Bridging Practices, Institutions, and Landscapes through a Scale-based Approach for Research and Practice: A Case Study of a Business Association in South India

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Abstract

There is a need for enterprises to incorporate information on the environment into decision making and to take action on ecological restoration. Within academia, a comprehensive understanding of the impacts on how business can serve sustainability transformation is still lacking as diverging holistic approaches and reductive approaches cloud academic thinking. The authors take a science-policy interface perspective to cover the role of cognitive proximity, matching and coordination of scientific knowledge from diverse stakeholders for effective policy making and implementation. We show through a literature review that temporal and spatial scales, soil and land degradation, institutions and ecosystem, and the role of human behavior and narrative are not adequately emphasized in sustainability research. A scale-based picture, focusing on landscapes, institutions and practices is proposed which can be used to align diverse fields by acting as "bridge" for improved science policy interface and decision making, facilitated through cognitive proximity, matching, and coordination. A case study on a business association from South India is used to demonstrate the scales based approach in practice. A scale-based approach can play a key role in connecting human behaviour, a social science thematic topic, with ecosystems, a natural science thematic topic.

Keywords: sustainability science; corporate responsibility; scale-based approach; ecosystems; business association

1. Introduction

Sustainable development problems are wicked problems (Rittel and Webber, 1972), with solutions dependent on the choice of societal trade-offs (Bardwell, 1991). Scholars have called for a unified field to answer these wicked problems (Kates, 2011; Grantham, 2004). Sustainability science has been enabled by problem-feeding from one discipline to another invoking methodological pluralism (Olsson et al., 2015; Thoren and Persson, 2013). Among social scientists, the ontological focus on methodological individualism is dominant (Chang, 2014). Environmental science, social science, and the humanities have diverse ontologies and frameworks that are incommensurable (Watts, 2017). For example, highly holistic transdisciplinary theories based on unification include socio-technical systems (STS), socio-ecological systems (SES) or planetary boundary (PB) (Mcginnis and Ostrom, 2014; Smith and Stirling, 2010; Steffen et al., 2015; Liu et al., 2015). Spash (2012) cautioned against pluralistic approaches as there is no criterion for combining multiple types of methodological approaches and research positions that could lead to unstructured pluralism.

Research on enterprise-led sustainability is getting popular with the increased role of enterprises in global multilateral governance (Global Policy Forum, 2015). Additionally, the ability to identify and prioritize public issues, while remaining competitive, is crucial for business (Nelson, 2006). Research has mainly considered the impact of social-ecological system on enterprises, not vice-versa (Whiteman et al., 2013). For enterprises and business, disaster risk reduction by enterprises is the need of the hour as enterprises are prone to impacts from floods, droughts, heat waves, etc. (De Bono et al., 2013). The private sector should shift investments and focus on the resilience, adaptability, and health of natural environments (Reynolds and Cranston, 2014). Business has started playing a role in business-protected area partnerships such as restoring tropical forests (Treuer et al., 2017). However, these approaches have not been mainstreamed, or systematized (Opdam and Steingröver, 2018). Less than five percent of all the companies refer to ecological process in their sustainability reports (Bjørn et al., 2017). Therefore, it is necessary for organizational scholars to move beyond building organizational resilience to social-ecological resilience (Whiteman et al., 2004).

In this paper, we take the approach of Schulz and Nicolai (2015) where business practitioners provide inspiration for researchers and other practitioners by covering a case of a business association in India focusing on disaster risk reduction. The research question guiding the investigation is how effective are different agents in creating science-policy interfaces[i] in a case study of a business association in South India. A case study method is used to elucidate a current coordinated approach used in Chennai, Tamil Nadu by a business association – Confederation of Indian Industries-South Region's (CII-SR) Water Alliance

Initiative – for an integrated ecosystem and disaster reduction management strategy. An atypical or extreme case is used capture specific information from an unusually good case. The research takes an action-oriented and solution-oriented research to look for deeper reasons behind a problem and proposes or investigates possible causes and solutions to these deeper reasons (Flyvbjerg, 2006).

The case study on CII-SR Water Alliance initiative is developed and analyzed based on three interviews[ii], secondary data from government sources elaborating on the current institutional design of the project and limitations of the initiative. The research questions are answered through a synthesis study by "combining separate elements or components" to create a "coherent" understanding through combining concepts from different scientific and thematic areas and steered through a literature review (Ritchey, 1991; Sidlauskas et al., 2010; Palmer et al., 2016).

Based on a literature review, various levels of analysis were identified by focusing on "sites of mediation" and "leverage points" between the business and ecosystem to address missed and hidden interactions. The authors don't attribute any hierarchy or multi-level thinking as they impose a "simplistic representation" of reality and the epistemic attributions can be deeply misleading (Eronen and Brooks, n.d.; Potochnik & McGill, 2012).

A multiple scale-based approach is placed as an organizing scheme for sustainability science and ecological economics, and an approach is promoted derived from the various levels of analysis. These scales reflect "leverage points" and "sites of mediation" in a given system of interest. The proposed scale-based approaches are elucidated with help of the introduced case study providing a solution-based study.

A scale-based picture is introduced which can certainly play the role of a more practice-based antidote to holistic and reductionist approaches. According to Cumming et al. (2016) scales are considered as a way to integrate diverse fields. Scales are referred to as "dimensions used to measure and study any phenomenon" which can be spatial, temporal, quantitative, or analytical, by Cash et al. (2006) developing ideas of Gibson et al. (2000). Potochnik & McGill (2012) define scale as the "size of the "ruler" used to measure a system"; the type of observations made is dependent on the choice of scale. They state that scale provides direction, range from small to big, in comparison to levels, which have a hierarchy from low to high, Scale are central in sustainability science as is completely central to defining the research question (Levin, 1992;Cash et al., 2006), and scientific claims and evidence are scale dependent.

The rest of the paper is divided into three parts. Section 2 and 3 describe the business-led environmental initiative in Chennai, South India and the conceptual framework respectively. Section 4.1 analyses the business assisted disaster mitigation initiative and emphasizes the clarion call to action by practitioners to researchers. Section 4.2 provides a literature review reflecting the role of business in ecosystems research and highlights the hidden links and missing interactions. Sections 4.3 and 4.4 capture the scale-based approach and the application of a scale-based approach to the case study. Sections 5 and 6 present the limitation of the scale-based approach and summarise the conclusion respectively.

2. Background Information

2.1 Study Site

Chennai, the capital of Tamil Nadu, is the fourth largest metropolitan city in India. The projected population of the region was 88 lakhs (8.8 million) in 2011 (CMDA, n.d.). The city is a flat coastal plain located on the Coromandel Coast on the Eastern seaboard of India and water shortage is a crucial concern. Apart from stream-generated river water, the Northeast Monsoon brings water to the state of Tamil Nadu (Balasubramani, 2006). The annual rainfall mean in the city is a healthy 1382.9 mm. However, the city receives more than half of its total annual rainfall from the Northeast Monsoon from late September to early December. Climate variability has increased regarding the intensity or dearth of the rainfall causing periodic flooding and drought (IMD, n.d.). Climate variability is accentuated in the city with the worst rainfall[iii] in 2015-16 and drought[iv] in 2016-17.

2.2 Study Project

The Confederation of Indian Industries-Southern Region (CII-SR) headquartered in Chennai decided to respond to water security challenges experienced by the region's industries from 2015-2016. It formed a committee with the state government in 2016; more specifically, the government officials responsible for providing safe and secure water, channeling water, and preventing floods. The project was thus titled "CII-SR Water Alliance"[v]. Note, CII-SR's outreach was necessitated due to the twin disasters which affected the Chennai region and its industries in 2015 and 2016. Additionally, the project plans for the removal of debris, de-silting, bund strengthening, and fencing of the lakes for water storage.

The project is to be carried out alongside district administration of the state government (CII, n.d.) for smoother implementation as they have local administrative control. Furthermore, CII-SR is also collaborating with multiple agencies in the state Government of Tamil Nadu.[2] Data on water, for example, is handled by multiple government agencies[vi] at the national level and at the provincial level[vii]. The India Water Tool[viii] presents information on projected baseline water stress in 2030. Ground water level data

[2] Mala, D., 2018. Personal Interview.

from the India Water Tool for each district is used as a first perspective tool for the Water Alliance project.

Project plans are built using CII-Triveni, a partner organization which developed the IWT, has worked on GIS studies for 200 lakes and currently completed detailed development project reports (DPR) for 20 water bodies.[3] For the successful implementation of lake restoration, information on water availability, water accessibility, water wastage, ground water storage, identification of fisheries, and the water shed with help of GIS is to be carried out.

The project envisages an exit strategy with the communities maintaining the lakes in rural areas, further involving them in the community-based restoration projects. In urban areas, the companies will maintain the lakes, ideally through the volunteerism of urban folk. Businesses will contribute to the lake restorations close to their field sites through the provisioning of money and labor. CII-SR will take up the role of completely maintaining these structures or facilitating negotiations with the government for a business proposal.

3. Conceptual Framework

In the paper we focus on the call to action to emphasize the business-ecosystem links and engaging stakeholders, their interest, and their application are helpful for implementing solutions. Researchers have to move beyond communicating research while increasing cognitive proximity among stakeholders, matching priorities and implementing those interventions as additional needs of science-policy interface.

3.1 Clarion Call to Action – Leverage Points and Planetary Opportunities

DeFries et al. (2012) have called for a "vision of planetary opportunities" approach focusing on "how, when, and where" mediations are made to understand biophysical processes and human societies; to analyze institutional and political process; and to develop social learning for sustainability. Leverage points i.e., "realms of leverage within which interventions in a given system of interest may be made" have been emphasized by Abson et al (2017) and Meadows (1999). Academicians and researchers need to clearly communicate the planetary opportunities and leverage points to the practitioners. We identify various levels of analysis between the business and ecosystem to address missed and hidden interactions based on the call to action by Meadows (1999), DeFries et al. (2012) and Abson et al. (2017).

3.2 Science-Policy Interface

[3] Mala, D., 2018. Personal Interview.

Van Den Hove (2007) defines science-policy interface as "social processes which encompass relations between scientists and other actors in the policy process, and which allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making." In this paper, we address cognitive proximity, matching, and coordination for improved science policy interface and decision making.

3.2.1 Cognitive Proximity for Expanded Framing

Finding solutions is dependent on how a challenge is identified, what issues conceptual frameworks represent and how the data is interpreted and presented. The framing of an issue also decides the public's perception on the issue (Nisbet, 2016). A justification of interdisciplinarity has been to present an interdisciplinary perspective by reconciling different framings (Wilkinson et al., 2011). Sharing a similar knowledge base (i.e. cognitive proximity (Breschi and Lissoni, 2009) is crucial while framing a scientific issue through a specific context. Cognitive proximity will influence how different epistemic communities acknowledge commonalities of an issue through a similar, if not the same, framing. For enterprises, resilience refers to the interdependencies between nature and society (Unruh, 2016).

3.2.2 Matching Interests

Once a framing establishes commonalities among diverse communities, it is necessary that the priority and interests of diverse communities are also similar; if not, then it is necessary that they are matched "such that they are corresponding and complementary". Additionally, matching strategies have been emphasized for bridging methods between natural-social science or problem and context characteristics (Kørnøv and Thissen, 2000; Kemp-Benedict et al., 2010). In matching strategies, it is not necessary for conceptual and local ideas to match initially (Tomich et al., 2004) if practical considerations match (Lansing, 2012).

3.2.3 Coordination for Engaging the Stakeholders

Political processes and institutions emphasize compromises between different stakeholders rather than place emphasis on evidence or truth (Carter and Jacobs, 2014; Kuzemko et al., 2016). The matched interests and incentives can be considered shallow if they do not translate into changes in the field which requires coordinated action—i.e. "that specific knowledge or facts compel certain policy responses" is necessary (Pielke, 2007). The matched interests can be aligned by providing suitable incentives to engage together in its application as decision makers compare rewards and options, and distribute their efforts based on the relative worth of the available options (Kubanek, 2017).

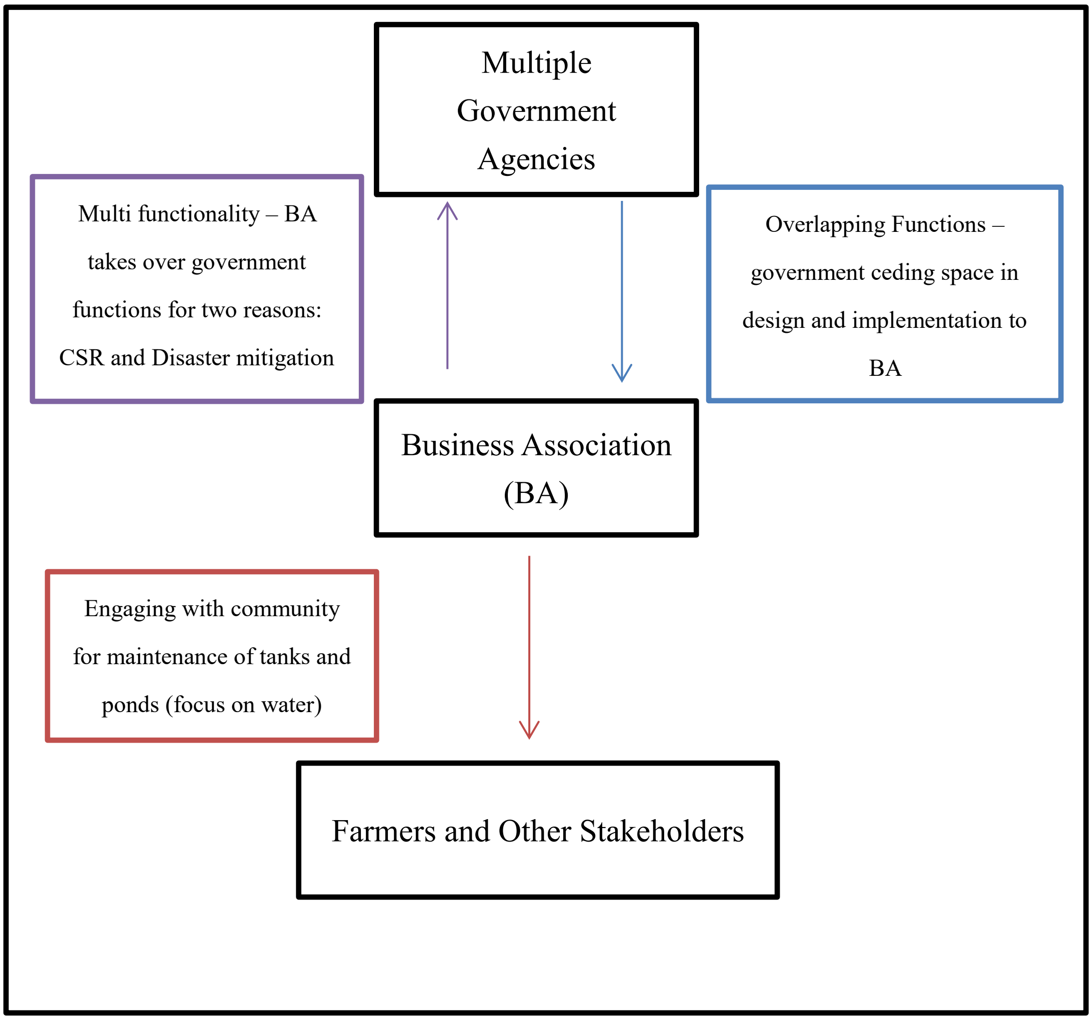

Figure 1- Current design of the CII-SR Water Alliance initiative with different stakeholders with color coded arrows and boxes representing the initiator and their role. BA is coordinating with multiple government agencies which have ceded certain administrative space to CII-SR to design and implement the Water Alliance project (overlapping functions). BA's interest in the project is to mitigate the impact of disaster and to fulfil the corporate social responsibility (CSR) legal requirement set by the national government (having multiple functionality for the BAs). The current focus on the initiative is on water and communities are engaged to maintain the tanks and ponds with no role for the farmers, and no interest in ecosystem potential of land.

4. Result and Discussion

Based on three interviews and secondary literature, the present structure of the project, water competitions and call to action are presented in Section 4.1. Based on the call to action by the practitioner, Section 4.2 presents the hidden links and missing interaction. Sections 4.3 and 4.4 list the scale-based approach and the proposed approach of the project based on the scale-based approach.

4.1 Business Assisted Disaster Mitigation

The CII-SR water alliance project was started to mitigate disaster and reduce the disaster's impact on CII-SR members' bottom line and operations. The CII-SR water alliance initiative is seen to serve multiple functions: disaster management of their risks and legal requirement laid down by the government. Figure 1 represents the different stakeholders and their roles in the current CII-SR water alliance initiative.

4.1.1 Water Competitions

The Companies Act, 2013 also makes it mandatory for business to provide a contribution of two percent of the profit for CSR activities (MCA, 2013). Furthermore, the provincial government has ceded administrative space to CII-SR to design and implement the project, such that different departments of the state functionary and CII-SR have overlapping functions. The multi-functionality and overlapping functions make the project unique and add an element of flexibility (Asokan, 2017). This has made the initiative workable in a bureaucratized environment.

The CII-SR Water Alliance project serves as a match-making initiative trying to match and complement the needs of business and their water conservation efforts to a societal need. Water use and availability are also important concerns for many businesses and enterprises in India. However, they are not high on the priority list of water allocations (MoWR, 2002).The National Water Policy 2012 has replaced the water allocation policy with emphasis on economic aspects (MoWR 2012), however the issues are politically charged between business, government and community. Of these allocations, agricultural farmers are the biggest water users. Competitions for water use in India are mainly between industries, residents and farmers and between urban and rural areas. The industrial-residential and -farmer competition are of main interest to the industries and relevant to the Water Alliance project.

4.1.2 Land-Water Link and Call to Action

There are continuing discussions for water competition solutions within CII-SR, thus the creation of the Water Alliance. Broadly, these two solutions include a plan, 1) centrally focused on the physical water resource, and 2) to include land use. The first solution involves understanding suitable lake recharge structures and developing proposals to build the recharge structure. The second solution would involve the agricultural watershed users and discusses how corporates can direct farmers towards using better crops or improving cropping patterns to reduce their water demand.[4] The CII-SR Water Alliance initiative is currently pursuing the first option regarding water recharging strategies with community participation to maintain the structures.

Currently, the need for negotiations is only discussed within the context of water in the Water Alliance project. On the other hand, agriculture is clearly understood to be the major water user in India in whichever local geography that is spoken of. Land-water connections are possible additions to the India Water Tool to further incorporate interdependent issues. Land use can be brought in through the collaboration with different water-relevant organizations to include additional layers[ix] of biodiversity, river management, or agriculture.[5] CII-water alliance is currently focused on pond, lake and tank restoration. However, note this exchange is restricted to the specifics of "water". Extreme weather events like droughts and floods are going to increase with a decrease in seasonal rainfall and increase in extreme precipitation during monsoon (IPCC, 2018). This calls for mitigation[x] and adaptation[xi] strategies to combat the hazard from the extreme events and conserving water. Academicians and researchers could be involved as facilitators, preparing study reports for each district and industrial association[6&7]. This calls for the role of academicians who can point to broader linkages between land-water in a structured way to help facilitate the tool (IWT) or projects (CII-water alliance).

4.2 Business-Ecosystem Hidden Links and Missing Interactions

The review includes approaches popularly used in sustainability science – e.g. organizational studies, corporate environmental sustainability, along with other mainstream research fields. The authors explore "sites of mediation" and "leverage points" that link between business and ecosystem using the different levels of analysis.

4.2.1 Time and Spatial Dynamics

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[4] Maggo, D., 2018. Personal Interview.
[5] Maggo, D., 2018. Personal Interview.
[6] Mala, D., 2018. Personal Interview.
[7] Joshi, S., 2018. Personal Interview.

A multidisciplinary systemic lens capable of appreciating the interconnectivity of economic, political, social, and ecological issues across temporal and spatial dimensions is required to understand the full impacts of humanity on ecosystem (ES) processes (Williams, 2017). Time and temporal dynamics are often not explicitly considered or conceptualized, however, in research and strategy-building towards sustainability transformations, for example, organizational studies or in social-ecological and socio-technical systems (Bansal et al., 2017; Weiser et al., 2017). Pascual et al. (2017) stress that "off-stage impacts on biodiversity and ecosystem services of place-based ecosystem management" should be reflected and are termed as 'ecosystem service burdens'. Similarly, Häyhä et al. (2016) emphasize that consumption patterns beyond political territory should be considered in sustainability science. Time and spatial scales along with its local and international impacts must be reflected and converted into relevant policy action to capture environmental degradation.

4.2.2 Soil and Land Degradation

Montgomery (2017) referred to the soil as "bare of protective vegetation and exposed to wind and rain." Human anthropogenic activities erode soil in cultivated areas, which in turn over the millennia limit the lifespan of human civilization because of decreased soil quality. Soil scientists have highlighted the importance of soil for human-nature interactions and have pushed for soil carbon to be used as an indicator in the Sustainable Development Goals or in general development (Koch et al., 2013). Soil security serves as an overarching concept in sustainable development as soil is connected to the human needs of food, fibre and fresh water. Soil also contributes to energy and climate sustainability and to maintain the biodiversity and overall protection of the ecosystem (McBratney et al., 2014). For example, healthy soil holding moisture will also help in reducing the impact of heat waves (Nissan et al., 2017). Furthermore, healthy ecosystems can capture carbon and can help in climate change mitigation (Lal, 2004).

With respect to ecosystem processes, soil also plays a major role in regulating droughts, floods, and heat waves (Ghatak et al., 2017). In the ecosystem process, ecosystem services (ES) are "the functions and products of ecosystems that benefit humans, or yield welfare to society" (MA, 2005). Further, Lele et al. (2013) point out, research on ecosystem should account for ecosystem disservices, tradeoffs between eco-system services, inclusion of abiotic elements and co-production of ecosystems in such studies.

Businesses still don't understand their dependence on soil and land (Davies, 2017). Most businesses and governments are not aware of soil's risk of degradation. Additionally, business and enterprise information disclosures often do not refer to geography, land use and land conversion, clean air – including greenhouse gas emissions, – availability and quality of freshwater, sustainable harvest, or the dependence on material resources (Kareiva et al., 2015). Businesses need to capture the importance of land and its services, disservices, ecosystem tradeoffs and co-production of production with abiotic elements.

4.2.3 Institutions

Affluence, a characteristic of wealth, is a critical factor in understanding water-energy-food-land nexuses as affluence leads to the higher use of resources than the resources' local availability (Wang et al., 2016). It is institutions like law, nation-states, companies, trade, and markets which make this resource overconsumption possible and can further exacerbate and enable this resource overconsumption globally.

Conceptually, Green et al. (2015) recommend the use of a resilience-based governance system in the legal field to overcome this challenge of dealing with uncertainty. Furthermore, scholars have identified legal hurdles to the implementation of sustainable development such as in the World Trade Organization's (WTO) dispute settlement mechanism which does not incorporate issues of sustainable development though the WTO recognizes it in principle (Pietro Castagno, 2014). Similarly, Jerneck (2017) emphasizes that financialization impedes climate change mitigation using the example of examining the early history of the solar photovoltaic industry in the United States. Connections and interactions between financial markets, financial actors, and instruments with ecosystem change have seldom been elaborated in the literature (Galaz et al., 2015).

Kim and Bosselmann (2015) posit that developing ecological integrity as a fundamental principle of trade institutions, similar to human rights, is necessary to overcome these challenges of resource over-consumption. Institutions play a key role in verifying information in society; as they encourage verification they will play a major role in enhancing ecological integrity (Sloman and Fernbach, 2018).

4.2.4 Narratives, Information, and Human Behavior

Edward Bernays explained in "Crystallizing Public Opinion" (1923) how corporations and governments could shape public attitudes, using the psychoanalytic findings of his uncle and Gustave Le Bon's ideas on crowd psychology. In his Treatise on Probabilities (1921), Keynes underlined the fact that people handle complexity through narratives and tailored stories. Robert Schiller defines a narrative as a "simple story or easily expressed explanation of events" and reiterates the importance of popular narratives of human interest or emotional change over time and its emphasis in understanding economics (Shiller, 2017). Similarly, scholars have focused on the multiple cognitive and psychological biases which can make people easy targets for phishermen (Akerlof and Shiller, 2015). Given this reality, it is necessary to consider how diversity in human behavior is involved in sustainable natural resource management and the effectiveness of policies (Schlüter et al., 2017).

4.3. Scale-based Approach

Work on ecosystem requires collaborative research including at the least “ecology, hydrology, economics, and political science” (Zhang et al., 2007). The scale-based approach follows a multi-scale developed based on the different level of analysis. These scales act as a bridge for finding common ground in problems and goals, and kinds of representations. These scales can provide realms of “sites of mediation” and “leverage points” within which interventions in a given system of interest can be studied and may be made.

4.3.1 Landscape

Soil is defined as the upper layer of the earth’s surface and the surface that is not covered by water is called land. Land, and thus soil, plays an important role in nature and society as it supports agriculture, habitat, and many other uses. A “landscapes” approach examining an ecosystem incorporates social, economic, cultural, and environmental aspects into problem setting and research thus incorporating a wider canvas (Sunderland, 2014). Though the use of landscapes has been emphasized in the field of forestry, broader implications for positive and negative impacts on agriculture, which has further implications for ecosystems and human society, have been stressed recently (Thaxton et al., 2016). Further, use of scientific knowledge at local landscape has also been discussed (Opdam et al., 2013).

Humans and anthropogenic pollution from land create most of the impacts on land, sea, and atmosphere. The land-sea impact of land use is evident in coastal environments as marine pollution due to land-based sewage disposal, agriculture residue, and carbon emissions (Halpern et al., 2008). The land-atmosphere implications of sustainable land management can bring about one-third of climate mitigation (Griscom et al., 2017). Climate mitigation would entail consideration for agricultural, forestry, wetland and coastal restoration, with particular ecosystem restorations to potentially yield local benefits. Furthermore, on the non-carbon related land-atmosphere connection, a modelling study suggests that densely vegetated lands play a major role producing 20% of the average land precipitation globally and around 50% in certain regions (Keys et al., 2016). By extension, forests can be used to mitigate problems related to water scarcity and global warming (Ellison et al., 2017). The scaling of land use effects, the land-ocean, land-atmosphere teleconnections are established. Land use is also relevant for abiotic processes like air pollution, renewable energy deployment and mining (Wood, 1990; Schechtman et al., 2011; Hilson, 2002)

According to the landscape approach, the consumption and use of resources by humans in a given landscape should be understood in its entirety. Thus, a landscape approach should complement sectorial approaches and value chain-based approaches using the frameworks of planetary boundaries and SDGs. Such an approach should reflect spatial scales, temporal scales, and the direction of change to capture indirect sustainability teleconnections and create shared value.

Further, land is a hotly contested issue with many stakeholders involved in the process, given its multi-functionality, in terms of the benefits, it provides humanity and ecosystems. Understanding anthropogenic land transformation and its impact on society has a rich tradition in social sciences, for example human geography and economics (Bičík et al., 2015; Hubacek and Bergh, 2002; Bockstael and Irwin, 2000). Landscapes can serve as a scale to incorporate the interactions between the ecosystem processes with their social processes in sustainability research.

Further, land is related with "space", can represent spatial parameters, and also reflects temporal impacts of degradation. Many academic disciplines are aligned to land or soil and, hence, the scale of landscape will reduce the cognitive distance of the topics, resulting in better framing of the problem due to cognitive proximity.

4.3.2 Institution and Practices

The social sciences primarily deploy the use of institutions as a scale of analysis in economic, political, historical, and sociological approaches. They are defined by Turner (1997) as "a complex of positions, roles, norms and values lodged in particular types of social structures and organizing relatively stable patterns of human activity with respect to fundamental problems in producing life-sustaining resources, in reproducing individuals, and in sustaining viable societal structures within a given environment".

Institutional scales serve as an actor in systems and are widely used in sustainability science, as well in SES and STS. Olsson et al. (2015) further go on to suggest the use of an institutional lens to connect the natural and social sciences. As mentioned earlier regarding the interaction of institutions and their authority over information verification, institutions like the WTO, national governments, and enterprises influence one another within society (Shaffer, 2015). Furthermore, ecosystems along with law, governance, markets, finance, and technology play an important role in ecosystem processes. There is a crucial need to understand these interactions and their implications on and between enterprises, international treaties, and their interface with policy making (Ruggie, 2017).

Institutional impacts on human behavior can be represented through practice theory. Practice theory "seeks to explain the relationship(s) that obtain between human action, on the one hand, and some global entity which we call 'the system'" (Ortner, 2006). Human practices represent the habits and decisions influencing an ecosystem. These practices are shaped by landscapes, institutions, and human behavior. The social practice theory shuns the assumption around individual behaviour and methodological individualism (Kuijer and Bakker, 2015). The theory connects the dialectic between society and the individual in an interconnected approach, emphasizing human habits and decisions as neither standalone, nor independent, but as influenced by other broader formations. The same concept of practices has been applied for mobility (Dixon et al. 2007; Townshend and Lake, 2009). A practice-based approach can connect human agency, diet and mobility with the ecosystem, since mobility, food consumption, and shelter account for the majority of anthropogenic impacts on environmental resources (Ivanova, 2016). However the same practices can represent human ingenuity towards ecosystem restoration. It's the social, institutional and infrastructural factors influencing human practices which can reduce human dependence on environmental resources.

4.4. Proposed Application of the Scale-based Approach

This section illustrates how researchers of the CII-SR Water Alliance could work to include the importance of land and water interconnections for further implications on research and policy-making. A scale-based approach elaborates in this case by addressing cognitive proximity, matching, and coordination. As described in table 1, in the section below we explore the use of three scales – landscape, institutions, and practices – for practice. Figure 2 represents the different stakeholders and their role in the proposed CII-SR Water Alliance initiative.

The approach follows the call of Lele et al. (2013) where ecosystems process is directly appraised for its services (i.e. water for business and disasters for farmers) rather than intrinsic value of biodiversity as has been the norm with the earlier approaches. Ecosystem restoration [xii] emphasizes benefits of mitigating land degradation (Crossman et al., 2017) and the associated benefits for farmers in the context of climate change (Vignola et al., 2015). However, the authors here agree with Falkenmark (2018), emphasizing a shift in water thinking where business take the lead in ecosystem restoration for water conservation. Further, use of resilience-based thinking for matching interest and provision of climate service and financial incentives for coordinated action can be other two approaches.

Table 1: Science Policy Interface, the associated scales, and their application in the case study- CII SR Water Alliance initiative

Science Policy Interface	Cognitive Proximity - Framing the problems with the community	Matching Priorities	Coordination - Aligning the priorities for application

Associated Scale	Landscapes	Institution	Practices
Interface of Scale and Science Policy Interface in the CII- SR Water Alliance projects	Landscape framing approach can capture the multiple interactions between soils, land, and agriculture that business is also dependent on and consider the multiple stakeholders who affect these landscapes	International trade and markets influence the regional cropping pattern State and local governance rules on water use and cropping pattern. Water budgeting between different water users	Ecosystem maintenance by farmers, cropping patterns, preparing the soil for increased water infiltration, ecosystem performance and local harvest of rain and runoff water by farmers, soil restoration

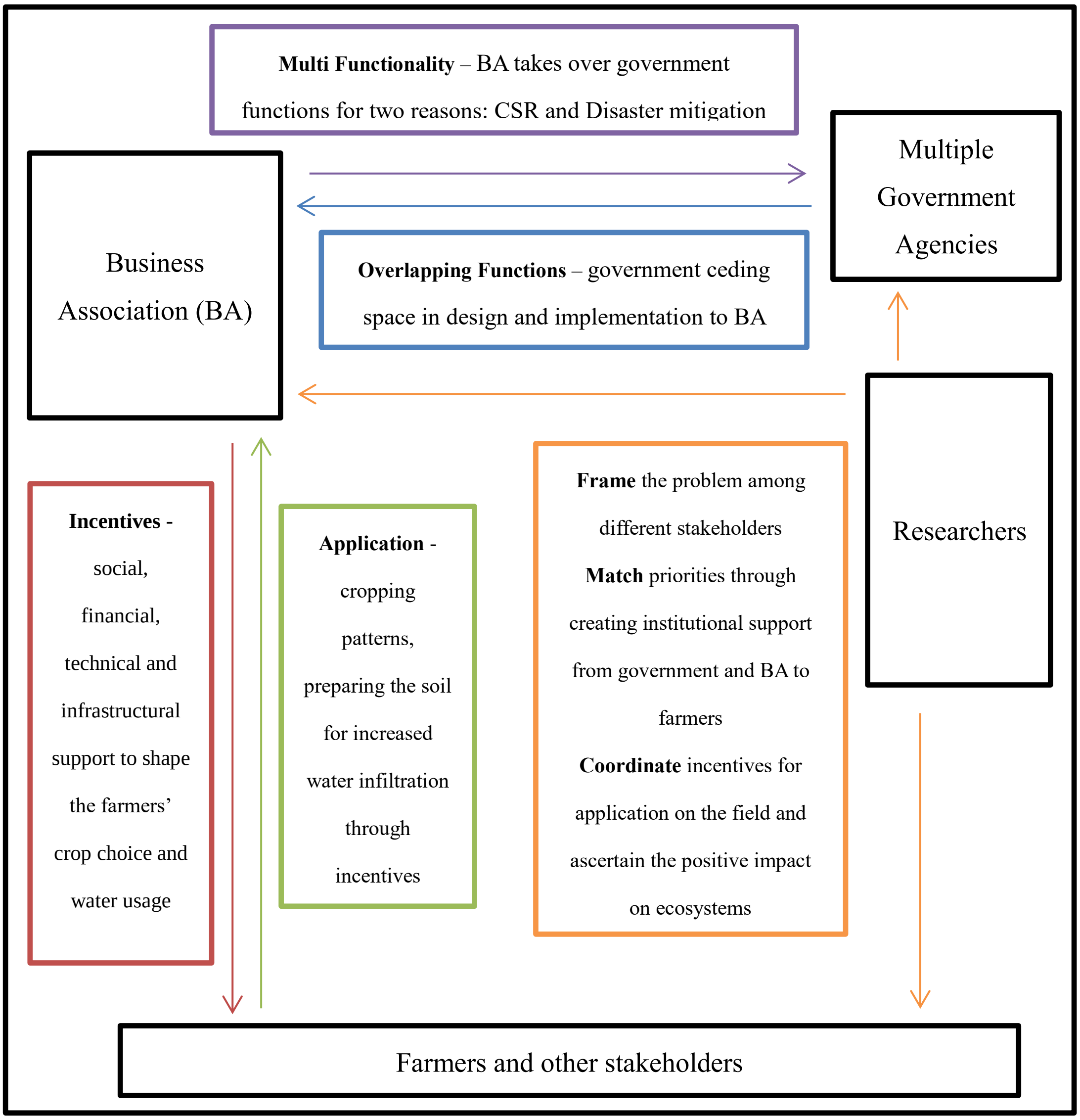

Figure 2 - Proposed design of the CII-SR Water Alliance initiative with different stakeholders with color coded arrows and boxes representing the initiator and their role. The interaction between BA and multiple government agencies is the same as mentioned earlier. Based on the science policy interface discussed, researchers can provide support to BAs, government agencies, farmers, and other stakeholders by framing the issues, matching and coordinating incentives. Framing the issues of water conservation through landscapes can integrate land-water interactions and BA-farmer linkages. Further, matching priorities and the coordination of different institutional support between BA and farmers through social, financial, technical and infrastructural incentives can influence the farmer. Land use decisions by the farmers save water by preparing the soil for increased water infiltration, ecosystem performance, and the local harvest of rain, runoff water and through soil restoration.

4.4.1 Landscape - Cognitive Proximity for Framing

Falkenmark (2018) and Keys and Falkenmark (2018) highlighs the importance of green water, water from soil, atmospheric precipitation and evapotranspiration in non-humid areas. This entails cross-scale management approaches for water management

CII-SR industries are a net user of ecosystems as they withdraw, use and deplete water resources. The farmer is viewed as a user, and at the same time, maintainer of the ecosystem processes. Farmers through their water withdrawal use and deplete water resources; however, with right kind of farming they can also increase the water retention capacity of the soil. These adjustments will help in meeting local water requirements, such as for domestic use. These different practices are to be framed together to provide a positive impact on the ecosystem through use of landscapes.

Beyond water requirements, flooding can for instance be mitigated and lead to successful climate adaptation by the increased focus on landscapes through ecosystem-based restoration, a local phenomenon. The unintended benefits of this landscape approach can also lead to climate change mitigation through ecosystem, a global phenomenon. Better soils, groundwater, and wetlands can mitigate some of the effects of sea-level rise, such as salt-water intrusion into boreholes. Landscapes have relevance for an Ecosystem-Based Adaptation and Mitigation[xiii] (EBAM) approach by capturing carbon, restoring soils and reclaiming water, which help in climate change mitigation and adaptation.

To move beyond the singular focus on water, the CII-SR industries have to incorporate a broader framing. Using a landscape framing approach can capture the multiple interactions between soils, land, and agriculture that business is also dependent on and consider the multiple stakeholders who affect these landscapes. The farmer is then viewed as both an integral component of the plan as a user of the ecosystem, and at the same time, critical to the maintenance of the ecosystem processes – which is not currently the case. How this framing can be translated into policy and it application is the next concern.

4.4.2 Institutions – Matching

Once framing is established, matching priorities between different stakeholders and implementing them is necessary. Businesses are primary water users in some locations of India but are not as widespread as agriculture. Businesses need to engage with different stakeholders and understand their risks. The maintenance of agricultural ecosystems is crucial in maintaining the health of the ecosystem and further reduces agricultural-derived disservices like the loss of biodiversity and nutrient overloading (Zhang et al., 2007).

Enterprise resilience means to understand the interdependencies between nature and society (Unruh, 2016). Resilience can play an important role for different actors in understanding interdependencies and interactions that should be framed together. The importance of flexibility and resilience, and their functionality can play a role in aligning interests of diverse researchers and stakeholders (Asokan et al., 2017). Thinking through resilience can help different stakeholders come to a middle ground by framing their interests such that are complementary and corresponding. For example, the involved actors in the Water Alliance project may be viewed as users, maintainers, or both, of the ecosystem depending on their practice.

Matching interests can be achieved through articulating resilience of diverse actors through a relational approach – by establishing the link between ecosystem, farmers and business association (Darnhofer et al., 2016). A relational approach based on relational values[xiv] can open a new value set in addition to instrumental and intrinsic values. Such an effort is not just geared towards societal good but also serves business interests and creates shared value promoting understanding between business and farmers (Porter et al., 2011). With support and incentives, farmers can serve certain business interests and broader sustainability transformation agendas. These incentives can be social, financial, technical and infrastructural support to shape the farmers' crop choice and water usage. Use of institutional scale can help incorporate these dynamics.

4.4.3 Coordination – Practices

Co-ordination of practices in pertinent implementation of irrigation technology without co-ordination on water allocations has been found to increase water consumption as farmers use technology to increase consumption per unit area and area irrigated (Perry et al., 2017). CII-SR industries should study and coordinate the impact of diverse institutional factors on social practice. These will also include factors which are external and beyond their influence, for example, institutional factors like international trade, water budgeting among users, legal laws, domestic market mechanisms, and non-institutional parameters like climatic variability. Business can also bring in money, knowledge of markets, and expertise in ecosystem processes to the farmers for matching interest between the stakeholders as part of CSR initiatives, while still benefitting business operations. Climate services[xv] or sustainability services between farmers and CII-SR can be helpful in co-ordinating strategies, institutional design and its implementation together. Provision of sustainability services becomes a legitimate part of climate governance[xvi].

Farming practices can positively lead to soil, groundwater and wetlands maintenance as these are critical to manage hazards from extreme events. Farmers can help in ecosystem maintenance through cropping practices with low impact on the surroundings, preparing the soil for increased water infiltration, and local harvest of rain and runoff water. Various practices like retention ditches, contour farming, water harvesting by external catchments, contour furrows, stone lines, grass strips, planting pits, semi-circular bunds, earth basins, mulching, cover crops and conservation tillage can be implemented by farmers (Duveskog et al., 2003). To shape the farmer practices, coordinating the matched priorities among CII-SR industries and farmers by providing suitable financial, technical, informational, and institutional incentives and support is essential. Furthermore, these initiatives can be suitably integrated with sustainability reporting and climate governance regimes globally.

5. Limitations of the approach

The language barrier plays a contributing role towards lack of trust between researchers (Norton & Toman, 1997).Social scientists and natural scientists tend to work on different spatial scales (Chave & Levin, 2004), and scale-based approaches might not integrate all methodologies and values (Stevens et al., 2007).

The scale-based approach does not provide solutions to all the challenges of sustainability science and excludes areas which are not covered by the selected scales. The challenge of the scale-based approach is that analysis with predetermined framing would still incorporate diverse concepts, methods and models from different disciplines. When ontologies of the disciplines are not compatible, an “unstructured” outcome can result in ontological relativism.

Differences in ontology and epistemology make interdisciplinary connections and communication difficult to establish (e.g., Persson et al., 2018a). Beyond ontology, unifications or integration can be about: concepts, explanations, virtues, goals, methods, models, and kinds of representations (Persson et al., 2018b). The scale-based approach provides a basic ontological background and can act as language facilitator, which further requires constructive dialogues to align results, discussion and explanations from the analysis (Persson et al., 2018a).

Further research is needed to ascertain the relevance and suitability of a scale-based approach in sustainability science research, and if suitable, suggest scales which can be considered relevant for sustainability science research to broaden the scope and fine-tune its application.

6. Conclusion

There is a need for enterprises to incorporate information on resources consumption into already existing guidelines and take action on ecological restoration. A scale-based picture, focusing on landscapes, institutional scale and practices can help in a practical, scientifically-embedded approach to sustainability science. Academically, this scale-based interactional expertise can be used to align diverse fields through cognitive proximity, matching and coordination which can act as “bridge” for improved science policy interface and decision making.

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Appendix

Appendix 1 – List of the interviews with the name of the person, their designation with location and time of the interview

Portal/Initiative	Person	Designation	Location and Date
India Water Tool	Deepa Maggo	Manager, Water, World Business Council for Sustainable Development	Delhi – 5th January, 2018
Confederation of Indian Industry – SR	Dr. K. Deepamala	Director & Head-Development Initiatives	Chennai – 17th January, 2018
CII-ITC Centre Of Excellence for Sustainable Development	Sachin Joshi	Chief Operating Officer	Delhi – 23rd January 2018

[i] For the purpose of this paper, science–policy interfaces are defined as "social processes which encompass relations between scientists and other actors in the policy process, and which allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making" (Van den Hove, 2007)

[ii] A member of CII-SR's Water Alliance Initiative was interviewed to gather information on the project. Further interviews were conducted with members of India Water Tool – a web based interactive tool on water developed in partnership with CII and CII-CESD – a CII think tank to enable business and its stakeholders to undertake in sustainable value creation – to incorporate perspective of business leaders' working on sustainability in India. All three members were selected given their proximity to the CII and unstructured interviews were conducted to collect information on the project and their views on sustainability challenges in India. Refer to the appendix for the list with the details of the interviews. Researchers transcribed interviews for the relevant research questions and conducted the analysis (Schilling, 2006). Research questions are answered without processing knowledge about the form of statements and their position in the text (Glaser and Laudel, 2013).

[iii] In 2015, rainfall battered the Coromandel Coast of India. On 17th November 2015, parts of Chennai became inundated. In November, the city received 1200 mm of rainfall, three times the monthly average

and the highest on record for the month since 1918 (NRSC, 2016). The low-pressure system which brought this rainfall ended on the 24th November. Another system developed on the 29th of November (IMD, 2015). The system brought in 290 mm of rainfall on December 1st compared against the monthly average of 177.4 mm (NRSC, 2016; IMD, 2015). The city was declared to be in a state of disaster on the evening of December 2nd with heavy rainfall. The low-pressure system caused widespread damage to not only people and communities, but also to the industries in the region. The worst affected were the small- and medium-scale industries and Chennai's automobile- and IT-industrial hubs.

[iv] In January 2017, Tamil Nadu declared all 32 districts drought-stricken as the worst drought in 144 years hit due to the failure of Northeast Monsoon in 2016 (Tamil Nadu Government Gazette, 2017). The drought severely impacted the industries as many industries are dependent on ground water. The once-in-a-century rainfall in 2015/16 followed by the worst drought in 144 years in 2016/17 markedly impacted the industries.

[v] THE CII-Water Alliance focuses on three districts: Chennai, Thiruvallur, and Kanchipuram. The project focuses on restoration and upkeep of community tanks and ponds in three districts by business association with the help of government and communities. Among the 10,000 lakes under Public Works Department (PWD) control and further 20,000 lakes under community control in Tamil Nadu. Around 1,942 lakes have been identified in Kanchipuram, 1,686 in Thiruvallur, and 142 lakes identified in Chennai's district are to be initially part of the overall Water Alliance project. The broader vision of the project is to create impact assessments for 1,000 lakes in each district to make interventions at a later stage.

[vi] Data on water is handled by multiple central government departments - Central Ground Water Department (CGWD) on ground water, Ministry of Water Resources on surface water, and the Ministry of Drinking Water and Sanitation looking into the water use and allocation of non-agricultural and non-industrial purposes at the national level.

[vii] Data on water is handled by multiple provincial government departments - water infrastructure like dams is under Public Works Department, drinking water supply under Tamil Nadu Water Supply and Drainage Board (TWAD), groundwater regulation under the State Ground and Surface Water Resources Data Centre (SGSWRDC) and administrative control with the district administration and revenue department – Irrigation Department and Surface Water Department.

[viii] The India Water Tool, developed by a consortium of business associations including members of CII-SR, brings together what was considered good-quality government data into a single platform for corporate use in India.

[ix] For example, the International Union for Conservation of Nature (IUCN) has a biodiversity specific tool by called Integrated Biodiversity Assessment Tool (IBAT); CII has a platform called India Business & Biodiversity Initiative (IBBI) also focusing on biodiversity. This would be added to the tool by either linking it via referencing or pulling the data into either of the respective tools.

[x] For the purpose of this paper, we define mitigation as "A human intervention to reduce the sources or

enhance the sinks of greenhouse gases".

[xi] For the purpose of this paper, we define adaptation as "the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate" (IPCC)

[xii] For the purpose of this paper, ecosystem restoration improves: "soil stability and condition; surface and groundwater water quality; habitat and biodiversity; micro and global climate stability; and amenity, cultural and recreational benefits to people" (Crossman and Bryan, 2009; Barral et al., 2015; Alexander et al., 2016 as cited in Crossman et al., 2017).

[xiii] For the purpose of this paper, we define EBAM as "incorporating ecosystem services into an overall adaptation and mitigation strategy to help people to adapt to the adverse effects of climate change" (CBD).

[xiv] For the purpose of this paper, relational values are defined as encompassing "eudaimonic" values – values associated with living a good life as well as reflection about how preferences and societal choices relate to notions of justice, reciprocity, care and virtue".

[xv] For the purpose of this paper, climate services are defined as scientifically based information and products that enhance users' knowledge and understanding about the impacts of climate on their decisions and actions (AMS, 2015). They include sharing information, trends, analysis, assessments counselling on best practices development and evaluation. Exchange of climate services (Street, 2016).

[xvi] For the purpose of this paper, climate governance is defined as "aimed at steering social systems towards preventing, mitigating or adapting to the risks posed by climate change".(Jagers & Stripple, 2003).