Corrigendum: Reinterpreting local wisdom of *Rumah Kaki Seribu* as sustainable architecture

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The source of these pictures did not written. It should be:

**Figure 1.** [https://core.ac.uk/download/pdf/151236531.pdf](https://core.ac.uk/download/pdf/151236531.pdf) by YIP Hematang, page 95.[7]

**Figure 2.** [https://indonesiakaya.com/pustaka-indonesia/rumah-kaki-seribu-khas-suku-arfak](https://indonesiakaya.com/pustaka-indonesia/rumah-kaki-seribu-khas-suku-arfak) [8]

**Figure 3.** [https://jurnalpapuaasia.unipa.ac.id/index.php/jurnalpapuasia/article/view/52/31](https://jurnalpapuaasia.unipa.ac.id/index.php/jurnalpapuasia/article/view/52/31) by Kilian, Z dkk. page 39[9]

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The author acknowledges that the above sources of pictures cited as reference 7, 8, 9, in paper should have been made clearer and through this corrigendum this is addressed.
Reinterpreting local wisdom of Rumah Kaki Seribu as sustainable architecture

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Abstract. Awareness of the increasing global issues regarding global warming and climate change has encouraged building designers to look back on knowledge of traditional architecture as energy-efficient and sustainable solutions. This study focuses on the traditional architecture of Rumah Kaki Seribu as sustainable architecture. Rumah Kaki Seribu is a traditional architecture located in the Arfak Mountains, West Papua, inhabited by the Arfak Tribe. Each architectural element of Rumah Kaki Seribu has a different sustainability value. The sustainability value of Rumah Kaki Seribu discussed is the concentration on the fireplace element and the roof element. The fireplace and roof elements were analyzed using the eco-cultural concept of the six competing logics of sustainable architecture by Simon Guy and Graham Farmer. Eco-cultural logic is a logic that is closely related to traditional architecture. The characteristics of sustainable buildings that use eco-cultural logic can be determined by looking at several parameters, namely the image of space, the source of environmental knowledge, the building image, technologies, and the idealized concept of place. The study aims to learn traditional architecture as a design approach to understand and respect the environmental context for solutions to global issues that occur.

1. Introduction
The environment is all that shapes and affects the human ability to live on earth. Environmental degradation such as pollution, loss of biodiversity, deforestation, global warming, and climate change have become fundamental problems worldwide \cite{1}. The study \textit{Impact of Climate Change on Buildings} \cite{2} shows that building design affects global climate change in the present and the future. The building sector consumes most of the energy and drives the most significant CO\textsubscript{2} emissions. It is because the buildings are designed not by the environmental and natural context.

Sustainable architecture is an approach used to understand the environmental context. The sustainable architecture approach can be traced back to the design principles applied in most traditional buildings by the ancestors. Traditional architecture can adapt to the local climate and nature to create local wisdom \cite{3}.

Local wisdom of traditional architecture in the study of \textit{Studies on sustainable features of vernacular architecture in different regions across the world: A comprehensive synthesis and evaluation} \cite{3} show the linkage to sustainable values by responding to climate change, environmental pollution, and the desire to reduce energy consumption in buildings. By responding to the ecological context, traditional architecture continuously adapts to the local physical characteristics and local cultural characters to create a uniqueness and identity in the architecture in each region \cite{4}. This local
wise wisdom was conveyed by the ancestors from generation to generation, hoping that respect for nature, the environment, and culture will continue to be maintained.

Living in harmony with nature has been taught by our ancestors. When building houses, they plant new trees first before cutting the old ones. This way of life has implemented the values of sustainability itself. The ancestors designed the house by analyzing local conditions and solving problems through practical handling [5]. Spatial planning, laying openings, and selecting materials are efforts to communicate with local climatic conditions. Traditional architecture has used sustainability as a design approach to embodying local wisdom.

Traditional architecture represents an approach that is friendly to the local climate, nature, environment, and resources and is a natural solution to environmental needs worldwide. Architecture and sustainable building progress in the future, as architects need to know the past and use this strategy as a balanced approach to achieving optimal environmental efficiency [3]. This study aims to learn traditional architecture as a design approach in understanding and respecting ecological contexts. This study focuses on the analysis of the local wisdom of the Rumah Kaki Scribu as sustainable architecture.

2. Adopting eco-cultural logic for reinterpreting traditional house as a sustainable architecture

Eco-cultural is one of the Six Competing Logics of Sustainable Architecture [6]. Logic is a particular arrangement of ideas, concepts, and categorizations produced, reproduced, and transformed in a specific set of practices through which is given to social and physical realities. This logic is deemed to be exclusive or frozen in time and space. Each logic focuses on green buildings forming differently depending on environmental problems and argues alternative concepts about what constitutes a sustainable place.

Each logic is supported by a presentation of the advantages and disadvantages of its environment. Logics describes the choice of technology used in a broad design strategy based on the formation of places in an environment. The six competing logics of sustainable architecture in Table 1, are typologically divided into six logics, eco-technic, eco-centric, eco-aesthetic, eco-cultural, eco-medical, and eco-social. In discussing the reinterpretation of traditional houses as sustainable architecture, eco-cultural is used as a parameter to analyze the value of sustainability in the local wisdom of the Rumah Kaki Scribu.

The authors chose eco-cultural logic because the case study used is a traditional house with local cultural context, simple technology, and dwelling the lifestyle of the local people. The eco-technic aspect focuses on high technology, while eco-centric focuses on recycled material and renewable material technology. Eco-aesthetic focuses on nonlinear organic forms as the identity of an area, eco-medical focuses on development with high pollution locations, the technology used is non-toxic, natural, and passive design. Eco-social focuses on the social life of vertical housing. So these five logics are not suitable for this research.

Eco-cultural logic is a fundamental reorientation of values that involves concerns about the environment and culture. This logic emphasizes the preservation and conservation of various existing cultural archetypes by transforming and reusing traditional construction techniques, building typologies, and settlement patterns, each with a history of evolution and local use. This emphasizes the uniqueness of the place, the use of local materials, and a formal response appropriate to climatic and micro-climatic conditions. The symbolic issues that underlie this concept are authenticity and the idea that sustainable building must be related to the images of locality and place.

Eco-cultural logic is a logic that is closely related to traditional architecture. The characteristics of sustainable buildings that use the concept of eco-cultural logic can be determined by looking at several parameters from the image of space, the source of environmental knowledge, the building image, the technologies used, and the idealized concept of place. In this concept, the impression of space is displayed based on the local cultural, and regional context. The phenomenology of the environment inspires sources of environmental knowledge and the ecology of the local culture so that the building images displayed tend to be original, harmonious, and typological. The technology used in the eco-cultural logic uses local technology that is local, low-tech, commonplace, and vernacular. The ideal concept of a place emphasizes the process of dwelling or relearning a place.
| Logic         | Image of Space                           | Source of Environmental Knowledge | Building Image                           | Technologies                                      | Idealized Concept of Place                                                                 |
|--------------|------------------------------------------|----------------------------------|------------------------------------------|--------------------------------------------------|---------------------------------------------------------------------------------------------|
| Eco-technic  | Global context                           | Technorational Scientific        | Commercial                                | Integrated                                        | Integration of global environmental concerns into conventional building design strategies.  |
|              | Macrophysical                            |                                   | Modern                                    | Energy efficient                                   | Urban vision of the compact and dense city.                                                   |
|              |                                          |                                   | Future oriented                           | High-tech Intelligent                              |                                                                                             |
| Eco-centric  | Fragile                                  | Systemic ecology Metaphysical holism | Polluter                                   | Autonomous                                        | Harmony with nature through decentralized, autonomous buildings with limited ecological footprints. |
|              | Macrobiotic                              |                                   | Parasitic Consumer                        | Renewable Recycled Intermediate                   | Ensuring the stability, integrity, and “flourishing” of local and global biodiversity.       |
| Eco-aesthetic| Alienating Anthropocentric                | Sensual Postmodern Science        | Iconic                                    | Pragmatic new                                    | Universally reconstructed in the light of new ecological knowledge and transforming our consciousness of nature. |
|              |                                          |                                   | Architectural New Age                     | Nonlinear organic                                 |                                                                                             |
| Eco-cultural | Cultural context                         | Phenomenology Cultural Ecology    | Authentic                                  | Local                                             | Learning to “dwell” through buildings adapted to local and bioregional physical and cultural characteristics. |
|              | Regional                                 |                                   | Harmonious Typological                    | Low-tech                                         |                                                                                             |
|              |                                          |                                   |                                         | Commonplace vernacular                            |                                                                                             |
| Eco-medical  | Polluted                                 | Medical Clinical ecology          | Healthy                                    | Passive                                           | A natural and tactile environment which ensures the health, well-being, and quality of life for individuals. |
|              | Hazardous                                |                                   | Living                                    | Nontoxic                                         |                                                                                             |
|              |                                          |                                   | Caring                                    | Natural                                          |                                                                                             |
|              |                                          |                                   |                                          | Tactile                                          |                                                                                             |
| Eco-social   | Social Context Hierarchical              | Sociology Social ecology          | Democratic                                  | Flexible Participatory                             | Reconciliation of individual and community in socially cohesive manner through decentralized “organic”, nonhierarchical, and participatory communities. |
|              |                                          |                                   | Home Individual                           | Appropriate locally managed                       |                                                                                             |

The traditional form of Rumah Kaki Seribu is seen as a sign that the culture has naturally developed a lifestyle following its physical environment. The application of eco-cultural logic is illustrated in the regional approaches of architects such as Glenn Murcutt in Australia, Charles Correa in India, Geoffrey Bawa in Sri Lanka, Hassan Fathy in Egypt, and Yori Antar in the conservation of the Wae Rebo village in Indonesia.

### 3. Characteristics of Rumah Kaki Seribu

Rumah Kaki Seribu is located in the Arfak Mountains, Manokwari, West Papua, and has become the identity of the Arfak Tribe. The characteristics of the Rumah Kaki Seribu are situated on the topography and climatic conditions in the Arfak Mountains area. The shape of the building is geometric with a rectangle, stilted, and consists of the head (roof), body (walls and floor), and feet (foundation). The pattern of community settlements is scattered on the slopes of the mountains and forests surrounding the hills. The choice of building location is generally on the plateau slopes of mountains and forests, avoiding open areas for the safety of residents from wild animals. Rumah Kaki Seribu is a communal residence for 5 to 10 families.
Rumah Kaki Seribu uses natural materials and utilizes the climate for ventilation and lighting systems. Horizontal and vertical ventilation systems in the Rumah Kaki Seribu generate thermal comfort in the spaces inside. The interior of Rumah Kaki Seribu, such as tables, shelves, fireplaces, and chairs, is dominated by wood material. Construction of Rumah Kaki Seribu starts from the roof, walls, and column structure using wood materials to harmonize with nature.

![Figure 1. Wood materials in Rumah Kaki Seribu.](image)

The process of obtaining materials for the Rumah Kaki Seribu is by cutting down wood located close to the construction site. Logging is allowed if they have planted the wood in the forest to substitute for their cut wood. Before cutting the tree trunk, strip the leaves first so that the tree dies slowly. The purpose of this logging process is to protect the soil from erosion or landslides.

The division of the area in the Arfak Tribe developed from generation to generation by their ancestors. The division is to allocate the residential space and the division of the forest area. This allocation is intended to maintain the balance of nature.

Each architectural element of Rumah Kaki Seribu has a different sustainability value. The sustainability value of Rumah Kaki Seribu discussed is the concentration on the fireplace element and the roof element.

![Figure 2. Arfak tribe settlements on the slopes of the Arfak mountains.](image)
4. Reinterpreting local wisdom of Rumah Kaki Seribu with eco-cultural logic

In reinterpreting local wisdom, Rumah Kaki Seribu already has the concept of eco-cultural logic as sustainable architecture. The parameters of the eco-cultural logic analysis at Rumah Kaki Seribu are determined by the image of space, the source of environmental knowledge, image building, technologies, and the idealized concept of place. The architecture of Rumah Kaki Seribu can be seen as a sign that culture has naturally influenced the development of a lifestyle according to its physical environment.

4.1. Cultural and Regional Context as image of space from fireplace and roof elements

Arfak tribal people have local knowledge about the local climatic conditions, which are tropical mountains. Local wisdom passed down from generation to generation is used to manage forest areas and the various natural resources. The fireplace in Rumah Kaki Seribu is designed to respond to the local climate for residents' comfort. The position of sleeping with the feet near the fireplace element is used to warm the feet and body of the occupants when the air temperature is low.

![Figure 3. The fireplace location on floor plan.](image)

With air temperatures ranging from 19-28°C, the building roof covering material is in the form of reeds which can reduce the sun's heat at high temperatures and provide warmth at low temperatures. The elements of the roof of the building, including the materials that form it, are a solution to local climate problems. Roof covering with alang-alang material can reduce the load on the building structure so that it remains strong when an earthquake occurs.

![Figure 4. Alang-alang as roof covering.](image)
4.2. Phenomenology and cultural ecology as source of environmental knowledge from fireplace and roof element

The Source of local wisdom in the environment from generation to generation can be seen from the experience of the community, which is trial and error and the ability of the local community to adapt to the local social and physical environment. One form of local wisdom in the Thousand Foot Houses is the fireplace element on the left and right sides of the building. The existence of a fireplace indirectly causes smoke to fill the space in the building.

The smoke rising from the fireplace does not make the occupants in the building comfortable. If the occupants are standing, smoke can get into the eyes and nose, which, if inhaled for a long time, can cause respiratory problems. The presence of smoke affects the behavior of the local community to make a distance between the walls and roof of the house around 10-25cm as an air gap to release smoke from inside. This air gap is intended so that the smoke can come out immediately and does not cause disturbance to the health of the occupants in the house.

Apart from air gaps between walls and roof, Rumah Kaki Seribu also has gaps between the grass on the roof cover to allow air movement or as a vent for the exit of smoke from inside the house. The construction of the Rumah Kaki Seribu also has many pores which help the smoke escape from the inside. Through experiences and experiments carried out by the local community, to achieve comfort and create sustainability in the local social and physical environment.
Figure 7. Alang-alang roof cover gap.

4.5. Authentic, harmonious, and typological as building image from fireplace and roof elements
Fireplace and building roof materials are environmentally friendly materials, in contrast to industrial materials that use chemicals in the manufacturing process. Timber material as a fireplace element and roof frame with alang-alang material covering the roof of Rumah Kaki Seribu do not contain pollutants that pose a risk to human health and the ecosystem. The material used in the fireplace uses a layer of bisuwe bark, then coated with a layer of mub leaves from the binep tree, then put the soil and put firewood at the top.

Figure 8. Fireplace material details.

From generation to generation, the wood material for the roof of Rumah Kaki Seribu is classified according to its characteristics to produce different functions. The roof construction uses six types of wood: bingam, bitai, berab, buswei, bijeu and arwop wood. Each wood has a difference in temperature caused by variations in size and position on the roof. Bingam wood has the highest temperature in the morning. During the day, berab, bijeu, and bitai have higher temperatures. It is due to the three kinds of wood, which are located right under the tin roof, to get more heat intensity than the other wood.

Both the fireplace element and the roof element of Rumah Kaki Seribu respect the environmental context. Both in the design process, construction, use, and when the building reaches its end, it becomes harmonious with nature. All materials are natural and authentic materials taken from gardens and forests beside the slopes of the mountains. The Arfak tribe is aware of the need for wood material to replant and maintain its resources.
4.4. Local, low-tech, and vernacular technologies from fireplace and roof elements

Most of the materials used in the fireplace and roof elements of the Rumah Kaki Seribu are wood. This wood cultivation process uses local low-tech technology, so it does not cause energy that can damage the environment. The use of wood material is excellent in insulating heat. The conductivity of wood is only 1/10 of the conductivity of the brick, where the thermal conductivity of wood is 0.08 - 0.16 J / (s.m.C), while the thermal conductivity of the brick is 0.84 J / (s.m.C).

One form of optimizing space ventilation for the comfort of Rumah Kaki Seribu is done by using a vertical ventilation system. The local community has local wisdom by thinking about the possibility of air displacement due to differences in air temperature or what is known as the stack effect system. Through a process of trial and error, from the placement of the fireplace element to the community's response to creating an air gap to release smoke, Rumah Kaki Seribu has indirectly thought about how air movement was created passively to increase comfort in space. Transfer of air will flow from the high pressure (cold temperature) to the low pressure (hot temperature) part. It applies horizontally and vertically, in the vertical direction, the tendency of hot air to flow from the lower to the higher.

This displacement occurs due to differences in air temperature, where air with a high temperature has a lighter weight so that it will move upwards, and the place left behind will be filled with a lower temperature air.

Figure 9. Shape of alang-alang roof of Rumah Kaki Seribu.

Figure 10. Stack effect process in Rumah Kaki Seribu.
This vertical ventilation system can occur if there is an air outlet at the top of the chamber and an air inlet at the bottom. This air transfer is also used as ventilation of smoke when the fireplace is working. The smoke from the fireplace will move up due to the push from the cold air at the bottom of the house to rise. There are steps in the construction of the roof elements of Rumah Kaki Seribu:

- first assembling the truss of the roof
- installing gording (ngomma), bubungan (ipowa), usuk (itapmot), and batten (itawa)
- installing roof coverings of pandan leaves (cawa) and alang-alang

The roof height ranges from 4.5 - 5 meters. One form of local technology applied is the connection between roofing materials, where the joints between the wood are tied using rattan ropes and bark fibers.

![Figure 11. Roof construction of Rumah Kaki Seribu.](image)

The roof of Rumah Kaki Seribu is a gable roof with a slope of about 35 degrees. This slope creates a good absorption of solar thermal radiation and makes it easier for rainwater to flow easily. The use of alang-alang as a roof covering has the advantage of absorbing sound / acoustic absorption. Another advantage is its ability to adapt to the climate and its environment. When there is a drastic drop in outdoor air temperature, the indoor air temperature will automatically become warmer, and vice versa. The use of alang-alang also has insect resistance and exposure to rainwater. Alang-alang comes from mountainous areas with a minimum length of 85 cm and is generally at least six months old.

![Figure 12. Alang-alang as an acoustic absorption.](image)
4.5. **Idealized concept of place**

The concept of a place in Rumah Kaki Seribu is to "dwelling" or inhabit a building that adapts the physical characteristics of the environment and the characteristics of the local culture. The shape of the building of Rumah Kaki Seribu can be seen as a sign that the culture has naturally developed a lifestyle according to its physical environment. This concept emphasizes developing the authenticity of a place and a sense of responsibility to protect landscapes and ecosystems from disturbance.

5. **Discussion and conclusion**

By applying eco-cultural logic as a sustainable concept, seeing the formation of the fireplace element and the roof element at Rumah Kaki Seribu shows the expression of everyday life. Formation expression is an understanding of environmental phenomenology and the form of how the local community inhabits. Local wisdom that can be developed as sustainable architectural thinking is explained as follows:

**Table 2. Conclusion.**

| Architecture Element | Local Wisdom                                                                 | Sustainability Value                  |
|----------------------|-----------------------------------------------------------------------------|---------------------------------------|
| Fireplace element    | The existence of a fireplace responds to climatic conditions to warm the occupants. | Cultural & Regional Context           |
|                      | Design by trial and error the air gap between the wall and the roof for the exhaust flow of the fireplace. | Phenomenology & Cultural Ecology      |
|                      | Using environmentally friendly wood materials.                             | Authentic & Harmonious                |
|                      | Using a stack effect system with low-tech technology through the air gaps in the walls and roof. | Local, Low-tech, & Vernacular         |
| Roof element         | The use of alang-alang as a roof covering can reduce solar thermal radiation. | Cultural & Regional Context           |
|                      | Designing by trial and error the air gaps in the alang-alang roof for air circulation and the exhaust flow of fireplace smoke. | Phenomenology & Cultural Ecology      |
|                      | Classification of wood materials based on their characteristics.            | Authentic & Typological               |
|                      | The joints between the roof covering materials use rattan rope ties and bark fibers. | Local, Low-tech, & Vernacular         |

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