

Re-embedding economies in ecologies: resilience building in more than human communities

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Abstract

The modern hyper-separation of economy from ecology has severed the ties that people have with environments and species that sustain life. A first step towards strengthening resilience at a human scale involves appreciating, caring for and repairing the longstanding ecological relationships that have supported life over the millennia. The capacity to appreciate these relationships has, however, been diminished by a utilitarian positioning of natural environments by economic science. Ecologists have gone further in capturing the interdependence of economies and ecologies with the concept of socio-ecological resilience. Of concern, however, is the persistence of a vision of an economy ordered by market determinations in which there is no role for ethical negotiation between humans and with the non-human world. This paper reframes economy-ecology relations, resituating humans within ecological communities and resituating non-humans in ethical terms. It advances the idea of community economies (as opposed to capitalist economies) and argues that these must be built if we are to sustain life in the Anthropocene. The argument is illustrated with reference to two construction projects situated in Monsoon Asia.

Keywords

local resilience, ethical behaviour, climate change, negotiations

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Introduction

In what has been named the age of the Anthropocene, human systems have become a geological force capable of affecting and altering earth systems (Steffan, Broadbate, Deutsch, Gaffney and Ludwig, 2015).ⁱ There are fears that a critical transition phase has been reached whereby planetary systems have been forced outside of the domain of Holocene stability (Folke et al., 2010). It is increasingly clear that the model of economic organization and growth that has driven development over the past 200 years is responsible for this crisis (Dumanoski, 2009). The global impact of ‘The Great Acceleration’ of Gross Domestic Product, population growth, urbanization, energy and water use since the 1950s has produced measurable levels of global warming, increased climatic instability, and dramatic species loss (Steffan et al., 2015). Life ‘as we have known it’ is under threat.

Across a range of fields scholars concur that radical change is urgently needed. Feminist eco-philosopher Val Plumwood, for example, offered this powerful warning:

If our species does not survive the ecological crisis, it will probably be due to our failure to imagine and work out new ways to live with the earth, to rework ourselves and our high energy, high consumption, and hyper-instrumental societies adaptively. (2007, p.1)

She wrote of the need to “go onwards in a different mode of humanity” if we are to survive the ecological crisis humans have produced. In a similar vein, design theorist Tony Fry has called for a new project, the Sustainment, of equal magnitude and import to that of the Enlightenment. The Sustainment is, for Fry (n.d., <http://www.thestudioattheedgeoftheworld.com/the-sustainment.html>):

a vital intellectual and pragmatic project of discovery marking a turn of humanity that acknowledges that ‘to be sustained’ requires another kind of earthly habitation that understands: the indivisible relation between creation and destruction; that nothing will change unless our mode of being changes; and that which has to change extends to every dimension of human environmental, economic, social, cultural and psychological existence. To grasp this is to comprehend that human ‘development’ to date has been bonded to an ever-increasing condition of unsustainability whereby human ‘progress’ has negated all the related conditions of ‘our’ dependence.

The hyper-separation of humans from nature that has taken place within industrialized economies over the last two hundred years has reduced the ability of humans to be affected by the non-human world. Plumwood and Fry call for new ways of inhabiting the earth. They point to the need to rethink what economic development is and to reconfigure the lived relationships between economies, ecologies and built environments.

The relatively new field of Resilience Science addresses complex adaptive systems and provides a promising step forward from the conceptual hyper-separation of ecological from economic analysis that has contributed to the current crisis. The concept of 'social-ecological resilience', for example, situates people and nature, or economies and ecologies, as interdependent systems that change, adapt and transform (Holling 2001; Folke et al 2010; Walker and Cooper, 2011). This article considers whether resilience thinking, as advanced by the Resilience Alliance (e.g. Holling, 1973, 1986, 2001; Folke, 2006; Folke et al., 2010) can offer guidance in the current context. In a social-ecological system *adaptability* is the capacity to harness collective action to 'bounce back' after threat and re-establish some kind of stable condition, whereas *transformability* is the capacity to 'bounce forward' and "create a fundamentally new social-ecological system when ecological, political, social or economic conditions make the existing conditions untenable" (Folke 2006, p.262; Manyena, O'Brien, O'Keefe and Rose, 2011). This paper asks: Can resilience thinking guide the kind of transformational change that the coming of the Anthropocene demands? What does the resilience approach say about how the economy might 'bounce forward'? In particular, can the concept of social-ecological resilience be applied to the task of transforming the built environment of cities, where economic growth is physically manifest in durable material structures?

The argument is organized into three sections. Section 1 critically reviews the resilience literature for how interdependence between ecologies and economies is positioned. It suggests that the model of economy drawn upon by Resilience Science is limited by an over emphasis on stores and flows of capital and the potential of self-organized markets to bring about transformation. It argues that politics and ethics are not only banished from the operations of resilience dynamics but also from the discursive representation of resilience. Section 2 offers a reframing of economic identity and the dynamics of social-ecological

resilience. It proposes a non-capitalocentric vision of the diverse economy in which ethical practices of habitat maintenance might be actively pursued to build the resilience of more than human community economies. Drawing on the field of Environmental Humanities, this section situates human economic activity *within* ecologies. Here interdependence is not framed in terms of 'natural' ecologies providing services for 'human' economies but in terms of ethical negotiations between human and non-human economies in ecologies of more than human communities. Jane Jacobs' (2000) thinking on the 'nature of economies' and J.K. Gibson-Graham's (2006) theory of community economies are employed to help theorize ethical moments of resilience building. Section 3 turns to the matter of buildings and physical infrastructure in neighbourhood based community economies. Two innovative processes of co-construction, one in Indonesia, the other in Cambodia are interrogated for what they reveal about the interdependence of diverse human and non-human economies and ecologies, and the role of ethical negotiation in building neighbourhood resilience. These cases are presented as local examples of "going on" in an exploratory mode that accepts and works with instability, uncertainty and contingency.

1. Social-ecological resilience: a systems approach to ecological and economic interdependence

The concept of resilience is employed in many different contexts—natural resource management, engineering, design, anthropology and social psychology. In recent years resilience thinking has spread from its formulation in ecosystems science to "rapidly infiltrate vast areas of the social sciences", particularly those concerned with the logistics of crisis management (Walker and Cooper, 2011, p.143, 144). If resilience has replaced sustainability as "the buzzword of the moment" as Porter and Davoudi argue (2012, p.329), it is probably because it speaks to the need to theorize dynamics of transformation across the broad fronts of natural systems, social systems, psyches and built environments. The argument in this paper is motivated by a concern to work *with* the concept of resilience but to do so paying critical attention to the way interdependence between ecologies and economies is represented. The discussion proceeds by examining Holling's notion of socio-ecological resilience as a theory that integrates society, economy and the biosphere (Walker

and Cooper, 2011, p.147) and “deepens our understanding of linked ecological/economic/decision systems” (Holling, 2001, p.391).

In the move away from equilibrium-oriented ‘engineering’ resilience to a properly ‘ecological’ resilience, non-linear adaptive cycles are seen to produce changed states and even new systemic relationships, but the persistence of a defining system structure. The term capital is used to invoke “the inherent potential of a system that is available for change” (Holling, 2001, p.393). Capital is the stored ‘wealth’ of a system, whether this be an ecosystem made up of biophysical capital, or an economic system made up of financial, manufactured, cultural, social and human capital (Folke et al., 2010, p.261). The never-ending adaptive cycles that interlink natural systems, human systems, human-nature systems and social-ecological systems involve “growth, accumulation, restructuring, and renewal” (Holling, 2001, p.392-4). This integrative theory of transformation resonates with Schumpeterian and Marxian narratives of capitalist development involving crisis, creative destruction, restructuring, and the emergence of ‘new’ forms of capitalism. Walker and Cooper draw out the conceptual links between Holling’s later work on the self-organizing and self-regulating capacities of complex adaptive systems and Hayek’s “mature theory of spontaneous market order and social evolution” (2011, p.147). They argue that, writing in the 1970s, both Holling and Hayek rejected “metaphors of classical thermodynamics” and were “preoccupied by questions of epistemic limits to prediction”. Both were critical, for example, of the Club of Rome’s “assertions of ecological limits to growth” (p.144). In his 2001 paper Holling looks to the “forward looking behaviours of people”:

These behaviors play a role in transmitting future scarcities into current prices, thereby inducing conservation behaviors in the real economic world. This forward-looking process functions through futures markets and the strategic purchase and holding of commodities. They provide very large incentives for some people to forecast the coming scarcity better than the rest of the market and to take a position to profit from it. But what one market participant can do, all can do; thus, this process transmits information to the market as a whole. (2001, p.401)

Holling notes that there are, of course, limits to the operation of this complex system, for example, when institutional rigidity and political power pervert the “essential liberal and equitable” workings of a market (p. 401). Here we see the synergy with neoliberal policy

informed by Hayek's adherence to the self-organizing dynamics of the 'free' market (Walker and Cooper 2011, p.150).

The conception of ecology-economy interdependence that informs this founding vision of resilience is but one (very influential) representation. The question of concern in this article is whether this approach can be usefully deployed to engender the radical transformations, especially in the economic arena, that are needed today? Many scholars working in this field would agree with Folke that "research in social-ecological resilience is still in the exploratory phase" (2006, p.263). In the spirit of contributing to this exploration it is worth considering what is excluded by a unifying theory of social-ecological systems and the effects of this exclusion.

A quest to integrate the "essence of ecological, economic and social science theory" as simply as possible motivates the systems thinking that informs Resilience Science (Holling, 2001, p.391). A system is "a discernible and stable entity that maintains its structure in spite of both the plasticity of its ongoing micro changes and the replacement of its components" (Lawn, 2001, p.148). Any system is defined not only by what is included but what is excluded. So, just as the early field of ecology "excluded humans or treated human actions as external to the system" (Folke, 2006, p.262), modernist representations of the economy excluded the environment from its system. It took the new discipline of ecological economics (see, for example, Daly and Farley, 2010) to translate the environment into 'natural capital' and position it *within* the economic system as providing 'ecological services'. Resilience studies embraced this melding of two separate systems into one, and instated a unifying logic of complex adaptation and transformation to govern economy-ecology interdependence. But exclusions remain. What of all the diverse human economic activities that cannot be capitalized and priced? What of the relations between human and environments that are not about 'servicing' but are about mutual care and stewardship? What about the developmental dynamics that are not driven by accumulation, the releasing of potential, creative restructuring and structural maintenance? Indeed, if it is the capitalist economic system (albeit in the form of a new 'regime of accumulation') that persists, how might radical transformation and a new development trajectory come about?

Most importantly systems exclude politics. When a language of capitals is used to value the stocks and flows of everything from river water to family care, 'capitalism' becomes synonymous with 'the economy'. Culture, government and life itself are seen to operate 'within capitalism'. Represented as a system of production, markets and finance that operates at a global scale, nothing escapes capitalism's grasp, there is no alternative, and no outside. This 'capitalocentric' way of thinking limits the imaginary of 'other worlds' and constrains politics (Gibson-Graham, 1996, p.6). But stepping outside of a realist epistemology, and accepting the political nature of knowledge production, it is increasingly accepted that theories offer performative 'approaches' that make certain things more real than others (Law and Urry, 2004). There is, thus, a choice to be made as to whether the capitalist economy is represented as a force of nature or as a precarious assemblage of powers, practices, technologies and discourses that must be continually reconfigured and performed (St. Martin, Roelvink and Gibson-Graham, 2015). Similarly there is a choice to be made as to whether the environment is represented as a resource for human consumption or as a vibrant complex of interconnected communities of living and non-living things with the will to flourish (Rose, 2004).

To summarize, Resilience Science has made major advances in the understanding of complex adaptive systems that work according to "far from equilibrium" dynamics (Folke, 2006, p.257). It has brought the instability of living systems to the fore. This work is invaluable when grasping the interactions of earth and human systems at the planetary down to the local scale. It has contributed to the understanding of global warming and what the coming of the Anthropocene means in terms of critical thresholds and transitions. However, the representation of the economy as stocks and flows of capital that release potential, restructure and reconfigure according to the spontaneous operations of markets limits the ability of the resilience approach to imagine radical economic change. It fails to overcome the separation of human and non-human worlds and shores up an instrumentalism that is dangerous. If the transformational shift of the deep type advocated by Plumwood and Fry is to occur there is a need for more experimental and ethically driven conceptions of economic dynamics and a less utilitarian view of economy-ecology interdependence.

2. Re-embedding economy *within* ecology and reframing resilience as more than human community flourishing

In this section new developments in the Environmental Humanities and non-capitalocentric economic thinking are used to theorize ecology-economy interdependence using a different kind of ecological entry point. As is well known the Greek term *oikos*, the common etymological root of both ‘economy’ and ‘ecology’, is translated as ‘household’ or ‘habitat’. *Oikonomia*, or economy, partners *oikos* with *nomos*, a term which embodies certain tensions between its meaning as either ‘management’ cum ‘negotiation’ of the domestic household or habitat, or as ‘customary’, as opposed to state, law—here showing the link between *nomos* and nomad.ⁱⁱ Gibson-Graham and Miller (2015) propose a definition of economy as the negotiation of order within habitats. This definition allows for a consideration of the economies of different species that negotiate livelihoods in varied habitats, thus taking the term well beyond the domesticated and mastery-oriented ‘management’ of human households and national economies, toward the kind of multi-species negotiation that needs cultivating in the Anthropocene (Miller, 2016, pers.com). What then of ecology or *oikologia*, which partners *oikos* with *logos*, that is, the knowledge or account of habitat? Rather than equating ecology with ‘natural systems’ as is the common practice, ecology becomes a conceptual framework from which to view the articulated whole of interacting economies including the interdependence of order in human, animal and plant habitats.

The idea that it is not only humans who have economies, but that other species and living entities also manage and negotiate their livelihoods (in, for example, bee economies, bamboo economies, bacterial economies etc), and the idea that human economies are in continual interdependent relationship with these other economies may well be strange. But, as Gibson-Graham and Miller argue:

there is no more ground for the construction of a human ‘economy’ separate from its ecological context than there would be for ecologists to consider the provisioning practices of bees as an independent ‘system’—with its own internal laws and imperatives—wholly separate from their constitutive interrelationships with flowering plants, other pollinators, soil mycorrhizae, nitrogen fixing

bacteria, seed dispersing birds and mammals. Human sociality is simply a particular manifestation of the mutual interrelationships between and among species and between and among communities of living beings that implicate lives ranging from mitochondria in our cells to pollinators that make agriculture possible. (2015, p. 10)

The extent to which this notion seems strange is but a measure of the success of a powerful modern discourse of economy that has separated out human livelihood negotiation from that of non-human livelihoods. So when parts of the environment are represented as 'resources' or 'ecological services' that function as stores of 'natural capital' that can be mobilized as monetized 'inputs' into the human economic system they become completely divorced from the lively ecosystems from which they emerge. At the same time human-non-human interdependence is reduced to utility and stripped of any ethical content.ⁱⁱⁱ

An ecological entry point highlights the vast diversity of economic activities that support livelihoods in a 'more than capitalist' economy. This includes unpaid and alternatively paid labour as well as waged labour; the sharing and allocation of non-commodified products as well as commodity market transactions; sole proprietorship, cooperatives and social enterprise as well as capitalist business; collective private and communal forms of property as well as individual private property; and non-mainstream forms of investment alongside mainstream finance (Gibson-Graham, 2008; Gibson-Graham, Cameron and Healy, 2013). Non-capitalist practices and their dynamic interdependencies are not captured by capitalocentric economic discourse. Indeed they are deemed unimportant in light of systemic dynamics like capital accumulation and dis-accumulation, financialization and crisis, the mechanics of commodity and investment supply and demand. Today, there is much interest in the growth of non-capitalist or post-capitalist economies—that is, social, cooperative, *buen vivir*, degrowth and collaborative economies in which the activating dynamics are ethical commitments to a range of outcomes other than profitability and private wealth accumulation (see, for example, Bollier and Helfrich, 2014).^{iv} An non-capitalocentric framing allows for resilience to be explored within this ecology of interacting economic diversity.

In a diverse economy, humans, non-human species and natural elements can all be seen as actively co-producing well-being and care. Plumwood's philosophical reflections are useful in helping to delink agency from the human subject. She writes:

the reductionist materialism that is regarded as the new beginning to modernity is actually just a truncated dualism which preserves at its heart the original splitting and reducing process, stripping mind, intelligence and agency out of materiality and awarding it to a separate driver. It represents nature as passive and uncreative, real creativity coming only from (various) mind-identified drivers, usually humans or humanoid. (2009, p.119)

In the field of Environmental Humanities, which Plumwood helped to establish, this separation is overcome through the study of ethical connection. Rose, for example, extends Levinas' view of human connectivity whereby subjectivity arrives "in the form of a responsibility toward another" to human-non-human interrelationships (Newton, 1995, p. 12 quoted in Rose 2004, p.13). In her view connectivity and responsibility are central to the operations of resilience. She transports the language of systems into the ethical domain of mutual flourishing:

The term 'resilience' is used in a technical way by ecologists. It refers to relationships within ecosystems and is attuned to the instability of living systems. Each living thing has its own will to flourish, its own 'conatus' in philosophical language. The will to flourish brings every living thing into relationship with other living and non-living parts of the environment. When those relationships work to enable life to flourish, the system itself may be said to be resilient. ...it will be self-organising and self-repairing. In human terms, resilience has a similar meaning, referring to the capacity of groups of people to sustain themselves in flourishing relationships with their environment, to cope with catastrophe, and to find ways to continue. (2004, p.7)

When ethical connectivity (which may be represented by a more experimental notion of system connectivity) is taken as a starting point, economic analysis, in the first instance, would identify the range of economic activities that are maintaining human and non-human livelihoods and the dynamic interactions between diverse human economies and diverse non-human economies. The questions that emerge are, for example: What kind of economic

relationships foster sustainable ways of flourishing? Which economic relationships promote resilience and which destroy it?

In her book *The Nature of Economies* Jane Jacobs (2000) proposes that the dynamics of natural ecosystems be taken up as principles for cultivating sustainable and resilient economic regions.^v She highlights the dynamics of:

- habitat maintenance—that is, the continual adjustment and correction of relationships between organisms to survive well together,
- increasing diversity and redundancy—as the more diversity leads to more effective support for life,
- circulation and capture of energy and matter that helps diverse activities and niches to self-refuel, and
- complex interdependence of developments and co-developments that co-evolve in an unpredictable but self-organizing manner.

Jacobs suggests that these dynamics can be activated within regional economies through, for example, economic sectoral diversification and thickening of local interactions along the supply chain. Gibson-Graham, Cameron and Healy (2013) have further linked these dynamics to the building of *more than human community economies* in which being-in-common is negotiated with all other life forms. Here ‘community economies’ are not simply commercial transactions and business operating in a local area. As already discussed, ‘economy’ signals the *oikos* or habitat, that which supports life, whereas ‘community’ is evoked in the active sense of negotiating being-in-common as a multispecies, human and non-human community, a ‘we’ that includes all of those with whom human livelihoods are interdependent and interrelated.^{vi} A community economy is, thus, a space of co-learning in which humans are beginning to “see the non-human sphere in ethical terms” (Plumwood 2009, p. no page).^{vii} This does not mean locating ethical consciousness in the non-human but including non-humans in a wider more than human community. The ethical concerns of community economies (as laid out in Gibson-Graham, Cameron and Healy, 2013, pp. xviii-xix) can be read through Jacobs’ set of resilience dynamics as follows.

In a community economy habitat maintenance is supported by:

- the work of humans and earth others to meet basic needs and survive together well and equitably,
- transacting with/encountering human and earth others in ways that support mutual wellbeing, and
- consuming sustainably.

Diversity in a community economy involves fostering:

- multiple, co-existing forms of labour, transactions, enterprise, property and investment,
- economic sectoral diversity, and
- species and ecological diversity.

Self-refuelling in a community economy takes place by:

- distributing natural and social surplus to enrich social and environmental health,
- caring for—maintaining, replenishing, and growing—the natural and cultural commons, and
- investing wealth in future generations of human and earth others so that they can live well.

Co-evolving developments and interdependence result from:

- human-human and human-non-human negotiations within community economies that cannot be specified in advance and where the bounds of negotiation are continually being fixed and extended.

The key theoretical moves in this section thus far have been first to reframe the identity of ‘the economy’ as diverse and more than human, and to re-embed economies *within* ecologies. The second move has been to view the dynamics of interactions between human and non-human economies in terms of ethical negotiation. Once more, it is a measure of the success of western systems of thinking that the idea that animate and inanimate materials might possess creative, agentic properties is so strange or ludicrous. Shifting thinking in this realm involves the kind of radical change that Fry gestures to in his concept of The Sustainment. It may well require a new kind of analytical practice in which critical judgement is suspended while exploratory work is done as to how this reconfigured ‘we’ negotiates questions of needs and survival, surplus generation and distribution, transactions and encounters, consumption, commons sharing and investment in futures.

This section concludes with a brief consideration of the implications of this reframing for resilience in the built environment. As Steffan et al., (2015) document, the rapid urbanization that has taken place across the globe since the 1950s is one powerful component of the Great Acceleration in human activity that is affecting planetary systems. Today, more than half the world's population lives in urban areas (UN, 2014). If the challenges of climate change are to be met so as to go on in a different mode of humanity, then transformative capacities must be focused on the “buildings, infrastructures and cultural landscapes” (Hassler and Kohler, 2014, p.222) that economic growth has produced.

Yet the built environment is often represented in terms of its durability and rigidity to change, as sedimented stocks of natural, human and finance capital that “enable and facilitate certain kinds of activity” and, it could be added, not others (Hollnagel, 2014, p.222; see also Harvey, 1985). How then to go on in a different mode of humanity? How can built environments deal with the instability and unpredictability of change and still maintain the function of providing flourishing habitats for humans and earth others? How might resilience in more than human community economies be practiced in built environments and urban systems? The final Section takes up Hollnagel's conception of built environments (or systems in his terms) as *socio-technical habitats* (2014, p.227) and explores how resilience might be built through 1) on-going negotiations to ensure human and non-human habitat maintenance, 2) protecting and generating economic and ecological diversity and 3) developing a new relationship to durability, one less focused on lasting built forms and more on lasting abilities to re-perform ethical acts.

3. Building Resilience in Monsoon Asia

Some of the most rapid growth of population and urbanization on the planet is taking place in South and Southeast Asia, or what has historically been referred to by the west as ‘Monsoon Asia’ (Steffan et al., 2015). In this region the prospect of rising sea levels offers a major threat to many of the newly urbanized areas and countries are already experiencing the massive force of increasingly unpredictable climate systems. The two cases of resilience building practices to be discussed in this Section are located in urban hinterlands in this

region. The first involves an ephemeral bamboo bridge that is built across the Mekong River each dry season from Cambodia's second biggest city, Kampong Cham, to the small village of Koh Paen. The second is of an experimental Tropical Town for migrant workers in Batam, Indonesia. Both are projects of construction designed to deal with ongoing and inherent instability. Tropical Town deals with the fluidity of flows of migrant workers in and out of the precinct, while trying to foreshadow a different kind of economy through creating an urban habitat where work and home are not separated, and where self-provisioning is possible. The annual rebuilding of Kampong Cham's bridge is an ethical practice of more than human community building and a means to co-exist with the flows of the river using regenerative design.

Resilience scientists Folke et al (2010, p.20) propose that "transformational change at smaller scales enables resilience at larger scales" and that

Society must seriously consider ways to foster resilience of smaller more manageable SESs [social-ecological systems] that contribute to Earth System resilience and to explore options for deliberate transformation of SESs that threaten Earth System resilience. (Folke et al., 2010, Abstract, inclusion added).

These two small case study snapshots are presented as tentative examples of resilience building that could offer insights into more deliberate and large scale transformations in the built environment.

Kampong Cham's Ephemeral Bamboo Bridge

In the city of Kampong Cham, on the banks of the Mekong River in eastern Cambodia a 1.5 kilometre long bamboo bridge is built every year during the dry season to the mid-river island of Koh Paen (Figure 1). When the monsoon rains come the bridge is engulfed by water and washed away, only to be built again when the dry season returns. A traveller's blog gives an embodied sense of the structure:

When looking at the bridge from the side, you can see a lot of crossing bamboo sticks which form a beautiful framework.... a carpet of several layers of canes cut in halves extends over it, absorbing the impact of the vehicles.... I love crossing the bridge with my bike. The irregular ground moves under my wheels, it

oscillates and adapts according to the vehicles which are passing by at each moment, going over it gives you a great sense of adventure....At the beginning, going through the bridge next to a car is pretty scary, because the floor bends with the weight of the car, but, after a couple of times, you relax once you realize the bridge is strong enough...

(Marante, 2016, <http://artwatereness.com/portfolio/the-bamboo-bridge/>)

Just a kilometre upstream where the river narrows stands the mighty Kizuna Bridge, also 1.5 kilometres in length, a quintessential symbol of Cambodia's modernity. Perched high on pylons to escape the floods, this concrete and steel construction displays all the elegant efficiencies of curved form following function. Completed in 2001 and funded by a \$56 million grant from the Japanese Government, it spans the Mekong River and was the first bridge to join the west and east of the country, thus enabling rampant business-as-usual development of north eastern Cambodia and trade links with Vietnam (Prime Minister Hun Sen, BBC News, 4/12/2001).

Figure 1 to go here

From a vantage point on the Kizuna Bridge, looking down river to the quaint bamboo bridge, what can be seen? Is it a backwards glimpse into a pre-modern age where vernacular design, local materials, manual labour and a dominating nature yokes bare survival to the endless repetition of a painstaking task? Or could the bamboo bridge contain lessons for a future of economic and ecological resilience?

This ephemeral bridge works *with* instability and yet is part of a flourishing ecosystem that combines interdependent human and non-human economies. The relative strength and vulnerability of the bridge is a constant reminder of the complex non-human/human interdependencies involved in surviving well together. As a human construction the bridge draws on the strength of natural fibres strong enough to hold up human, animal and machine traffic. At the same time, as a natural construction that cannot withstand the force of water in the wet season the bridge breaks up and washes away when the force of the currents are too great.

The bamboo bridge is an integral part of maintaining life supporting human and non-human habitats. Its annual rebuilding has gone on for at least 100 years, with a break only during the Pol Pot regime.^{viii} The (re)construction is aligned with the cyclical temporality of human rituals, water flows and bamboo growth. Each year it is rebuilt in time to support the intense sociality of new year festivals when the bamboo structure groans with traffic of all kinds. It is washed away at the beginning of the monsoon season allowing the swollen river to manage its massive increase in water flow.^{ix} Bamboo habitats situated along the Mekong River supply the materials for the bridge rebuild each year. The harvesting transaction involves negotiating an ethical relationship of mutual benefit. Bamboo grows according to a 3-7 year life cycle. When it is harvested, the underground system of roots and rhizomes remain intact and the plant sends up new shoots which become culms. Too frequent harvesting of any one clump might endanger its survival, but the regular thinning of culms and clearing out of decaying culms allows for more light and promotes regrowth. When human-bamboo relationships are equitably balanced, well-maintained clumps have a higher productivity than that of unharvested wild clumps. The practices of maintaining bamboo habitats in turn have positive effects on other habitats, by controlling river bank erosion, improving groundwater levels and soil nutrition (Hill, 2013; van der Lugt, Vogtländer and Brezet, 2009).

The bridge is an agent in the neighbourhood community economy, contributing to the diversity of labour practices by providing paid work for people in a largely non-cash economy. It provides employment for village bamboo harvesters, and up to 30 carpenters and thatchers. Many of the bridge craftsmen are also subsistence farmers and fishers, so this paid employment supplements their in kind subsistence income. Traffic controllers at each end of the bridge are paid to organize the one way direction of flow with walkie talkies and a small toll is charged for use. During its lifespan the bridge is maintained by 5 repairers. The bridge workers are employed by a 'rich' local businessman, or patron, who wins the 5 year contract for building the bridge and collects the toll revenue to pay for the materials, workers and maintainers.

The energy captured and circulated in and around the bridge promotes the self-refuelling of a more than human community economy. As already discussed, the local supply of bamboo to build the bridge promotes the growth of new bamboo culms. The work on the bamboo bridge returns every year and provides an income stream from tourist and local resident toll payers that is circulated within the community—via the local patron to bridge repairers to food and service providers. The bamboo construction skills possessed by local craftsmen are part of a social and cultural commons. Rebuilding the bridge each year keeps traditional bamboo construction skills alive and is a form of continuous retooling that prevents intergenerational skills loss. Whether the local businessman/patron profits in a monetary sense from building the bridge for five years is unknown, so how the bridge is linked to surplus generation and distribution can only be a matter for speculation. He could be acting as a social entrepreneur who organizes a ‘for purpose’ business that serves the local residents, and this may have other payoffs in terms of loyalty and political power (Lyne, 2016). Or he may undertake the construction purely as a way of achieving personal gain.

The elements of this case that might be a model for resilience building in the Anthropocene can be highlighted against the backdrop of the Kizuna Bridge. This large concrete development project generated short term, one off, paid employment for construction workers. Its connections and interdependence with limestone and gravel quarries (and the environmental degradation they cause) and international aid funds (and the associated political deals they arise from) remain hidden and out of sight. In contrast, the bamboo bridge is a socio-technical infrastructure that promotes transparent ethical negotiations.

The “indivisible relation between creation and destruction” (Fry, n.d.) is at the core of these negotiations. While the physical structure of the bridge is regularly created and destroyed, the process of negotiating building—interacting with bamboo clumps, with water currents, with the local patron, with fishers and farmers who are also craftsmen—involves a sensitivity to survival and sustainability. What constitutes durability in this instance is not the resilience of the engineering of the bridge, but the transparent ethical practices surrounding its construction.

It was not until after the Pol Pot regime that bridge building, once a non-monetized community organized process, was commercialized. This development has not, however, undermined the operations of a community economy, but has added a new source of paid labour and cash flows to the already diverse economic landscape. The bridge is an ongoing contributor to economic diversity and the self-refuelling and flourishing of many different human and non-human economies.

Batam's Incremental Housing Project

The urban centres of Monsoon Asia are under pressure to house increasing numbers of people as migrants from rural areas flock to the city to find employment and join family members who have previously made the move. An experiment in building neighbourhood resilience is being undertaken by a team of researchers from the Future Cities Laboratory (ETH Zürich) on Indonesia's Batam Island. Batam is located within the Indonesia-Malaysia-Singapore Growth Triangle set up in the late 1980s-90s, a short ferry ride away from Singapore.^x It functions as a free trade port and industrial hinterland, or back-factory site, from which cheap labour, land and resources for manufacturing and warehousing can be accessed by Singapore's tertiary and quaternary sectors and to which investment capital flows. There has been a steady inflow of labour into Batam from other parts of Indonesia with a limited flow out and onto Singapore, mainly by domestic workers.

New arrivals live either in single sex dorms in compounds linked to the industrial estates and tourist hotels; in a limited number of state subsidized six story walk up apartment blocks called *rusun* or *rumah sunsun* (vertical houses); or in self built houses called *ruli* or *rumah liar* (literally "wild" or "unregulated" housing) in crowded squatter settlements (Cairns, 2015, p.3). The squatter settlements have grown up along roadsides, in nature reserves and parks. They include buildings that are built

incrementally, in line with fluctuations of household size and membership and variations of the associated domestic economy. A room might be extended, a veranda enclosed, a floor added, a garden cultivated—as household needs require, finances afford, and imagination allows. The settlement's built fabric can be as diverse as its social and economic fabric.

(ibid, p. 4)

As in squatter settlements across the world, household production and non-market transactions are intermixed with spaces of manufacturing and commercial transaction. Activities usually conducted in the private space of the home spill out onto the street and into public space of all kinds. A polyglot mix of natural materials and recycled manufactured materials are used by householders to fabricate their homes. Some are able to upgrade their dwellings using funds from remittances sent by relatives working overseas. Usually this takes the form of a concrete structure and iron roofing. Buildings are functional but shoddily and inefficiently constructed, and sanitation and water supply arrangements are ad hoc.

Researchers led by Stephen Cairns from the Future Cities Laboratory have joined with planners from the Batam Municipal Planning Department and architects from the University of Indonesia to pioneer affordable incremental housing that is designed to be able to expand without increasing the building footprint for the rapidly growing migrant population.^{xi} The cheapest high rise developments on Batam are aimed at the growing middle class and are way out of reach for most rural migrant households. The Tropical Town project is aimed to fill this gap. The plan is to enrol philanthropic developers to build a prototype of this housing to prove its projected densities, ecological footprint and the viability of its economic modelling.

The model *rubah* or *rumah tambah* (expandable house) is:

a dwelling that is capable of being expanded vertically according to household need, capacity, or desire....Each *rubah* dwelling also incorporates simple rainwater harvesting, solar energy generation, and collective septic tank technologies, giving it a degree of resource autonomy....The house has income-generating potentialin the form of space for rent or economic enterprises such as tailoring, food stalls or electronic goods repair.

(Cairns, 2015, p.6)

This model (see Figure 2) has been co-produced with migrant community members whose existing *ruli* provide some of the expandable design features. Further input from community members was obtained via a survey of activities, needs and stories of household growth. A diverse economy inventory was used to document the wide range of livelihood activities people are engaged in and this fed into individual housing unit design.

Figure 2 to go here

A multi-generational household growth model was devised based on projected needs for space, income, water, energy, waste management and garden food production for subsistence or sale. As shown in Figure 3 the neighbourhood plan allows for close settlement, that can expand vertically without compromising space for gardens, bamboo groves and public communal space.

Figure 3 to go here

There are numerous opportunities for ethical negotiation built into the *rubah* that will potentially contribute to neighbourhood resilience. First, multiple human and non-human habitats are accommodated and sustained. The house is built to allow for extended family, friends or unknown others to be accommodated relatively easily. The housing habitat adapts to changing conditions ensuring that people survive well together with adequate space and facilities. Household water harvesting and a collective septic system reduce stress on local water resources. These technologies establish a relationship of care for water storage, quality and flow constituting a shared commons whereby benefit is distributed to both humans and non-humans. Finally, open access solar energy is captured and shared constituting another commons that supports life by reducing pollution of the atmosphere. All these aspects of the *rubah* could be seen as contributing to *architectural* resilience (Vale, Shamsuddin, Gray and Bertumen, 2014).

Second, the design of Tropical Town explicitly supports diverse economic activities. Many migrants will not move straight into paid jobs in the so-called 'formal' economy, that is, in capitalist businesses or state owned authorities. Instead they will establish micro-enterprises or become employees in small unregistered businesses. The goods and services offered by these micro and small businesses, such as cheap food for people on the go and individualized or small group public transportation, provide for the needs of the city as a whole. The Tropical Town housing design acknowledges the precarious nature of paid employment and thus includes spaces for self-provisioning of household food on a small

plot of land, and independent production or commercial activities from a small shop front or workshop on the ground floor of the house. This is a major innovation in incremental housing design that designs *into* the fabric of a 'residential' area, opportunities for diverse economies.

Tropical Town is, thus, much more than a housing project. The built environment fosters a diverse economy in which there lie opportunities for supply chain link up between services and small scale producers and increased potential for surplus generation at a household level. This provides the conditions for self-refuelling at a neighbourhood scale. The expandability of the house allows for good connections to be maintained with the migrants' place of origin, allowing for trans-local communities to thrive on the movement within and beyond the nation. Finally, the affordability of the house means that each generation will be able to progressively buy and own a housing unit and still have savings to invest in education and future generations.

Batam's Tropical Town is still in the development phase and the projected positive outcomes previously outlined remain hypothetical. The promise it holds for building resilience is yet to be realized. Certainly the conditions are set for a very interesting form of urban economic resilience to be co-developed. Ongoing experimentation with using renewable building materials such as bamboo and other natural fibres is taking place at the Future Cities Laboratory. The main challenge is how the non-human plant and animal habitats that have been destroyed by development on Batam might be nurtured back into a more robust membership in a more than human community. Perhaps the practice of building and living in the *ruma* might allow human residents the opportunity to learn to be affected in ways that increase the desire for more than human wellbeing.

Conclusion

The question of what constitutes resilience is of current concern and has generated a rich and burgeoning literature across many fields. This paper has argued for the need to re-embed economies *into* ecologies, recognising that all life forms are involved in negotiating livelihoods in habitats that are interconnected with others. Human economies are

interdependent with plant, animal, bacterial economies and more, and the future depends on building the capacity to live together in flourishing ecologies that work with disequilibrium complexity and instability. The case studies of habitat maintenance and resilience-building in Monsoon Asia provide rich materials with which to explore the ways that resilient more than human communities might come into being through practices of ethical economic deliberation and built environment design.

All over Monsoon Asia there are examples of resilience-building practices that have yet to be documented and theorized as such.^{xii} Many of these involve fostering and facilitating diverse economic activities (such as reciprocal labour exchange, pooling of surplus for redistribution to community members, gifting labour and goods, barter, self-provisioning) aimed at habitat maintenance and the restoration of habitats in the wake of natural hazards (Bankoff, 2007). Included in this are a range of practices and methods of designing, constructing, and repairing the built environment. The case studies in this paper show how practices of ethical deliberation and building design come together to produce resilient more than human community economies at the neighbourhood scale. In both instances resilience is linked to the ability to adapt to the mobility of people and material structures and the temporality of flows of water and migrants, plant growth and solar energy. As recognition of the need for regenerative design grows more than human community economies will provide living laboratories for further experimentation and model development.

To conclude, Vale's notion of 'progressive resilience' (2014) links resilience to avenues for democratic and participatory deliberation in ethical decision-making. Vale inserts into the dialogue a sense of power and politics worth rehearsing here:

Who will take control of the term and drive its usage? Will it be driven by the engineer's concept of resilience as a 'bounce back' to some pre-perturbation status quo that is assumed to be more desirable than the present, or will resilience thinking embrace the uncertainties of ecological models, in which a new system may operate with a different hierarchy? Both versions of resilience, however, too easily assume that there is some future steady-state (or a return to a past one). Yet what happens

if assumptions about past or future stability are untenable, or if social environments that are stable are also deeply inequitable? (2014, p.192)

In this conception, resilience embraces ‘opportunities for political voice, resistance, and the challenging of power structures’ (Shaw in Vale 2014, p.198). This more performative version of resilience is attentive to how resilience is articulated in stories, symbols and politics. It shifts attention away from systems and onto issues of politics. The built environment appears less like an artefact and more like complexly interdependent socio-ecological habitats that are not stable – or equally distributed.

This paper has presented a number of strategies for developing a richer understanding of resilience in the built environment that are a pre-condition for survival in a climate changing world. It has not presented a model for a transformative (utopian) bounce forward, but has, instead, found transformational ecological-economic relations in the present—i.e. in cases that are experimenting with resilience right now. This performative move empowers a notion of resilience that breaks with dualisms, systems, linear notions of time, development and change. The focus on ecology-economy relations that are mobilised around ethical concerns or dynamics highlights a research approach that is less concerned with one size fits all models and more with learning from work-in-progress experiments of resilience building. The hope is that this learning can be re-articulated elsewhere in communities where very different sets of circumstances and ecology-economy relations exist and where building a more resilient neighbourhood takes a different form. Habitat maintenance, diversity and co-design matter as ethical strategies, but how they get worked up in situ requires researchers to embrace an openness to surprise.

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ⁱ The Anthropocene is the name given to the newest geological era that follows the Holocene and marks the beginning of human activity as a major shaper of earth systems (Crutzen and Stoermer, 2000; Gibson, Rose and Fincher, 2015). Steffan et al., (2015) argue for resituating the beginning of the Anthropocene from the beginning of industrialization in 1750 to 1950 when “The Great Acceleration” of economic growth and ecological interference took off. The term *Anthropocene* has become increasingly contested, some preferring *Captialocene* or *Plantationocene* (Haraway, 2015). Haraway argues for the Anthropocene as a boundary event, thus opening up the question of what might emerge (other than dithering) to characterize the era we are entering (p. 161).

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- ⁱⁱ As developed by Deleuze and Guattari in *A Thousand Plateaus*. Thanks to Ethan Miller for these insights and clarifications (pers. Comm. 20/02/2016).
- ⁱⁱⁱ The move to recognise ‘the economy’ as an historical, discursive creation with real effects, rather than an objective ontological category (Mitchell, 1998, 2008; Callon, 2007), invites further interrogation of the inclusions and exclusions that constitute modern economic knowledge.
- ^{iv} The Next System Project convenes essays on many of these alternative economy approaches. See <http://thenextsystem.org/new-systems-possibilities-and-proposals/>
- ^v Jacobs’ discussion of ecologically inspired regional development has been applied at the scale of localities or neighbourhoods by Gibson, Cahill and McKay (2010).
- ^{vi} This formulation follows that of philosopher Jean Luc Nancy (2000) but extends his thinking from the being-in-common of humans to the more than human.
- ^{vii} Other matters of concern where this co-learning is taking place include the rights of food producing animals, soil health, and disease management.
- ^{viii} Ms Sengkeang, a resident of Koh Paen Island reports that the bridge has been built every year since the fall of the Pol Pot regime 40 years ago. Mr. Kroch Sokheng, also a resident of Koh Paen Island, remembers his grandmother saying it was being built annually when she was born, which places it as a 100 year old practice. Our thanks to Isaac Lyne and Heng Seanghath for gathering this information and for sharing their knowledge of the bamboo bridge.
- ^{ix} Michelle Bastian argues that appreciating other (non-linear) temporalities is an important part of reworking narrow western conceptions of agency and allowing for nature to be re-written “as a powerful creative actor” (2009, p.116).
- ^x Thanks are due to Stephen Cairns for discussions over the years about the development of Batam and access to the evolving Tropical Town project. Observations included in this discussion also date from field work conducted by Katherine Gibson in December 2000.
- ^{xi} See the Tropical Town Project <http://www.fcl.ethz.ch/project/tropical-town/>. While Tropical Town is similar to the Chilean architect Alejandro Aravena’s well publicized incremental housing project in Quinta Monroy (see Aravena and Iacobelli, 2013; Vale et al., 2014), there are some important differences. For example, Tropical Town explicitly designs for an integration of diverse livelihood functions into the residential neighbourhood.
- ^{xii} This is a key objective of the Australian Research Council Discovery Project “Strengthening economic resilience in Monsoon Asia” DP150102285 which has supported research for this paper.