

## Does sustainability emerge from the relationship between scales?

### Slide 1 – title slide

- This talk emerged out of the process of writing a chapter on sustainability in a 1<sup>st</sup> year textbook that has been published by Cambridge Uni Press in July 2012.
- Broadly, there are two main ways that researchers have approached sustainability – practice focused or theoretical approach.
- This paper takes a theoretical approach but then considers the implications for practice

This paper uses systems, emergence and scale to explore sustainability and focuses in particular on the relationships between scales that we think may be critical for moving the theoretical discussion and practice towards the goal of sustainability.

### Slide 2 –Framing theory

- **SYSTEMS**
- This paper takes a systems approach and thus argues that sustainability is a quality of the system
- When we talk of a system it can be as large or small as you desire, it has a boundary, contains elements that interact – e.g., the human body, a political system, but even something abstract, like an emotion
- **EMERGENCE**
- Patterns, behaviours, and properties may emerge from interactions within a system.
- Key elements of emergence theory that we draw upon here are that:
- Interactions in a system between local actors are happening at the ‘micro scale’. These may be direct or indirect actions.
- Observations that detect patterns need to be made at the scale above the level where actions are directly impacting on their environment. Emergent patterns are identified at the ‘macro scale’.
- e.g., (scientists monitor water quality at the macro scale, while farmers and residents might act to improve the quality of water by reducing phosphate use in fertiliser and laundry detergents)
- A further important feature we think is helpful from emergence theory is that pattern emerges from local actions without the orchestration of a leader.
- **SCALE**
- However, changes at the macro scale affect the micro scale and vice versa. And here we are talking about both temporal as well as spatial scales
- single actors can effect major changes
- So: Micro is equivalent in this talk to thinking about actions that occur at the bottom and have **affects upwards**, and are detected at the macro scale.
- While macro is the reverse - actions or policy that are implemented at the macro scale that have **affects downwards**, with those at the local level experiencing their impacts.
- As can be seen with the example of the scientists monitoring water quality and the farmers change in fertiliser use mentioned earlier.
- We explored this line of reasoning in more detail through a series of working definitions in a chapter in the new textbook ...(flyers available later if interested...)
- We argue that the quality of sustainability emerges from systems that are nourishing and that persist, and give a final working definition of...

### Slide 3 – Definition of sustainability

- By **Nourishing** we mean - The active support of a system by its environment and the elements within it so that it may persist
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- This definition can be applied equally well to natural and human systems. We aim to give examples from both, and focus particularly on human decision-making systems in the talk, as the site of change.
- For the remainder of this talk we'd like to focus on the theoretical space between the micro and macro where we think new questions and thinking might illuminate new paths forward

#### **Slide 4 - space between micro and macro scales**

- The structure of the space between the micro and macro scales is critical in the processes leading to sustainability, as is the nature of the relationships between these scales.
- The space between micro and macro is difficult to describe.
- It is not static
- The size of the gap between the micro and macro may vary depending on the systems. It may be that the same person is acting at both levels, just changing perspective slightly, or it may be that there is no overlap between who is acting at the two levels.
- To explore the space and the relationships between scales in this talk, we will be moving through a series of questions which we think act as a helpful tool for reflecting upon the ability of our decision making structures to support sustainability: - How well do the micro and macro scales know and understand each other? How well do they communicate and feedback to each other, and is communication bi-directional?. And how does the structure of the space contribute to communication, nourishment and understanding?
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#### **Slide 5 – Knowing the other scale**

- Different cultures operate at different scales. People operating at one scale can often feel that those at another scale are alien and mysterious, and that they cannot gain access to these different scales.
- It becomes a foreign space in which the person feels uncomfortable, lost, disoriented, and resistant.
- The sense of alienation from the scale above and the scale below can prevent the flow of information that is needed for good decision making, and attempts to work towards sustainability.

**Action to address the issue:** Different scales need to know each other. We need to understand the scales above and below. We have to be aware of this tendency to develop different cultures at different scales, and establish structures, habits or values to prevent it from creating barriers to understanding. There are many options; for example: ensuring all participants in decision making have experiences at different scales to develop sympathies, understandings, and appreciations; and considering the choices of language, venue and framing of interactions.

- **Norton (2002)** has pointed out that decision making across scales is the fundamental area for mismatch. He suggests there is a need to work at the space between the scales to develop theory and practice, rather than acting at one or another scale (Norton). Norton describes this as a pragmatist approach – with continual reworking of the theory and practice to inform each other.

#### **Slide 6 - Communication and feedback between micro and macro**

language tends to be different at the micro and macro scale – e.g. the language of the farmer and the scientist or policy maker. They use different terms, as they are identifying boundaries around different things. Interpretation between scales is difficult, and problematic. Meta-language develops going up the scales. Going down scales the meta-language needs to be transformed into an applied context. For example, the farmer at the local has to interpret the patterns about the whole river system, and those monitoring at the river have to interpret and generalize the many individual data

points. These mismatches make understanding, exchange and communication challenging and we would suggest may obstruct our attempts to move towards sustainability. Information gets stuck at the different levels, and it becomes harder for the iterative process to be alive and meaningful rather than stagnant or formulaic, or perhaps blind to what is happening at each scale. It is very risky, and significant, because it colours how we interpret reality.

- **Norton (2002)** similarly bemoans the lack of shared language that connects the disciplines that aim to communicate and work towards addressing the challenges around sustainability.
- **Action:** He advocates that we should come from a position of problem solving with a shared language that evolves from the process, in the place between scales. So that theory and language are reflected in the process of solving problems, with participants collaborating with the best solution in mind, rather than from positions of competing interests.
- open and vigorous communication with a tolerance of diversity of views and active listening would support better understanding and movement of ideas between scales, and the emergence of well-adapted theory.
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### Slide 7 – Structure of the space between scales

- The **structure** through which information is shared is as much a part of shaping the outcome as the actors that interact, whether directly or indirectly.
- E.g., ; Termites will add to a pile of soil grains they encounter because the grain has been dropped there by another termite, there is turbulence in the air and a chemical signal from the termite that has come before. Over time construction of walls results and turbulence of airflow is minimised. (Miller book – Smart Swarm) Termites are responding to their environment and the structure of their mound to leave signals to other termites to add to the wall. Communication is completed indirectly resulting in an outcome that betters the termite colony as a whole. But they do not have a sense of the whole mound or the pattern they are creating.
- Structures and process define, bound and restrict the ability to flexibly and adaptively respond to new ideas and innovations
- For example, once something gets established as an important macro goal, it affects all things that precede to respond to this goal. For example, in education – university entrance scores determine decisions through earlier years, even before people have their babies – what suburb live in to get into best schools.
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- The structures of our communication channels are associated with power structures and impact upon the potential for innovation and freedom. For e.g., more formalised channels of communication like policy documents being transferred between parties, give a very different message from body language.
- It is therefore critical that we examine the structure through which humans communicate between scales to facilitate rather than obstruct, and to encourage reasoned decisions, rather than inappropriate responses when the communication through the channel is poor - like in mob behaviour (Peter Miller – Smart Swarm). Or, bureaucratic obfuscation through extensive red tape and legal language.
- Structures which encourage understanding and communication between the macro and micro scales, in both directions are the kind that are more likely to lead to and support sustainability
- Making the boundary less defined seems to be an important way of bringing the scales closer together, so the scale change is less noticeable

## **Slide 8 – Processes to support emergence**

There are two processes to consider as we engage with this model of sustainability: those that are required to support emergence, and those that are required to ensure that the emergence leads to sustainability.

- Emergence is more likely to occur in a system with greater diversity and complexity where there is more interacting and sharing of information and minimal outside control.
- The outcomes from such interactions are unknown and may be perceived as chaotic and risky (Miller 2010).
- However, it is through risk taking that we discover new and unexpected outcomes or pathways.
- That means we need to:
  - create a space for risk taking
  - reduce our perceived need for our own security
  - Maintain diversity and complexity
  - Reduce control from above and encourage decision making that is based on the local information and environment (Johnson 2003)
- An example of creating this space is the legislated zone in Arizona where they are trialling self sufficient 'earthships' that are not connected to the reticulated systems in any way.
- A more abstract example, might be Wikipedia – a collectively edited encyclopedia of knowledge.
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## **Slide 9 – Processes that ensure emergence leads to sustainability**

Because emergence can lead to wonderful insights and disastrous outcomes (e.g. digital viruses that adapt and cause damage to our computers, or online bullying), how do we ensure that the emergent patterns we try to encourage lead to sustainability?

We think we need to;

Nourish the system and its environment, so engage with awareness both in our direct impacts within a system, and in our impacts upon the supporting environment of that system.

Develop frameworks and indicators to determine whether nourishment can be detected at a macro scale.

Maintain an iterative process of nourishment through understanding, communication and review of the structures, between the macro and the micro, (although it may be in a single direction for a period of time (such as been a child and their parent).

Develop decisions and policy through interactions at the micro level, but always informed by monitoring and feedback from a macro level whose aim is to identify where the system and its environment are or are not nourishing or being nourished.

## **Slide 10 – what is needed to lead to sustainability**

- In summary – Our explorations to date suggest
- Systems and emergence have much to offer
- What is needed to support the emergence of sustainability?
- Efforts at each scale to get to know the scales above and below

- Attention to the communication channels between the micro and macro scales  
Monitoring structures, tools and processes to continually check whether the environment is able to continue to nourish the system, and whether the system is able to continue to nourish the environment.
- Decision making structures and processes that avoid power being either from the top down or the bottom up, but concentrate upon maintaining understanding and open communication between the scales.
- Language between disciplines that can shift to allow clearer communication between micro and macro scales
- Diversity and complexity Spaces for risk taking
- The tolerance of a greater degrees of vulnerability in terms of our interdependency with our social and broader environments at the micro scale
- In our actions at the micro scale we must be thinking how we can be nourishing to the systems we are part of.

### **Slide 11 – what’s next for working towards sustainability**

- Looking forward to investigating indigenous culture. The Australian indigenous system required communication that is prescribed by cultural requirements to maintain the responsibilities of living with the environment and creating dependence on the collective whole, ensuring there was duplication in knowledge carriers, having a command ethic to share and trade knowledge. In terms of structures that facilitate better communication between the scales – these are models we can consider.
  - Considerations of the role of command and character ethics in ‘flattening’ the space between scales of decision making. Laws and financial incentives are unlikely to have the breadth or depth of impact that social codes that come from establishing command and character ethics are likely to have.
  - Development of a framework is required that is responsive to whether nourishment can be detected at a macro scale.
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- **Hazards of emergence**
  - Humans and other species can be misled when exposed to large numbers of conspecifics – (fish lead towards a predator if many other fish going in the same direction, humans lead to mob behaviours without questioning the flow on affects (music selection) or morality (removing mattress from roadway).
  - Miller suggests stronger laws and financial incentives to shape humans away from inappropriate mob like responses. We think stronger command and character ethics (a feature common in the 1950s and before, but greatly diminished in the last 50+ years) would assist humans to make better decision with greater ease in contexts where it becomes less certain. Laws and financial incentives are unlikely to have the breadth or depth of impact that social codes that come from establishing command and character ethics are likely to have. For eg...? Church coming on board to galvanise attitude to caring for earth in name of god (command ethic) resulted in X change? While adding law about ?? has had Y result?? Command and character ethics should be developed through appropriate democratic processes. Indeed, if you have the right sort of process, they may not lead to system wide sustainability. Education is useful here to assist the people making decisions, and will presumably lead to better decisions. Need counterbalances to competition, like temperance and honesty. See (Frekany and Whyte 2012) or (Cafaro 2001) We cannot expect perfection, we need to allow for the fact that these feelings are not straight forward, simple things. We

are waiver creatures, attracted to a little grit and riskiness. When ethics become entrenched in cultural norms can be repressing, and for women in particular. Is there data to support that virtues have positive impact on the environment – was the environment cared for more when temperance, honesty etc were more dominantly held and acted upon? Perhaps it is determined by the boundary over which the virtue must be applied to – to what and over what extent do my ethics need to apply?

- It is not just the physical structure through which information is shared, but also the language that we use in sharing knowledge. ...Kate I think you are better able to speak/write to this, as you've read the work by Norton (2005)...
- Another insight that emergence theory brings to thinking about systems, scale and sustainability, is the openness of response, some call adaptiveness and others describe it as risk taking
- Giving local actors more space to respond to their environment with fewer controls may provide the freedom to create new, unexpected and helpful responses. It may also produce mistakes, damage and greater problems.
- Trial and error through history can give us many ideas about what has and has not worked to facilitate communication – e.g., political structures at many scales (democratic??), we have seen great changes in how equitable societies can be if they are more democratic, out of the democratic process greater diversity and more equal distribution of wealth can occur, as compared with other systems of decision making, e.g., when power is not shared. The Australian indigenous system required communication that is prescribed by cultural requirements to maintain the responsibilities of living with the environment. In terms of structures that facilitate better communication between the scales – these are models we can consider. Can draw upon personal experience – communication in families, in work places...want to be able to identify key ingredients...could look at business literature
- One possibility that comes from Australian indigenous cultural practices is to - Flatten the space (removing or redistributing micro and macro) – creating dependence on the collective whole, ensuring there is duplication in knowledge carriers, having a command ethic to share and trade knowledge

The democratic process is one structure that has developed to assist communication between macro and micro scales. It can facilitate a diversity of voices and views to be expressed and knowledge shared. Through this greater diversity, more ideas, options, solutions can arise.

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### **Abstract:**

Sustainability has become a 'catch all' term that has been attached to products, processes, companies and movements, but may be losing any relevance to society in the process. As Norton (2005) points out, the conceptual and linguistic framework within which sustainability is understood is important. We apply systems thinking and emergence theory and take into account the importance of scale to present an integrated way of thinking about sustainability that identifies a point of interaction where policy and discussion might be better directed.

We consider sustainability as an emergent quality of a system that occurs when the interactions within the system and between the system and its environment are nourishing. This conception is useful for three key reasons: it indicates the kinds of relationships individual humans and human groups need to be engaged in at the micro level maybe more detail on this; it provides a guide for the monitoring functions that might be needed at a macro level to recognise emergent patterns more on the nature of the monitoring; and most importantly, it places emphasis ultimately neither upon the micro or the macro scales but upon the relationship between these two. By drawing

attention to the interaction between the two we seek to stimulate discussion on how these best can speak to each other and facilitate the emergence of sustainability.

Systems thinking illuminates two key aspects that help in thinking about sustainability: boundaries and relationships. Thinking of sustainability as a quality of a system highlights the boundaries we draw, the negotiation we undertake between reality and our efforts to describe and understand it, as well as the interactions between and within systems that need to be nourishing and nourished. It is through these multitudes of nourishing interactions that we believe sustainability emerges.

Nourishment in this context is the active support of a system by its environment and the elements within it so that it may persist, like the active role of muscles in holding a pose. Emergence theory tells us that it is through interactions at a micro scale, between elements of a system and without control from above, that emergent properties may occur. Emergence however, can only be detected at the scale above where the individual interactions are occurring. Hence, the relationship between sub and super systems is a critical focal point for thinking about sustainability.

There are two processes to consider as we engage with this model of sustainability: those that are required to support emergence, and those that are required to ensure that the emergence leads to sustainability. Emergence is fostered by complexity, risk, and reduced control from above. For sustainability to emerge, the interactions between and within systems need to be nourishing, and some form of feedback or monitoring is needed to assess whether this is being achieved.

Emergence is more likely to occur in a system with greater diversity and complexity where there is more interacting and sharing of information and minimal outside control. The outcomes from such interactions are unknown and may be perceived as chaotic and risky (Miller 2010). However, it is through risk taking that we discover new and unexpected outcomes or pathways. Some recent examples in science show how, by trying experiments that were expected to fail new discoveries that challenged accepted theories were discovered. Examples include Nobel gases that react despite all earlier predictions (Hargittai 2009), and spontaneous reactions that go in both directions despite the second law of thermodynamics predicting that they should only go in one (Tabony 2006). If we reduce our desire for security we create the freedom for alternatives, including sustainability, to emerge from an evolution of interactions. We judge if an emergent property is sustainable or not depending on whether the risks are beneficial or harmful. Consequently a closer look at the human decision making system is a critical part of this model. More on risk and uncertainty

In human decision-making systems there is a similar need for diverse contributors and opportunities for risk to facilitate the possibility of emergent outcomes. Emergence is more likely when each individual makes decisions based on the information they gather about their local environment and relative changes (Johnson 2003). We think looking for some measure of nourishment will be one way to establish whether sustainability is an emergent outcome. Nourishment will primarily occur at the micro level but those doing the nourishing and within the system, are unlikely to be able to judge whether their actions are resulting in sustainable outcomes. Monitoring at the macro scale is where sustainability is likely to be detected and feedback to the micro scale will facilitate whether current practices continue or are changed. So, to foster sustainability, not only do we need room for risk taking but a framework that is responsive to whether nourishment can be detected at a macro scale.

There appears to be a tension between what is needed at the micro scale and the role of the macro scale. The micro scale needs risk and diversity for the possibility of sustainability to emerge. The macro scale is needed to detect the emergent patterns and provide feedback, but if it begins to play a directive role, emergence may be stifled no directive role for macro monitoring. Emergence theory suggests that the best kind of relationship between the micro and macro levels is one where the macro level merely monitors and provides information, so that individuals and groups at the micro level can be informed but autonomous in their actions. This is risky and in conflict with current practices. The act of monitoring and feedback is important, but where should the decision making

take place? How to manage and care for this interactive space between the scales is the challenge we are posing to the sustainability community. Put in that question.

For the emergence to focus towards sustainability the conversation between micro and macro must remain open and vigorous to both enable risk taking and ensure that the risks are targeted towards nourishment. Add in This paper will look further at this space and pose the questions that we think need further exploration if this model is accepted as a possible path towards emerging sustainability.

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