respond to sea level rise (Quigley et al., 2018). According to Crowe & Foley (2017) and Dixon (2007), local community strategies provide a means of fostering a sense of sustainable community resilience. This indicates that the search for spatial strategies carried out by communities as local practices has significant potential for resilience. The exploration of local strategies as a means of resilience is a very important component of addressing sustainability issues, especially in coastal areas that are at risk from rising sea levels.

Climate change is acknowledged as a major factor underlying and accelerating sea level rise (Machlis et al., 2022). A coastal area is susceptible to sea level rise, tidal flooding, abrasion, erosion, and wind (Anita and Hamzah, 2013; Buchanan et al., 2020; Koerth et al., 2013; Yuliastuti et al., 2023). Therefore, coastal communities must be able to deal with rapid environmental changes, especially those caused by sea level rise (Isa et al., 2018; Kelly and Adger, 2000). Environmental changes that are occurring rapidly tend to raise public awareness about the importance of building an adaptable environment. There is great potential for regional development in research on how to minimize the impact of disasters in coastal areas.

There are many challenges that coastal communities face as a result of sea level rise, including strategies for surviving. One of the main options for dealing with sea level rise is to relocate from areas that are affected, but this is always hindered by economic limitations (Buchanan et al., 2020). The majority of people who have a good economic capacity choose to move. But if they are not financially capable, people affected by sea level rise should adapt as a form of adaptation, especially in their place of residence (Buchanan et al., 2020; Harani et al., 2023). Because they are based on capacity, adaptation strategies implemented by coastal communities are usually based on economic capacity.

Adaptation strategies for coastal areas subject to sea level rise have become a significant topic of discussion in the fields of architecture and urban design. Sea level rise that occurs continuously can be considered a disaster (Brammer, 2014; Nicholls, 2011; Sharaan et al., 2022). In various contexts, disaster mitigation strategies have been discussed (Anita and Hamzah, 2013; Charlesworth and Fien, 2022; Hamin and Gurran, 2009), both collectively and individually. Consequently, addressing rising sea levels in coastal areas is an important global concern (Buchanan et al., 2020; Nicholls, 2011). There are various types of coastal disasters, but this article is primarily concerned with the phenomenon of rising sea levels that often occurs in Indonesia. Considering that this region is tropical, spatial strategies are of particular importance, especially in domestic spaces. Additionally, coastal communities must adjust to rising sea levels while maintaining the comfort of their domestic spaces. Adaptation to rising sea levels in coastal areas requires architectural programming that prioritizes internal quality.

Sea level rise adaptation strategies have become a topic of discussion in the fields of architecture and urban design. A continuous rise in sea level can be considered a disaster arising from sea level rise or land subsidence (Brammer, 2014;

Nicholls, 2011; Sharaan et al., 2022). In many contexts, disaster mitigation strategies have been discussed, both collectively and individually, in a local and modern context, as well as in a specific and general context (Anita and Hamzah, 2013; Charlesworth and Fien, 2022; Hamin and Gurran, 2009). There are various forms in which coastal disaster problems may appear; this article focuses on the phenomenon of sea level rise that occurs frequently in Indonesia. As a tropical region, spatial strategies, particularly in domestic spaces, require sensitivity to reading conditions. The comfort of domestic spaces is certainly a concern of coastal communities, in addition to adapting to sea level rise. Adapting coastal areas to rising sea levels requires an approach to architectural programming that emphasizes internal quality.

This article describes how coastal communities utilize spatial practices to prepare for rising sea levels. Discourse and practice of design that can reduce the negative effects of disasters is an ongoing debate in the fields of architecture and urban planning (Charlesworth and Fien, 2022). By examining how a community responds to rising sea levels, which occur on a daily basis, one can gain an understanding of an effective approach to be applied. According to de Certeau et al. (1984), spatial practices can reflect the strategies used by communities to address certain phenomena. In this case, community strategies can be regarded as adaptive local practices (Harani et al., 2023b, 2023a; Yatmo and Atmodiwirjo, 2013) and can indicate community adaptation (Andrade et al., 2023; Harani et al., 2021). Andrade (2023) explains that disaster response policies that are based on local community strategies are adaptive strategies.

Koerth et al. (2013) stated that domestic adaptation in coastal areas is a survival strategy that can provide an efficient alternative to addressing the problem of rising sea levels. Various domestic strategies implemented as a form of adaptation in coastal areas to deal with rising sea levels include storing emergency equipment (Baker et al., 2017; Cretikos et al., 2008), arranging furniture (Grothmann and Reusswig, 2006), and raising the floor (Anita and Hamzah, 2013; Yuliastuti et al., 2023). According to Harani et al. (2023c), "*there are three spatial mechanisms in coastal communities that live with water: (1) The division of everyday spaces based on reading nature, (2) the plug-and-play mechanism carried out in domestic and public environments, and (3) Material systems used*" (p. 67). Few strategies have been discussed previously that highlight domestic strategies as local adaptation measures to cope with external environmental changes resulting from rising sea levels.

This article aims to explore various domestic strategies for houses in coastal areas with tropical climates. By exploring domestic strategies, the relationship between the inside and the outside is the main focus in light of the fact that external factors continually influence internal arrangements. It has been widely discussed regarding the inside-outside relationship regarding expansion of activities (Atmodiwirjo et al., 2015; Harani et al., 2021). However, it has not been extensively discussed regarding adaptation strategies. The purpose of this article is to contribute to the development of an adaptive and resilient design approach in coastal areas that is based on local spatial strategies that emerge as a result of human behavior.

2. Method

The purpose of this study is to examine domestic strategies from an everyday perspective, as described by de Certeau et al., (1984) as reading local knowledge (Highmore, 2002), as well as looking for truth in social reality that is constructed by society (Wang and Groat, 2013). The article employs constructivism to examine how natural disasters result in environmental changes that shape society's living spaces. Creswell & Creswell (2018) stated that constructivism is appropriate for tracing individuals and their activities within a particular context. To obtain a detailed understanding of the situation, observations, interviews, and visual records are used to collect data. The purpose of this approach is to take into account that the investigation focuses on everyday experiences.

A single case study method is used in this paper to explore field phenomena from an everyday perspective. This study focuses on Bendono Village, located in Demak Regency, Central Java. The purpose of this research is to identify spatial adaptation patterns that the local community has carried out to cope with rising sea levels that occur almost daily on a routine basis. The community of Bendono Village lives side by side with water in a region where the sea level continues to rise. The situation illustrates how coastal areas are at

risk of disasters due to rising sea levels, but many residents can still adapt to their way of life and endure. Despite limited resources and space, the selected location is resilient to the effects of rising sea levels.

As a result of global warming, sea levels in Bedono Village, Morosari have risen very significantly. As the sea level rises in this area, it is submerged in seawater at a rate of 2-3 cm per year (Yuwono et al., 2018). This has resulted in a reduction of the affected coastline from one kilometer to two kilometers since the turn of the century. This phenomenon results in the displacement of approximately 70,000 people (Damastuti et al., 2022). As a result of this geographical change, certain spatial adaptations have also taken place in people's homes. A spatial adaptation may involve raising the floor of the house, building a bridge to facilitate access, or building a new floor on top of an old house that has collapsed (Harani et al., 2023c; Yuwono et al., 2018).

The change in sea level over time is tracked using quantitative data and analyzed descriptively. Local domestic strategies are explored to adapt to sea level rise. To determine how domestic operations are carried out during the rise of sea level, we re-describe domestic spatiality and interview individuals. Perspectives from everyday life are utilized in the process. Additionally, observations of climate conditions as one of the considerations in the domestic strategies being traced are made using the climate consultant application and Autodesk format. In addition, an analysis of climate-based comfort can consider how the occupants of the house implement domestic spatial strategies.

The data were then categorized according to domestic conditions, domestic daily spatial practices, and domestic adaptations. In architectural research, reading space plays an important role (Wang and Groat, 2013), so this cataloguing sheds light on how spatial adaptation strategies, especially domestic adaptation strategies, are used in practice. An understanding of domestic strategies responding to sea level rise can be gained through re-describing, and tracing each change through drawings and interviews, as well as cataloguing data. Thereafter, it is analyzed as an example of resilience strategies used by coastal communities to deal with sea level rise.

3. Result & Discussion

Domestic space quality is influenced by how users organise their spatiality, particularly how residential space is organised by daily activities (Imrie, 2004). According to Imrie (2004), users with specific mobility limitations shape domestic spaces based on their movement capabilities. Different discourses on limited land in residential homes have led to a variety of different domestic strategies. Managing domestic space can be achieved by utilising space, regulating spatial functions, and arranging the arrangement of objects (Lirenzsa et al., 2020). Domestic adaptation strategies include using outdoor space for domestic activities such as cooking, eating, and washing (Harani et al., 2023a, 2021). It is, therefore, necessary to make various adaptations.

Based on the results of the data collection, various forms of housing are adapted to the disaster of rising sea levels by having unique domestic spaces. Changing the shape of domestic space in response to changes in the residential environment is one form of local strategy employed by the people of Bedono village, Morosari. As a result of this change, the community has become more resilient to disasters. Figure 1 illustrates various types of housing that have unique domestic spatial arrangements for dealing with disasters. (See Figure 1 on the next page)

Figure 1. Various types of housing that have unique domestic spatial arrangements for dealing with disasters

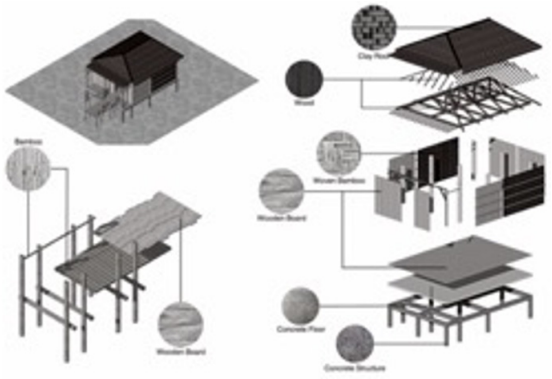
Source: Not specified

This form of housing is a form of local development in the Bedono Village, Morosari, which is adaptive and carried out on an individual basis according to the capabilities and needs of each house. Adaptation to natural disasters was evident in house standards, which emphasise beauty, function, and splendour based on aspirations, needs, and regulations (Beer and Faulkner, 2011). People who usually live on land have developed various domestic strategies in response to the change from living on land to living alongside water. Three forms of domestic strategy are viewed as a form of resilience to tidal disasters, including:

3.1. Raise and lower the floor level based on the alert level

As the sea level continues to rise, the people of Bedono Village have adapted by continuing to build homes and facilities in this area. Increasing road levels is the primary strategy for improving connectivity to residences in the community. Meanwhile, the rise in road level has forced residents to increase the level of their residences. The result is that people develop a variety of local strategies. Among them is raising the floor in proportions that are consistent with previous calculations of sea level rise. In the opinion of one of the residents, for example, if the increase of water level over the next 10 years will be 2 meters, then he will increase his residential level by 4 meters to survive for the next 10 years.

Figure 2. Raise and lower the floor level based on the alert level



Source: Not specified

Additionally, the bridge level is arranged as a link between the house and the road following this level increase. Bridges provide residents with access from roads that are sometimes submerged in water to their homes. This bridge was finally constructed by the people at this location with an up and down mechanism, so that when the tide is high, the bridge can be raised by removing the hooks and reattaching them, and then lowered when the high tide season ends. Generally, this mechanism is considered to be a local mechanism related to the level of the residence and living space of the residents of this area.

3.2. Material selection based on ease of assembly and disassembly

In Bedono Morosari Village, houses are constructed using local materials such as wood and bamboo, which are easily accessible. Choosing this type of material is a result of the ease with which it can be assembled and disassembled. Adapting to the changing weather conditions, the people in this region have raised their houses rapidly due to the continuous rise in seawater levels. A variety of houses use bamboo and wood materials as part of their residential construction, including connecting bridges, building floors, building walls, and building frames. Many strategies are used in the arrangement of these materials, such as stacking them from the top down. This is done to strengthen building and bridge frames. Figure 3 shows bamboo is tied with cloth or fibres and secured with nails.

Figure 3. Bamboo is tied with cloth or fibres and secured with nails

Source: Not specified

In addition, bamboo is arranged using a rowing mechanism that is strengthened by tying it with palm fibre and rope. The alignment of this binding is determined by the type of material obtained. This mechanism is usually used on bridges, terraces, and bridge handrails with a load level that is not too heavy. Many residences use this mechanism, particularly those that have changed from their original structure. The Bedono Village community has adopted this operation as a local strategy.

Bamboo was also chosen because it can be installed according to the rise and fall of sea levels. Apart from that, bamboo is also used as a material that can withstand hot temperatures on land and survive in water. As part of the process of determining spatial alignment, the material selection strategy can be viewed as a form of everyday spatial planning mechanism that takes into consideration the height and low of the bottom surface, especially during tide times.

The material selection mechanism is therefore a local strategy developed by the community to cope with the increasing tidal disasters. The material chosen has the characteristic of being easily assembled and dismantled, allowing for adaptation to natural conditions. There are two types of arrangement mechanisms, namely top-down arrangement and row arrangement.

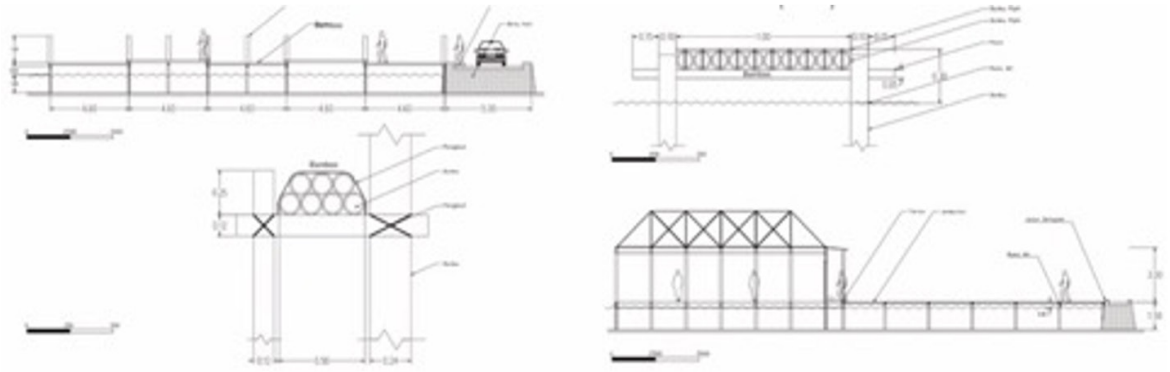
3.3 Enhancing the storage capacity of the top surface

Communities in areas affected by tidal disasters are also implementing domestic space utilization strategies. All surfaces, particularly those at the top level, are considered storage areas when utilizing domestic space. Several levels of storage are provided, namely the top level is for items that are vulnerable to water and are small in size, while the bottom level is for objects that are considered able to withstand water and are large. The electronic furniture should always be placed on raised supports at the highest floor level. This is to prevent seawater from rising and falling.

Surface optimization can be viewed as a form of reading space in three dimensions with a storage function. In residential settings, objects are generally arranged according to aesthetics. By arranging domestic items in this location, the space is more compact. Additionally, the reading of each surface as part of the storage makes the domestic space a system that reflects the user's daily activities based on the arrangement of these items. It can be seen from this that each space has an optimal level of quality as an area for fulfilling daily living activities.

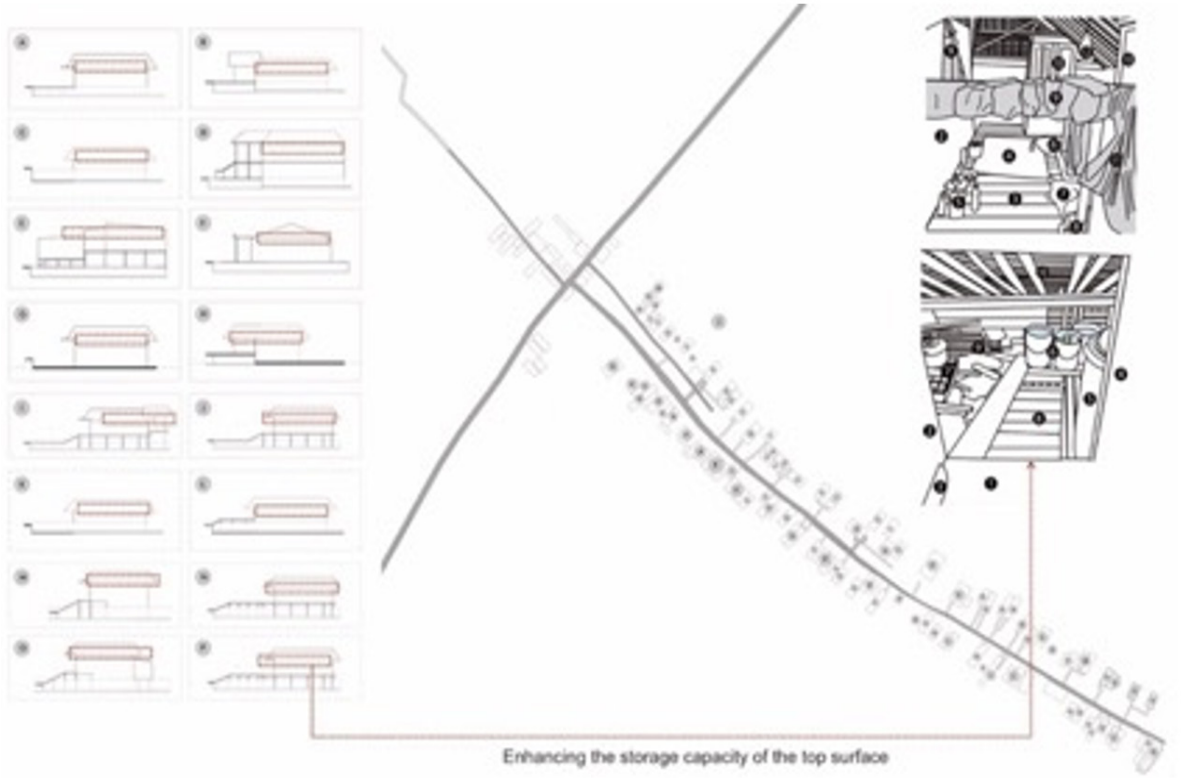
Arrangements of objects on the entire top surface can also demonstrate how people use the top surface. To accomplish this, the roof frame is not covered so that it can be used as a storage area. The use of nails for storage, storing important documents and diplomas. Apart from that, the top part is also used as a clothesline for storing clothes. The purpose of this strategy is to minimize the use of wardrobes. The reason for this is that many people are unaware that their clothing has become wet because the wardrobe is placed on the floor and has become submerged in water, especially during sudden rises in water levels. As a result of the various surface utilization strategies, it can be concluded that people utilize every space, both vertically and horizontally, as a place to live.

Figure 4. Local structure strategies for adaptation from disaster



Source: Not specified

Figure 5. Top surface for appropriation of storage



Source: Not specified

4. Conclusion

This study explores domestic spatial strategies driven by external environmental changes in Bedono Morosari Demak Village. These domestic spatial strategies have emerged as a result of rising sea levels that happen daily, creating the need to adapt and sustain their livelihood. This paper points out that, the relationship between external and internal spatialities of dwelling environments has not been widely discussed as part of disaster mitigation. Based on daily phenomena in coastal areas affected by disasters, this article attempts to examine such inside-outside relationship. Based on the findings of this study, domestic spatial planning strategies are based on an outside-in relationship. This study expands what Atmodiwirjo et al. (2015) states in how the outside-in inhabitation can occur when external activities and forces are brought into the domestic environment. This article shows the existence of a domestic strategy as a manifestation of an outside-in architectural programming, which exists as a form of adaptation to disasters.

The spatial planning in residences is often aimed to support user activities Adianto et al. (2021). This paper extend such understanding, exploring how such spatialities can be programmed by local dwellers to accommodate disaster preparedness. The article illustrates the potential of local practices as a means of protecting the environment from disasters. Specifically, this paper finds three domestic spatial strategies as a form of residential adaptation to disasters: (1) Raising and lowering floor levels based on alert level; (2) Material selection based on ease of assembly and disassembly; (3) Optimization of the top surface as a storage area. Such daily operations in domestic spaces enable the space to manifests in a three-dimensional way, by making use of all surfaces, especially the top surfaces. These domestic spatial strategies adds to what Bruyns (2018) describes as a tactical interior, by expanding the use of space in a micro and extensive way.

This paper argued that these findings can be used to construct domestic spatial programs that adapt to external changes, demonstrating

the outside-in programming as a strategic response to the environmental condition. The strategies indicate that the dynamic of the outside environmental condition becomes the trigger for adaptation of the domestic internal spaces, suggesting the needs to consider such outside-inside relationships within the design framework for adapting the living environment within the continuous natural disaster. Further research is needed to enrich various local strategies to develop holistic architectural programming, especially in coastal areas with different characteristics. Different contexts and daily practices allow for various domestic strategies. C

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