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Architecture as a living (eco)system: towards a regenerative design

Keywords: *living systems, regenerative design, ecological design, traditional ecological knowledge, design principles, design framework*

Abstract

Current discourses within the built environment increasingly underline the need for a shift in perception, thinking and values as a prerequisite to moving from sustainability to regeneration. This paper discusses how re-thinking the position and role of architecture within the human-architecture-environment system can be an essential step in this transition. While the regenerative approach undoubtedly emphasises the need for introducing a positive ecological impact as a design requirement, integrating ecological thinking and knowledge into the design process remains challenging. In exploring this question, this research work draws upon Fritjof Capra's living systems theory and its application to the field of architecture, discussing how viewing architecture as a living (eco)system can be the answer to acquiring the deep ecological awareness needed to start designing regeneratively. Through the layering of design principles, the research synthesis becomes a framework for thinking and making regenerative architecture that can be applied to the design process of any design question. To showcase how the design framework can be put into practice, a method to study places is further proposed by mapping the local human-architecture-environment system. The resulting map assists in gaining the necessary ecological knowledge about a given place by understanding how our culture and relationship with the local ecosystem shape its architecture. Finally, this paper encourages the introduction of such tools to design education and practice as a way to build the bridge between the regenerative theory and the practice of building.

Introduction_ From sustainability to regeneration

Increasingly architectural discussions underline a shift in values as a crucial requirement for the built environment's transition from sustainability to regeneration. Rather than simply minimising impact, the regenerative approach focuses on having a positive impact on both humans and the environment. As du Plessis (2012) describes it, it 'attempts to address the dysfunctional human-nature relationship by entering into a co-creative partnership with nature…through a set of localised ecological design and engineering practices rooted in the context and its social-ecological narratives'. Mang and Reed (2013) likewise suggest that 'regenerative development and design in a living system is a process of patterning human communities to align with the energetic patterns of a place in a way that both humans and the place coevolve.'

While the regenerative design framework clearly stresses the importance of introducing ecological impact as a necessary requirement for the built environment's transition to regeneration, applying and integrating this different ecological perspective into the design process remains challenging.

In exploring this topic, the following research questions were defined:
How can the understanding of ecosystems' patterns of organisation be used as a design tool for ecologically regenerative architecture?
How can the mapping of the human-architecture-environment system in a given place aid the design process of ecologically regenerative architecture?

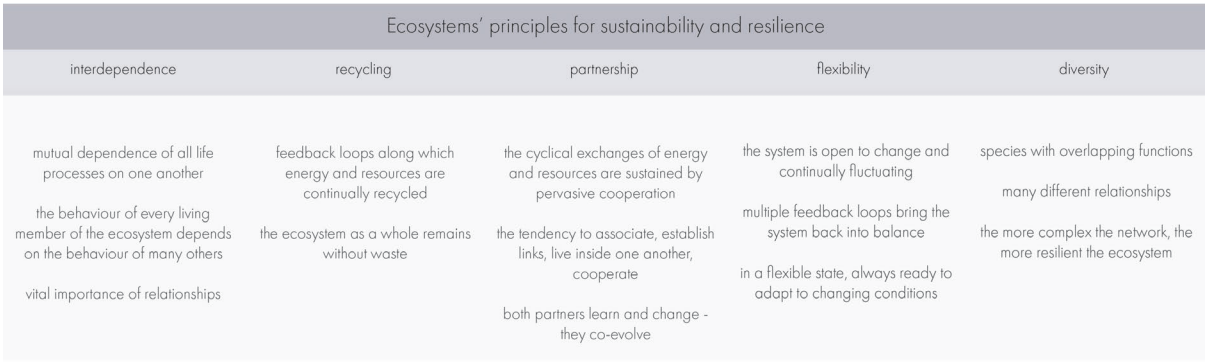
Through translation of the living systems theory to architecture and learning from traditional ecological knowledges of a case study in the coastal areas of Indonesia, the objective of this research is to foster a discussion about an alternative way of designing that views ecological knowledge as an essential tool in shaping regenerative built environments.

Theoretical framework_ Architecture as a living (eco)system

J. Cole (2012) argues that (living) systems thinking, community engagement and respect for place are the core tenets of regenerative design thinking. Hence, a deeper understanding of the living systems theory can hold the potential to guide a regenerative design process.

In 'The Web of Life', Fritjof Capra (1996) discusses how the theory of living systems - which understands life as a dynamic network of interconnected systems can provide 'a conceptual framework for the link between ecological communities and human communities'. He argues that to make a step towards reconnecting with nature and creating sustainable communities 'we can learn valuable lessons from the study of ecosystems, which *are* sustainable communities of plants, animals and microorganisms' (Capra, 1996). To do so, he suggests the need to understand the basic principles of ecology which enable living systems (organisms, ecosystems, social systems) to sustain life (Capra, 1996).

The five basic principles of ecology identified by Capra (1996) based on the understanding of ecosystems and their principles of organisation are *interdependence, recycling, partnership, flexibility and diversity*. The first three represent how ecosystems sustain life, while the latter two ensure the resilience of the system to the ever-changing environmental conditions (Capra, 1996) *[fig.1].* Such an ecological understanding can then serve as a guideline for building sustainable human communities (Capra, 1996).

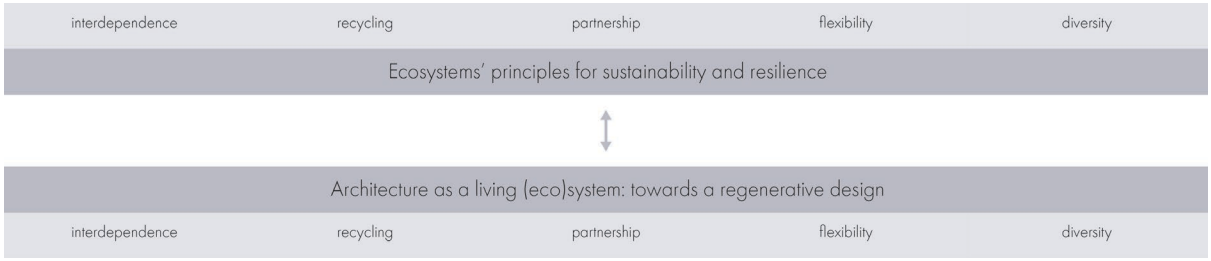


[fig.1] Ecosystems' principles for sustainability and resilience adapted from Fritjof Capra's 'The Web of Life' (1996)

Analogically, the theory of living systems can be further extended and translated to architecture and can similarly provide a conceptual framework as a design tool aiding the built environment's transition from sustainability to regeneration.

In other words, if ecosystems organise themselves according to these principles to maximise sustainability and resilience, then considering architecture as a living (eco)system organised according to the same principles will lead to an architecture with a more regenerative logic *[fig.2]*. Moreover, if architecture is to become part of the local ecosystem for it to be ecologically regenerative, it follows that it should be operating based on the same principles as the ecosystem itself and its elements operate. Here it is important to note that, as J. Cole (2012) argues, 'it is not the building that is 'regenerated' in the same sense as the self-healing and self-organising attributes of a living system, but by the ways that the act of building can be a catalyst for positive change within the unique 'place' in which it is situated'.

Consequently, the closer the pattern of organisation of architecture is to the five basic principles of ecology, the bigger its regenerative potential and resilience to changing conditions.



[fig.2] Translating the ecosystems' principles to architecture

So, what would the five principles' translation to architecture look like?

Case study_ Bajau Laut Sea People

Methodology_ Mapping a human-architecture-environment system

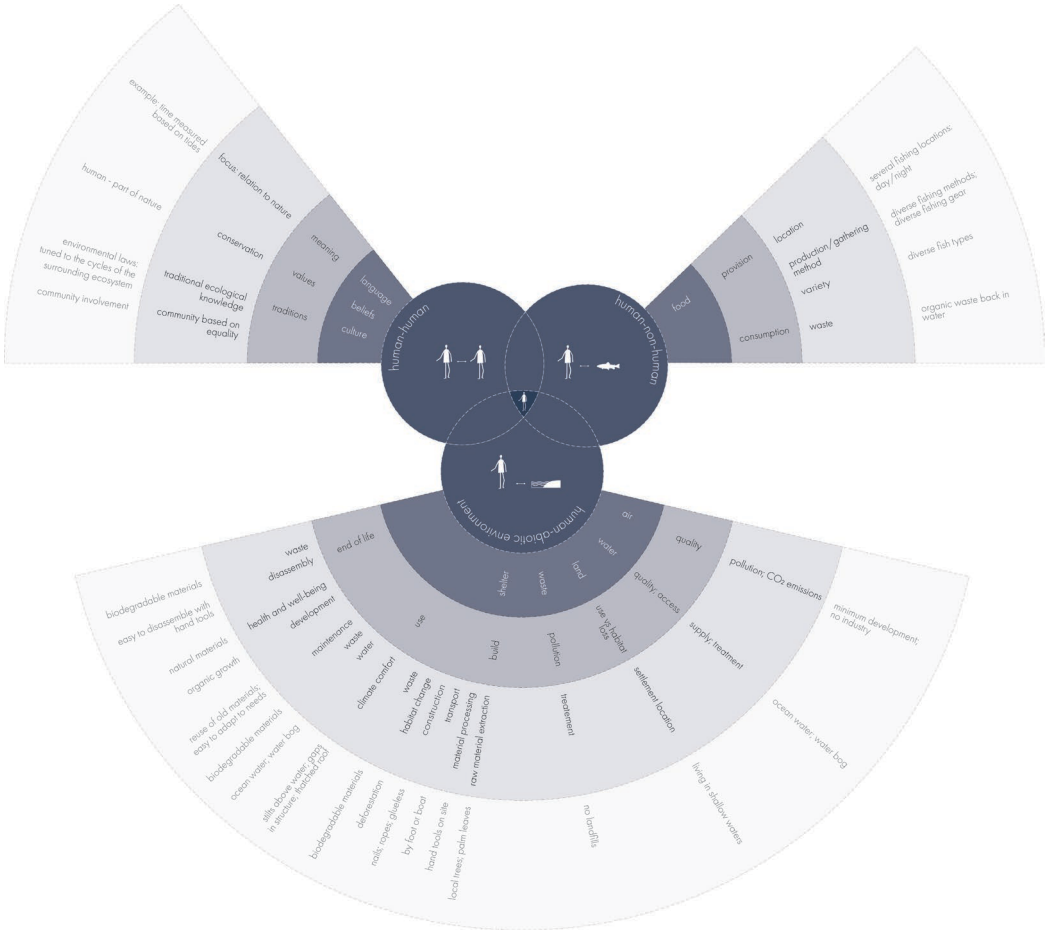
In figuring out what the five principles' translation to architecture may look like in terms of tangible examples, it is helpful to explore an existing situation where people inhabit a place closely related to a local ecosystem. If the local architecture is based on and a part of such a symbiotic partnership, then it should also be the closest to having a regenerative logic, and as follows, it should be operating according to and therefore exemplifying the five principles.

Accordingly, this research work followed the notion of 'architecture without architects' (Rudofsky, 1964) and Julia Watson's (2020) suggestion that the foundation of indigeneity is traditional ecological knowledge, through which 'symbiotic living systems intelligently harness the energy of ecosystems and adapt to environmental obstacles.' She further argues that such practices are 'inherently sustainable, being both an everyday response for human survival and an extraordinary response to environmental extremes…' (Watson, 2020).

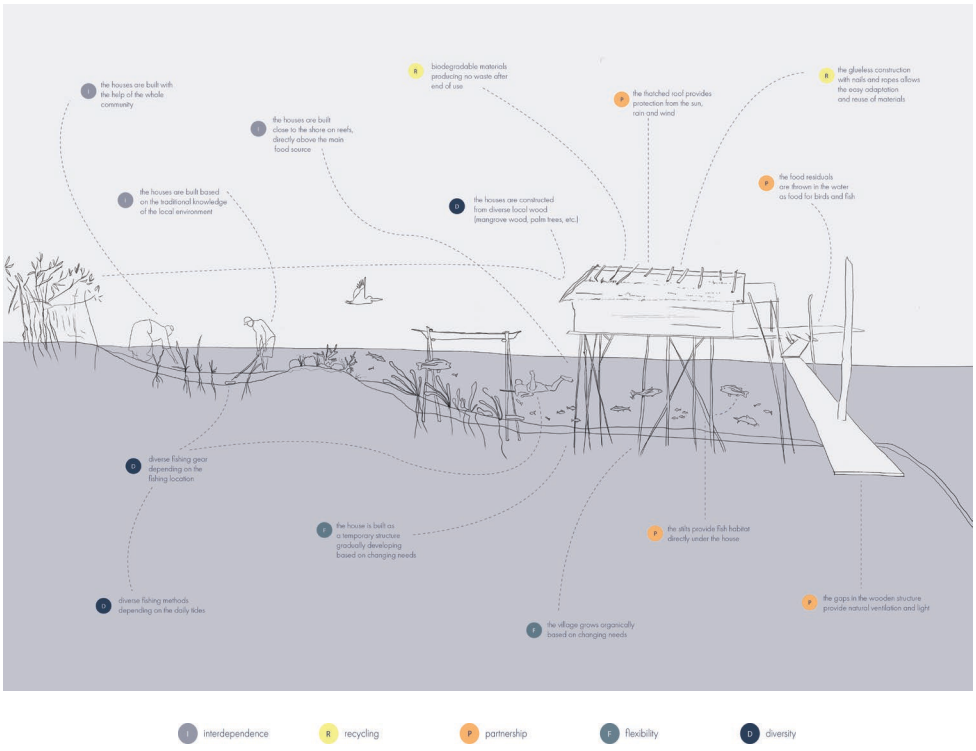
The case study of the habitational patterns of the Bajau Laut Sea People of the coastal areas of Indonesia offered such an example of practices of traditional ecological knowledge from which we can learn and derive tangible examples of architecture for each of the five principles.

The place was studied in the form of a mapping of the local people-architecture-environment system that simultaneously depicts and helps to understand the interactions and relationships between the humans, the non-humans and the abiotic environment (including architecture defined as 'shelter') in the context of the given ecosystem *[fig.3].* All the information needed to complete the mapping illustrated in *[fig.3]* was collected from Sather's book 'The Bajau Laut' (1997). The additional information concerning the architectural aspects of Bajau Laut's building traditions was derived from Sahibili's work 'The Concept and the Space Design of Bajau Laut Traditional House' (Sahibil, 2019). Knowledge about the tropical marine ecosystem was gained through the works of Peters et al. (1997) and Waycott et al. (2011).

The gathered information helps transform the map into a visualisation of the different ways in which the people's habits and the corresponding architecture relate to the local tropical marine ecosystem. By further analysing how the interactions relate to the five principles, it was possible to explore how the findings align with or go away from them, which helped to understand how and why the local architecture is moving closer to or further from regeneration *[fig.4].*



[fig.3] Mapping the human–architecture–environment system for the case study of the Bajau Laut Sea People



[fig.4] Understanding relationships between architecture and the local ecosystem for the case study of the Bajau Laut Sea People (ecosystem representation inspired by Peters et al. (1997) and Waycott et al. (2011) *and developed by the author)*

Results_ A framework for designing ecologically regenerative architecture

Critically examining the mapping of the local people-architecture-environment system *[fig.3]* and the visualisation of the different ways the local people and architecture relate to the local ecosystem *[fig.4]* resulted in the following observations.

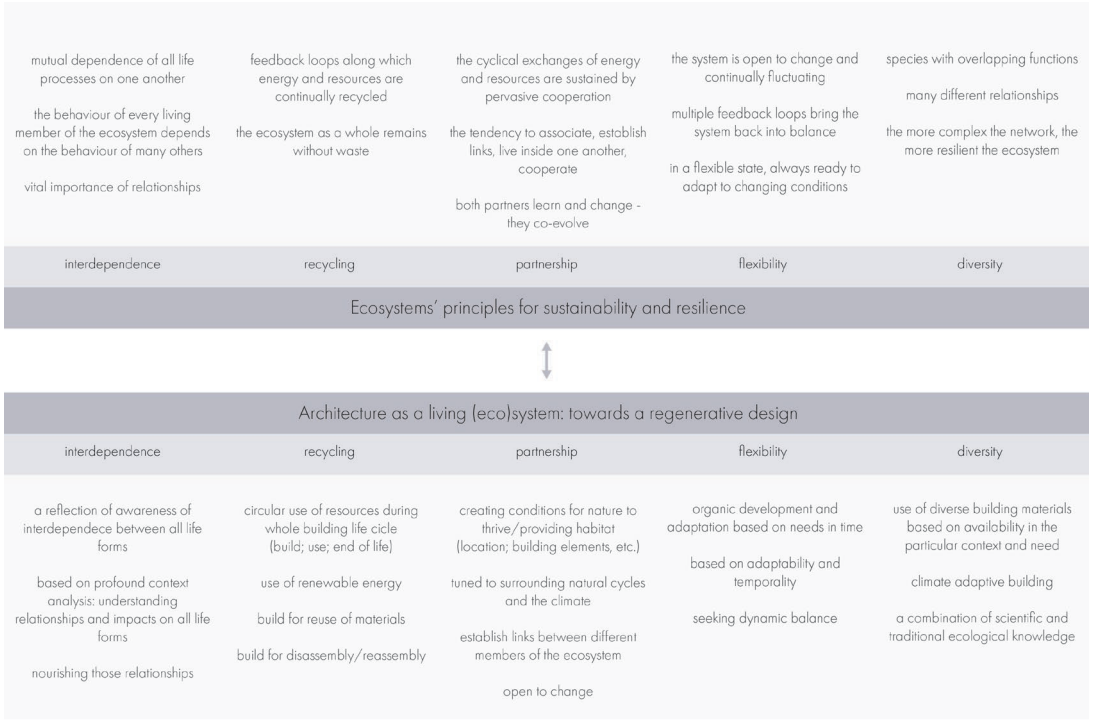
For the Bajau Laut Sea People, the connection between humans and the-rest-of-nature is based on direct interdependence between the individual, the community and the rest of the local ecosystem and, therefore, on the awareness of their mutual relationships and the direct feedback loops of the system. In turn, adapting habits, rather than adapting habitat, creates a dynamic balance between the stability of structure and the fluidity of change. Precisely that ensures the sustainability and resilience of the community and its architecture to the continuous changes in the environment.

Looking at the principles behind Bajau's architecture, it is visible that they closely reflect the principles that ecosystems use to maximise sustainability and resilience *[fig.4]*. The mapping, therefore, demonstrates how and why the traditional Bajau architecture is close to being ecologically regenerative. Respectively, the traditional ecological knowledges observed in the sustainable habitational patterns of the Bajau Laut exemplify what the five principles' translation to architecture can look like in terms of practical examples. Some of them are described with the following findings.

The architecture reflects people's awareness of the *interdependence* between all life forms. The houses are built close to the shore on reefs, directly above the primary food source. The circular use of resources during the whole building life cycle is closely aligned with the ecosystems' principle of *recycling*. The use of biodegradable local materials and the construction with nails and ropes produce almost no waste when houses are abandoned or demolished. The stilts in the water provide a habitat for fish, while the organic food waste, thrown directly in the water below the house, provides food for fish and birds. In this way, some elements of the house create conditions for nature to thrive, resulting in a *partnership* between the Bajau and other members of the local tropical marine ecosystem. The houses are also built as temporary structures, gradually further developed based on changing needs. This principle in Bajau's architecture relates to the *flexibility* of ecosystems. Finally, the use of diverse local wood (e.g. mangrove wood, palm wood) based on the availability in the context relates to the ecosystems' *diversity* aspect.

In this way, the Bajau Laut Sea People case study demonstrates that indeed architecture moves closer to regeneration if it closely follows the principles of ecosystems for sustainability and resilience. Consequently, the potential of architecture to be more or less regenerative will depend on how close or further away from the five principles a design is. Ecologically regenerative design is then not a precise physical form of architecture but one that is based on a sustainable pattern of organisation and on the mental process of the designer who is being ecologically literate.

Here it is important to note that the specific tangible examples of architecture's translation of the five principles *[fig.4]* are strictly derived from the relationship with the local tropical marine ecosystem. This means that for a different context, the precise solutions will differ according to the specific local ecosystems. While this speaks for the need for contextual innovation, the collection of practical examples can be translated into the following general design principles *[fig.5].*



[fig.5] Ecosystems – Architecture: ecological principles with examples

The findings from the theoretical framework of the living (eco)systems theory applied to the built environment and the general design principles derived from the case study of the traditional ecological knowledges of the Bajau Laut *[fig.5]* have been further developed in a design framework that can be applied to the design process of any design question that pursues ecological regeneration *[fig.6]*. While the design framework does not give precise solutions, it can serve as a backbone of design principles. The mapping method *[fig.3, 4]* can, in turn, assist in developing the necessary ecological understanding of the human-architecture-environment system of any given context.

Together the mapping and the design tools can help designers understand why architecture in a given context is regenerative, as well as assess whether a new design is regenerative by continuously re-evaluating its alignment with the design principles in the framework. The closer a design is to completing all checklist points, the closer it is to ecological regeneration.

[fig.6] A design framework for ecologically regenerative architecture

Conclusions and Discussion_ An alternative design process

This research paper highlights the importance of ecosystem knowledge in the built environment's transition from sustainability to regeneration. Learning from the ways in which ecosystems sustain life and applying those principles to architecture become essential steps in designing regeneratively. Translating the living (eco)systems theory to architecture and hence viewing architecture as a living (eco)system enables buildings to become aligned with and part of local ecosystems and achieve ecological regeneration. Regenerative architecture is then not a precise physical form of architecture but one that is based on a sustainable pattern of organisation, namely following the five principles that result in ecosystems' sustainability and resilience.

The case study of the habitational patterns of the Bajau Laut Sea People from the coastal areas of Indonesia showcases the vast potential of traditional ecological knowledges around the globe in providing sustainable and resilient solutions fine-tuned to local ecosystems. Julia Watson (2020) similarly highlights the 'need to expand our definition of sustainable technology to encompass…indigenous technologies, critical in the conversation for designers addressing climate change, as they are living examples that embody resilient thinking.' Mostly existing in rural areas across the globe, these ecological building practices present the challenge of combining traditional with scientific design methods if they are to be scaled to shape urban environments.

The proposed mapping method *[fig. 3,4]* assists in understanding how our culture and relationship with the ecosystem in a given place shape an ecological or less ecological architecture. The design framework *[fig.6]*, in turn, provides a backbone of design principles for regenerative design, which can assist built environment practitioners navigate in the design process of any design question. An ecologically regenerative architecture is achieved through a process of continuous iteration until the design is aligned with the five principles and all the checklist points of the framework are fulfilled. The precise solutions are strictly contextual and will depend on the local ecosystem. While a need for contextual innovation and celebrating the specificity of places is put forward, it simultaneously brings the challenge of no solution fits all. Perhaps this suggests the need for a global network of local knowledges and solutions which share the basis of the general ecosystems' principles for sustainability and resilience.

Such an alternative design mindset - a more-than-human (eco)systemic perspective - can open the creative potential of architecture to be ecologically regenerative and so demands the expansion of the conception of architecture as being relational to both human and non-human, process-driven by being tuned to the local ecosystem's cycles and flows and open-ended in its anticipation to change with the changing environment.

Finally, this paper encourages the further development of such frameworks to design education and practice as a way to build the bridge between the regenerative theory and the practice of building.

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