Strengthening Resilience by thinking of Knowledge as a Nutrient connecting the local person to global thinking: The case of Social Technology/*Tecnologia Social*

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INTRODUCTION

In April 2009, we held an international conference at York University, Toronto, Canada. *Ecojustice: How Will Disenfranchised Peoples Adapt to Climate Change*? (Dubreuil 2009, Klenk et al. 2010). A diverse group of activists and academics that work with NGOs from the Global South and North came together to discuss the challenges of adapting to climate change. Most significantly, the Canadian perspective was entirely represented by First Nations and Inuit, which was, and continues to be unusual at conferences of this kind, held in the southern part of Canada. While we are not aware of literature tracking the presence of indigenous peoples on conference panels, there is research giving data on the (under)representation of minorities and women at Social Sciences and Science, Technology, Engineering and Mathematics (STEM) conferences (e.g. Killian and Hardy 1998, Eisen 2012, Schroeder et al. 2013).

Our conference was very interdisciplinary (Dubreuil 2009, Klenk et al. 2010). It triggered and reinforced a cascade of diverse activities and research that has since, followed many intertwining pathways that diverged, crossed and reconnected over 5 years. Several key factors emerged from both the field experiences shared by conference participants, and subsequent research, indicating that the adaptive capacity of disenfranchised peoples in Brazil, India, South Africa, Canada and beyond, is enhanced by diverse kinds of shared knowledge. This shared knowledge essentially creates new kinds of insights and ideas, some of which are transdisciplinary (*sensu* Lélé and Norgaard 2005) in nature (Klenk et al. 2010) e.g. prompting a STEM academic (Bazely), familiar, only, with IPCC (Intergovernmental Panel on Climate Change) work on climate change,

to obtain observer status for York University at UNFCCC (United Nations Framework Convention on Climate Change), which is the policy-political arena for climate change.

In this chapter, we describe the *Knowledge as a Nutrient* framework that emerged from these conversations. We describe how it relates to the *Tecnologia Social* policy approach to sustainability, developed in Brazil (Dagnino et al. 2004, Fundação Banco do Brasil 2009, Costa 2013), which is not well known in the anglophone world. *Tecnologia Social* was both inspired by and rooted in Paulo Freire's pedagogical thinking (2000, Klix 2014). We show how this framework has the potential to increase community resilience and adaptive capacity, not only for communities that face and must adapt to climate change but for all communities in the throes of complex social, ecological, economic and political transitions.

Civil Society at the UN: Observer status for York University at UNFCCC

The UNFCCC allows civil society, including universities, to apply for observer status at its various Conferences of the Parties (COPs). One Ecojustice conference suggestion was that IRIS (Institute for Research and Innovation in Sustainability), York University, seek observer status, as a means of allowing diverse members of the York community: students, staff and faculty, to attend COP 15 (Klenk et al. 2010, UNFCCC 2014). Since Copenhagen 2009, many student, staff and faculty delegates have attended annual UNFCCC meetings in Cancún (Mexico), Durban (South Africa), Doha (Qatar) and Warsaw (Poland). These and other explicitly interdisciplinary international meetings such as *Climate, Sustainability & Development in Semi-arid regions: ICID+18*, in Fortaleza, Brazil (IISD 2010), and *Adaptation Futures: Third International Climate*

Change Conference, also in Fortaleza (UNEP 2014), have been spaces for the further interdisciplinary connections and conversations, that have informed our research (e.g. Perkins 2013, Bazely 2014).

Bringing an Ecological Perspective to the Transdisciplinary Table

Our ongoing interdisciplinary conversations and collaborations have led us to conceptualize *Knowledge as a Nutrient*. In popular Biology Department seminar presentation, "Ecologists (and scientists, in general) – why don't we get more respect?" Dawn Bazely outlines what ecologists can bring to the interdisciplinary table (Figure 1).

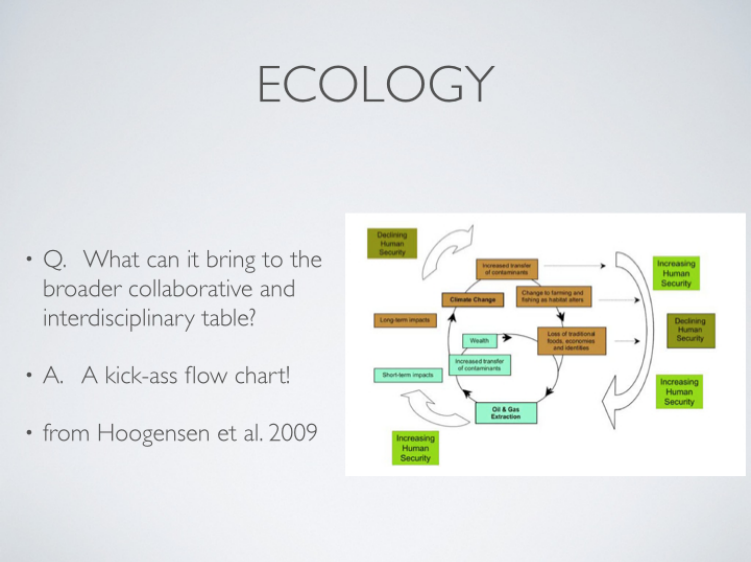

Figure 1. Slide from Bazely seminar, given at 4 biology departments, 2011-2014.

Questions about how nutrient cycles and networks drive ecosystem functioning, and influence stability, diversity and resilience have been asked in ecology for decades (e.g. Holling 1973, Gunderson 2000, Chapin et al. 2000, Elmqvist et al. 2003). Additionally, the adoption of the ecological concept of resilience in the social sciences,

and its evolution (reviewed by Janssen et al. 2006), has also led to its uptake in the climate adaptation field (Adger 2006)

When we reflected about how ecological theory may further contribute to solutions for diverse sustainability issues, including that of how human communities (particularly those with disenfranchised peoples), may be empowered as they are forced to adapt to climate change, we were struck by the many references to the importance of knowledge sharing (e.g. Klenk et al. 2010). This led us to think about how different kinds of climate adaptation and mitigation might link with ecology and to ask "if energy, nitrogen, phosphorus, carbon etc. are so important in determining ecosystem structure and function, why not also think of *knowledge* in the same way?" Too little of it will limit the diversity of efforts aimed at finding ways of adapting to ecological and environmental stressors. More of it should increase the diversity of options at the individual, community, national and international scales.

We present the *Knowledge as a Nutrient* concept in the standard ecology format of nutrient flow charts that are found in all biology text books (Figure 2). A basic chart has been adapted to illustrate that, through increased flows and connections, indicated by the size and strength of arrows, more knowledge may be brought into the public sphere, and also be prevented from disappearing. Scientists and academics in general, commonly point to barriers to knowledge mobilization and the consequence for policy and politics (e.g. Bazely et al. 2014).

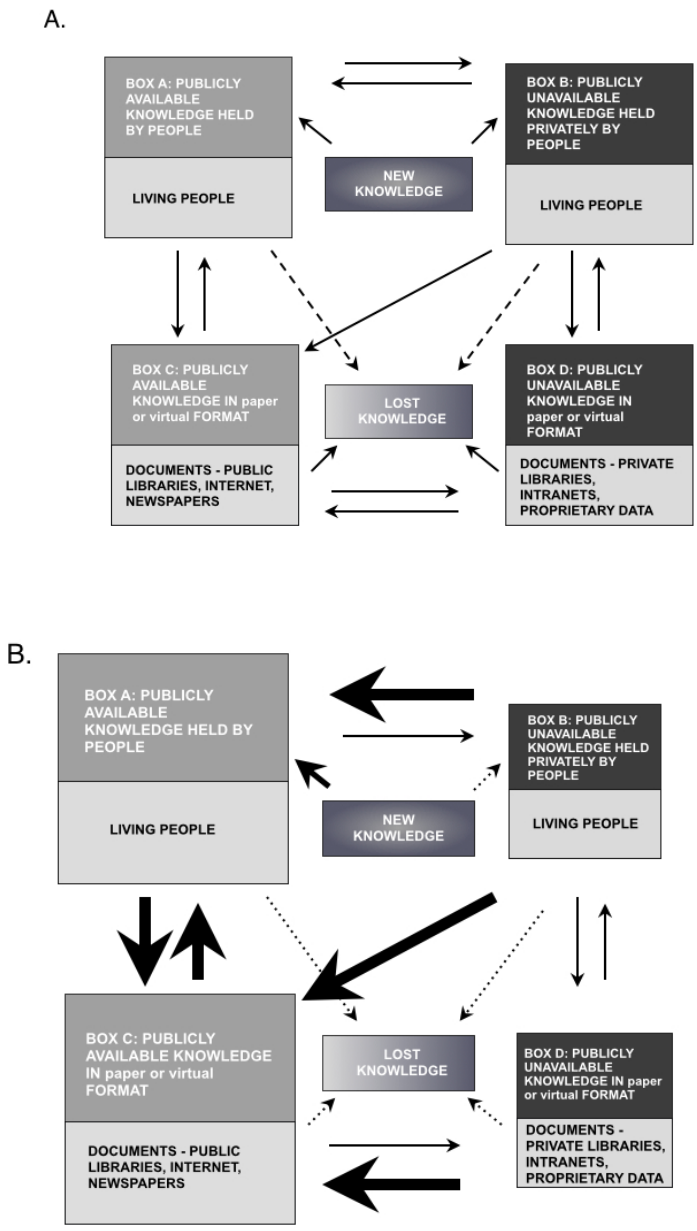

Figure 2. A. Adapted generalized nutrient cycle chart found in undergraduate biology textbooks (e.g. Campbell et al. 2008). We considered knowledge to be most similar to energy influxes from the sun. The boxes on the left represent the biotic or living components of the ecosystem. The boxes at right represent the abiotic components of ecosystems. The two boxes in the middle, represent new knowledge, similar to incoming solar radiation, which can also be lost from the earth, when it is re-radiated, and not captured in photosynthesis.

B. Through this increased knowledge flow, resilience and capacity for adaptation should increase. Also, the flow and circulation of knowledge will be strengthened by increased network connections and connectivity. Underlying assumptions: 1. That all relevant knowledge systems are included in decision-making (which significantly differs

from, but is related to the principle of including all affected in decision-making);
2. Knowledge storage must be reliable and be a function of knowledge mobilization, i.e., not a barrier to knowledge mobilization.

We are not the first people to conceptualize knowledge as an ecological concept, but we are the first, as far as we know, to conceptualize knowledge as a nutrient in the ecosystem. Other authors' discussions of knowledge ecosystems and its movement are conceptually very different from ours. Michaels et al. (2006) consider the steps that transform data to knowledge. Their concept is complementary to ours, and speaks to the finer scale of process. In contrast, Papaioannou et al.'s (2009) critical evaluation of the legitimacy of the knowledge ecology concept and the theory of the innovation ecosystem, is less complementary. They considered it as a reductionstic STEM-grounded approach, and evaluated its validity, ultimately concluding that it has substantial theoretical issues, because it is not appropriately grounded in historical processes of the social division of labour. Papaioannou et al. (2009) defined ecology as having a different meaning from ecosystem, which is, indeed, the case. However, their distinction is highly problematic, because it conflates the different meanings with different scales of approach taken in ecological research: from the individual to the population, to the community and the ecosystem. Papaioannou et al.'s (2009) definition of ecology, which is that it poses questions about an *individual*'s interactions with the environment, is, in fact, only one area of ecology. Ecology usually asks questions about how organisms interact with their environment at multiple spatial and temporal scales, simultaneously. Furthermore, in contrast to Papaioannou et al.'s (2009) assertion regarding history and context: they are very important in ecology: e.g. evolution, legacy effects, paleolimnology.

Thus, as with our consideration of the historical and current usages and definitions of the terms Social Technology/*Tecnologia Social*, it is clear, that in the interdisciplinary space, it is vital to explore diverse meanings of language and terms used, in a process that engages diverse scholars and many voices.

The *Tecnologia Social* approach: *Knowledge as a Nutrient* in action

The term, *Social Technology,* has a history of usage in recent anglophone literature that is startlingly different from what its translation, *Tecnologia Social*, means in Brazil (Dagnino 1976, Dagnino et al. 2004, Fundação Banco do Brasil 2009, Costa 2013). We believe that it is worthwhile to explore the different use and meaning of this term, in order to increase awareness of the fully realized Brazilian *social technology* framework, for researchers in sustainability, human development, and climate change adaptation and resilience. We avoid the longer history of the *Social Technology* concept, which dates back several centuries, and highlight the current significance of this concept for adaptation and development efforts in Brazil. Furthermore, we note that some Brazilian-Portuguese speakers may not be aware of the anglophone political and historical connotations that arise in the translation of *Tecnologia Social*: in progressive Anglophone circles, there remains vestigial resistance to the use of the term, for reasons summarized here. Therefore, we discuss both the Brazilian and (various) English meanings of the concept.

What is Tecnologia Social *in Brazil*?

- *Social Technology* is considered to be every product, method, technique or process designed to solve some kind of social problem and meet the principles of simplicity, low cost, easy applicability and proven social impact.
- Social technologies can be born within a community or academic environment. They can also combine popular knowledge and technical-scientific knowledge. Essentially, the effectiveness of these technologies multiplies, allowing development to scale-up. (Dagnino et al. 2004, Fundação Banco do Brasil 2009, Costa 2013).

Social technologies are key to economic, social and environmental sustainability. The four dimensions are: understanding science and technology; participation, citizenship and democracy; education; and social relevance. Social technologies facilitate inclusion and improve quality of life (Dagnino et al. 2004, Costa 2013). The *Tecnologia Social* framework addresses the needs of the most vulnerable communities that are most intensely affected by climate change (J. Malheiros pers. comm.). Local communities identify their needs and embark on an organized, collaborative, knowledge-sharing process, to develop the appropriate social technologies, e.g. those needed for climate change adaptation.

Not the same thing: Twentieth Century usage of the term in the anglophone world

Most recently, the term *social technology* has been associated with internet-based social networking systems. Research often discusses how and why businesses should interact with YouTube, Twitter and Facebook (Li and Bernoff 2008), or the usefulness of podcasting as a *social technology* for blended learning (Lau et al. 2010). Rice (2005) documented the increasing research into internet-related topics, and Kraut et al. (1998) examined the downside of this *social technology*; namely, how increased internet usage increased loneliness and depression.

To track the usage of the term in anglophone 20th century academic literature, we conducted a bibliometric search of peer-reviewed journal articles in all accessible databases of the ISI Web of Science, using "social technology" in the topic area. This returned a total of 104 papers. Prior to 1967, when reviews of the book *Social Technology* (Helmer et al. 1966) first appeared in the peer-reviewed literature, there was a total of 5 papers employing the term. None of them have been cited in academic journals. The first paper was published in 1901 (Henderson 1901), followed by four in the next 66 years (Henderson 1912, Bushnell 1936, Harding, Giles 1953).

Helmer et al. (1966) envisioned *social technology* as a practical means of bringing the social sciences closer to the "hard" (natural and physical) sciences (Aligica and Herritt 2009). Echoing Condorcet's 18th century view of the social sciences, Helmer et al. (1966) viewed the imprecision of social sciences with respect to their apparent lack of exactitude, and their frequent failure to produce reproducible results, as not being so very different from the hard sciences. When a scientist conducts research outside of controlled laboratory conditions, the results often become much messier and less clear cut. Social technologies are intended to be the practical applications of lessons learned in the social

sciences. They can help humanity to deal with emerging and future issues (Aligica and Herritt 2009), such as today's *wicked problems* of climate change and poverty (Durant and Legge 2006).

Social Technology (Helmer et al. 1966) aims to shift methodological approaches in the social sciences and implement the insights through operational model building and predictive exercises such as the Delphi method, which relies on expert opinion (Michael 1967). Expert-based predictive methodologies, immediately differentiate the Helmer et al. (1996) concept of *social technology* from the Brazilian one, which values bottom-up participatory methodologies and local knowledge. Even if Helmer's version of *social technology* aims to create "a more humane world for tomorrow" (Michael 1967), it appears to be imposed from the top-down.

Since Helmer et al. (1966), the concept of *social technology* has been used by anglophone researchers in diverse ways. The 96 articles published from 1970 to 2010 span 56 subject areas, including sociology (16 articles), management (10), business (7), economics (7), planning and development (7) psychology (7), multidisciplinary topics (7), and history and philosophy of science (6). While the term cuts across this very broad range of subject areas, its usage is rare within most of them, generally occurring only once or twice. Some of the 96 articles do not provide a specific definition of *social technology*, and use the term only once or twice, either in passing or in the title (e.g. Bastalich 2009).

Whether *social technology* is developed and implemented by university researchers or governments, there is often a suspicion of activities occurring under this rubric (e.g. Suedfeld's review (1973) of Varela's book, *Psychological Solutions to Social Problems:*

An Introduction to Social Technology (1971)). This may relate, in part, to the RAND Corporation, where Helmer worked for 22 years (Aligica and Herritt 2009), being involved in secret research for the US military (Campbell 2004). Another reason for this caution is related to the strong association between the terms *technology* and *engineering*. For many English speakers, *social engineering* calls eugenics to mind, along with an instinctive negative reaction (Schwartz 1992, Koch 2006, Gerodetti 2006).

Is there an overlap between the Brazilian Tecnologia Social *and a more progressive anglophone understanding of* social technology*?*

A number of English-language articles align themselves to varying degrees with the Brazilian perspective of *social technology*, with respect to enhancing societal wellbeing (Bloom et al. 2001, Szto 2007). Elsewhere, critical links have been made between *social technology* and *human rights* (Knopff 1989), the role of universities as institutions of *social technology* (Fuller 2003), and the often-overlooked contribution of human skills to wealth creation (Patel 1992).

A much earlier paper, written after the Great Depression, overlaps strongly with the Brazilian *Tecnologia Social*. Indeed, Bushnell (1936) wrote that "the challenge comes home to the sociologists today … the social technology required by the present social emergency calls for a comprehensive social-planning" that will address a slew of issues that resonate today:

"Vast technological unemployment; disgraceful housing for half our population; sweeping foreclosures of home mortgages; glaring contrasts of poverty and wealth; general insecurity; the paradox of scarcity in the presence of possible abundance;

business waiting for markets while withholding from labor adequate buying power; the holding back of inventions; the stinting of education, recreation and art; the waste and maldistribution of resources… all indicate a lack of planned cooperative control that cannot long continue without general, public disaster." (p.423)

However, recent anglophone usage of *social technology* is generally not in alignment with the comprehensive Brazilian framework speaking to democracy, activism, and collective human ingenuity (Dagnino 1976, Dagnino et al. 2004). *Tecnologia Social* is intended to provide a practical pathway for building capacity in local communities that will lead to greater empowerment, security, resilience and sustainability (Rodrigues and Barbieri 2008). In addition to goals of eradicating poverty and environmental stewardship, it promotes *deliberative citizenship*, the central aspect of the political dimension of how *Tecnologia Social* views development (Rodrigues and Barbieri 2008). With its local-global dialectic framework (MacLellan 2010), collaborative knowledge production and normative aims of improving social conditions, in our view, Brazilian *Tecnologia Social* merits much greater global attention and debate as an example of connecting diverse community members.

The Open Access Movement, Institutional Repositories and Digital Archives: Where Social Technology and *Tecnologia Social* intersect

How can the *Tecnologia Social* programmes developed and implemented in Brazil, gain wider attention? The internet and *Social Technology* (in its current, predominant anglophone sense) is one obvious means of communicating the experiences and knowledge generated by this inclusive Brazilian approach. As well, the *Knowledge as a*

Nutrient concept adds a useful illustrative dimension to efforts aimed at increase access to diverse kinds of knowledge. From peer-reviewed research to local knowledge, rooted in peoples around the world: the flow charts (Fig. 2) provide an illustration of hypotheses about how accelerating community adaptation to climate change may be achieved through expanded knowledge sharing and publicly available information.

We propose the Open Access movement (Willinsky 2006), spearheaded and supported by university Institutional Repositories (Lynch 2003), as a pathway for accelerating knowledge movement and mobilization. Additionally, putting information, that may normally be difficult to access, into Open Access Institutional Repositories, and tracking its uptake, provides a means of testing these predictions about the empowering effects of access to knowledge.

Institutional Repositories are self-archiving open access collections from a university's entire community (Lynch 2003). For example, the Churchill Community of Knowledge Digital Archive is one of many collections in YorkSpace, York University's Institutional Repository: http://yorkspace.library.yorku.ca/xmlui/handle/10315/8089. It comprises digitized media from the diverse long-term ecological research at Churchill, Manitoba, Canada. The public can easily access such repositories, which provide legal means of circumventing paywalls, via Google searches.

Dawn Bazely and colleagues have built the Open Access Churchill, Manitoba digital archive to document long-term (>40 years) of ecological research, including that on climate change impacts Analytics data tell us that it is widely used (Untershats et al. 2014). We are undertaking research to track this activity more formally. Another example of implementation of *Tecnologia Social* that uses Social Technology, is provided by

Paulo Cunha, a speaker at the 2009 conference (Klenk et al. 2010). He has developed a sustainability education programme based in Rio de Janeiro, Brazil (Cunha 2014). His approach emphasizes the importance of personal reflection & transformation, that is very much rooted in Freire's thinking (2000).

The concept of cryptocurrencies and the development of Bitcoin (Nakamoto 2008, Elias 2011, Reid and Harrigan 2013) is another intersection between Social Technology and *Tecnologial Social*. The recent launch of Permacredits (Hofman 2014, Poupard 2014), is, perhaps, the natural evolution that occurs when business people give up the consumer life-style for one that practices sustainability principles, from the permaculture perspective (Mollison 1988).

Conclusion

The opportunities for reflection, learning and transdisciplinary thinking provided by the inherent inclusivity, interdisciplinarity and collaborative thinking of the sustainability space, led us to develop a new use for standard ecological nutrient pathway models that considers *knowledge as a nutrient* (Fig. 2). Furthermore, our thinking about improved governance, community resilience and adaptation to climate change, resulted in an exploration of the diverse history of terminology usage: specifically, the differences and connections between the Brazilian *Tecnologia Social* approach to sustainability, and the current anglophone definition of *social technology*. In doing this, we now propose that together, they provide mechanisms and processes for testing the *Knowledge as a Nutrient* concept.

Finally, some key points discussed at the *Ecojustice* 2009 conference have emerged as principles that we believe reinforce the *Knowledge as a Nutrient* concept in ways that expand community resilience and adaptive capacity:

- relevant information must be widely and freely available;
- decision processes must be transparent and inclusive of all affected by the decisions;
- communication across disciplines must be recognized as equally important as knowledge-generation within disciplines;
- collaborative, equitable knowledge-sharing processes must be built, fostered, moderated and protected;
- transparency, diversity, and creativity must be paramount virtues;
- tendencies for private profit from knowledge production, barriers to knowledge-sharing, and technology development that benefits a few at the expense of many must be combatted;
- integration of public citizenship, lifelong education, social diversity, communication, and social-political-ecological responsibility must be recognized as the path to development.

The diverse calls for improved knowledge mobilization and transparency, as well as the caveats that characterize discussions about access to knowledge, and the *Tecnologia Socia*l concept, empasize their strong grounding in an ethics framework as well as their transdisciplinarity:

"[Technical models of the effects of climate change] offer us value judgements obscured by a cloak of objective detachment, when what is needed for climate justice is

value transparency, clear attention to all the impacts, and a science that cultivates a sentiment of responsibility and care instead of objective detachment". (Tuana 2013, p. 24).

"Developing inclusive, deliberative processes is the fastest, most effective way to address climate change, because it draws on local, place-based knowledge and identifies the needs of people most affected, thereby reducing inefficiencies that might result from top-down approaches". (McAllister et al. 2014, p. 10).

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