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Responding to Pollution Problems: Conceptual Analysis of Disciplinary Approaches

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Abstract: The scientific community to guide the analysis of pollution problems and solution generation adopts disciplinary approaches. This paper examines monodisciplinary where all attention is given to one element or relationship; multidisciplinary approach where disciplines are considered side by side and usually arranged by an intuitive notion of connections, interdisciplinary approach where disciplines are strongly connected, usually by way of a systematic framework and transdisciplinary approach were different elements of disciplines form a discipline. Conceptual schemes, the causal chain approach and systems approach which are offsprings from the different disciplinary approaches relevant for the development of frameworks for pollution management are examined. The paper ends by proposing adaptive management of complex systems, material flow analysis, cognitive switches in evolutionary approaches for problem analysis and opportunity discovery as the building blocks for the development of frameworks for sustainable pollution management in developing countries.

Keywords: disciplinary approach; pollution management; sustainability; problem analysis; opportunity discovery; policy design

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1. Introduction

Pollution problems have reached unprecedented levels in spite of the fact that governments, companies and individuals take corrective and preventive approaches pollution management. The slow progress made in address pollution problems could be attributed to lack of pollution management polices or enforcement of the policies in some cases which are grounded in disciplinary approaches.

Attempt my the scientific community to respond to pollution problems has been through the development of frameworks such as Driving, forces, Pressure, State, Impact and Response (DPSIR), Problem-in Context Framework (PiC) which are interdisciplinary tools that are used to communicate knowledge on state of the environment and causal factors related to pollution problems (Svarstad et al., 2008; De Groot, 1998). These frameworks are good at indentifying problems, but there is a unique problem with sustainability when it comes to solving the pollution problems. There is therefore the need to develop a framework within which individual disciplines can provide criteria and indicators related to sustainability, and where possible, use mono, multi and interdisciplinary approaches to respond to pollution problems when required.

This paper examines monodisciplinary where all attention is given to one element or relationship, multidisciplinary, interdisciplinary approach and transdisciplinary approach. Overview of conceptual schemes, the causal chain approach and the systems approach which are offsprings from the disciplinary approaches relevant for the development of framework for pollution management are discussed. The paper ends with a focus on building blocks for the development of a framework for pollution management in developing countries. More details on all aspects of the present paper are in the first author's PhD thesis (Tsetse, 2008).

2. Disciplinary Approaches

One of the major outcomes of the change in global environmental consciousness witnessed over the past three decades was its effect on the various disciplines of science. This change resulted in an academic process that led to different approaches to environmental problems. The response has been a two-way process that helped the environmental debate to benefit from insights of sciences, and for the scientific community to learn from their attempt to rise to the environmental challenge.

2.1. The Monodisciplinary Approach

The monodisciplinary approach originated within the domains of the different disciplines, leading to specialized areas within many of them (Bromme, 2000). Fields such as environmental economics, environmental engineering, environmental law and environmental biology are the outcome of monodisciplinary approach. Today, specialised environmental disciplines constitute the core elements of environmental education and research of major educational institutions around the world.

The monodisciplinary approaches are extensions of the basic principles and theories of the disciplinary domains towards the field of the environment, which is inherently an area of complexity. This complexity leads to two major constraints of the mono-disciplinary approach. First, as a means of understanding the root causes of the environmental crisis, none of the disciplines can provide full insight in environmental problems. The second is that solutions generated within the disciplinary domains usually have a quite limited scope of application.

Notwithstanding these constraints, the monodisciplinary approaches to environmental issues have been important for three main reasons. First, they have significantly expanded the knowledge about the different aspects of environmental issues. Typical achievements of the monodisciplinary approach are the dose-effect relationship models and other stand-alone models developed for social, ecological and economic disciplines. Second, this approach has exposed some of the basic assumptions of the traditions of science to critical examination. This has resulted in the questioning of assumptions thereby creating a forum for research that extends well beyond the traditional environmental problems. Finally, the impossibility of the mono-disciplinary approach to fully understand, let alone resolve, most of the environmental problems has opened doors for interdisciplinary dialogue.

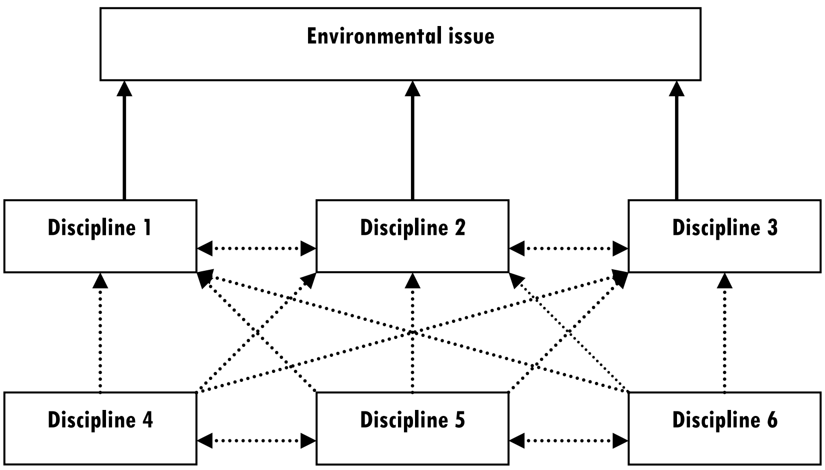
2.2. The Multidisciplinary Approach

The multidisciplinary approach is where more than one disicpline is connected side by side to deal with a particular issue without coming to a result that is significantly more than the sum of the disciplinary contributions (De Groot, 1992).

This approach bring additional strength to the several disciplines in question and the strenght is always in the exclusive services of the the home discipline. In otherward, mutidisiciplinary approach overflows disciplinary boundaries while its goal remain limited to the framework of disciplinary approach.(Polimeni, 1999; Nicolescu, 2005).

In the multidisciplinary approach, disciplines are connected but only weakly, as shown in Figure 1, where the arrows represent the contribution of each dsicpline to the ennvironmental issue while the dotted line show the weak interconnections between the disciplines.

Figure 1. Side by side connection of disciplines [adopted from Tsetse, (2008)].



2.3. The Interdisciplinary Approach

The environmental issues that are too complex to be treated within the scope of the different monodisciplines led to the evolution of the multidisciplinary approach. This in turn, led to the interdisciplinary approach in environmental education and research, exemplified by the establishment of many interdisciplinary environmental education and research centres at academic institutions. With the interdisciplinary approach, there is a strong connection between the contributing disciplines such that the result is more than the sum of the parts (Salter and Hearn, 1997; De Mey, 2000; Palmer, 2002). Thus, interdisciplinary approach is concerned with the transfer of methods from one discipline to another, but its goal remain within the framework of disciplinary research (Klein, 1990; Necolescu, 2005; Marilyn and Dennis, 2004).

A key move in the interdisciplinary approach is the transfer and adaptation of methodologies from one disciplinary area to another, but without the presence of an overarching body of theory, which results in boundaries between disciplines affecting how information is used and knowledge constructed (Easton, 1991; Benowitz, 1995; Jain Qin, et al., 1996; Palmer, 2002). This has led to a large extent to a mechanistic combination of concepts and tools generated under the different disciplinary domains. Much attention was therefore given to how the disciplinary contributions might be connected, and at what point in the analysis and solution of environmental problems. Following the causal routes of human actions and especially of changes in the environment (e.g. pollution pathways) gave rise to the most characteristic achievements of the interdisciplinary approach, which are the interdisciplinary frameworks such as Life Cycle Assessment, Environmental Impact Assessment and the Problem-in-Context framework.

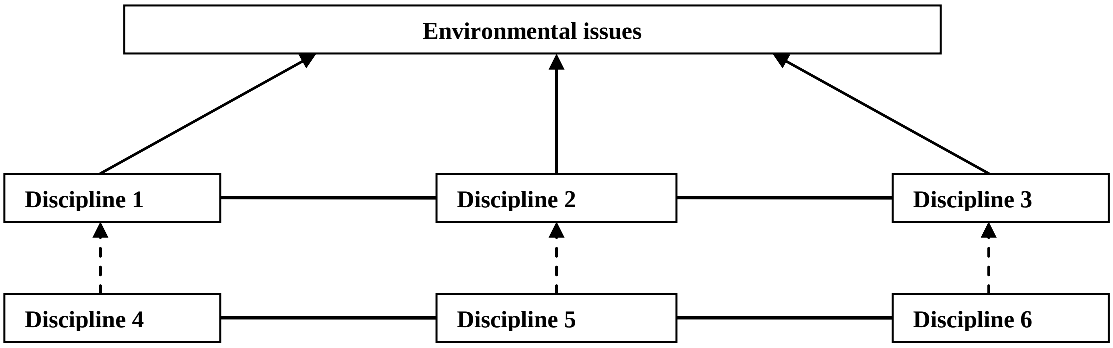
In this approach, limitations that are observed within the independent disciplines are often transferred to the interdisciplinary approach. The two main criticisms are:

- Interdisciplinary approaches remain shallow; they do not address root causes of environmental problems.
- Interdisciplinary approaches and frameworks remain dominated by monodisciplinary lines of thought such as ecological or economic.

These criticisms may be true indeed for many framework applications in practice. Applicant institutions are often dominated by certain disciplines (leading to one-sided application) and often shy away from addressing root causes. This may not be inherent in (all) frameworks themselves, however. Problem-in-Context (PiC), for instance, offers an avenue to identify root causes and fully embraces the natural, social and normative sciences (De Groot, 1992).

It has been said that although the interdisciplinary approaches try to be inclusive, the frameworks often remain anchored within one or another disciplinary domain (Palmer, 2002), and although the interdisciplinary efforts gave rise to useful scientific metaphors and models such as the pressure/state/impact model and models of metabolism, they have essentially resulted in an integration of methods rather than the forging of substantive theories (Leroy, 1997; Metzger, 1999; De Mey, 2000; Bromme, 2000). This appears to be true indeed. The frameworks, efficient as they are to arrive at practical solutions to concrete problems, do not challenge the researcher to develop new substantive concepts. The frameworks produce analyses and solutions by connecting existing disciplines (see Figure 2). Even though the frameworks, taken together might amount to a new ‘discipline for interdisciplinarity’ (De Groot, 1992), this new discipline remains only methodological. This has given rise to the transdisciplinary approach.

Figure 2. Strong connections between disciplines in an interdisciplinary approach [adopted from Tsetse, (2008)].



2.4. The Transdisciplinary Approach

Several definitions of transdiciplinary approach exist (Guimaraes and Funtowicz, 2006) but in this research it is described as a form of disciplinary approach in which boundaries between and beyond disciplines are transcended and knowledge and perspectives from different scientific disciplines as well as non-scientific sources are integrated (Finterman et al., 2001; Klien et al.,2001; Guimaraes and Funtowicz, 2006; Gibbons and Nowotny, 2001; Necolescu, 1987; 1999; 2001, 2005).

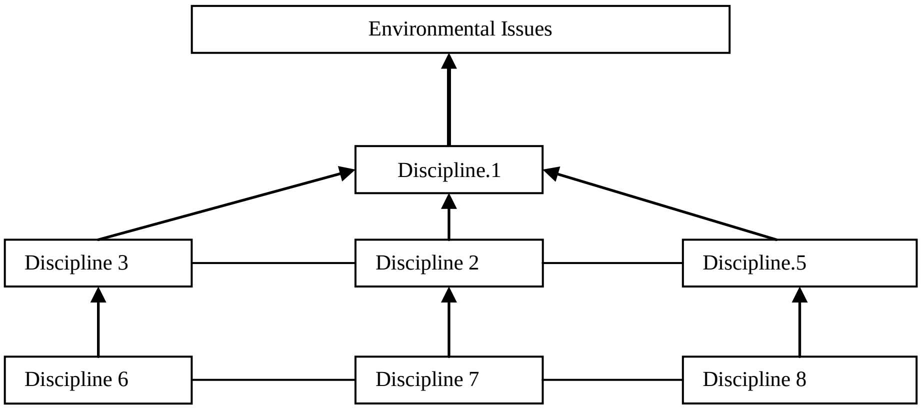
According to the transdisciplinary approach, the scientific approaches to environmental problems examined above present little fundamental understanding for the management of the environment. This is due to the fact that environmental problems are complex and dynamic subjects that essentially fall beyond the reach of the reductionist scientific thinking, even if the parts are connected by way of systematic frameworks. Scientific understanding of environmental problems such as pollution requires overcoming the limitations of the reductionistic approach that is inherent in our mainstream way of thinking. This implies the need for a change in paradigm (Klien et al.,2001; Nicolescu, 1987; 1999; 2001;2005).

A paradigm is a cultural pattern of doing science, consisting of a cognitive, a perceptual and a behavioural framework (Van der Vorst, 1997). The disciplinary approaches examined, if considered individually over a temporal scale, will show an evolutionary pattern of paradigms for managing environmental problems. The outcome of the shift in reductionistic approaches is the transdisciplinary approach that is based especially on system thinking.

The transdisciplinary view arose in order to get away from the superficial notion of disciplinarity, which has not been able to solve environmental problems effectively despite the huge efforts over the last 20 years. According to the International Centre for Transdisciplinary Studies and Research (1999): "Transdisciplinarity is not concerned with the simple transfer of a model from one branch of knowledge to another, but rather with the study of isomorphism between the different domains of knowledge". Transdisciplinarity aims at forging the flow of information circulating between the various branches of knowledge and discipline, permitting the emergence of unity amidst the diversity (Necolescu, 1987; Polimeni, 1999; 2001; 2006). Its objective is to lay bare the nature and characteristics of this flow of information and its principal task is the elaboration of a new language and new concepts to permit the emergence of a real dialogue between specialists in the different domains of knowledge.

Transdisciplinarity is therefore the linkage of several different disciplines at a higher hierarchical level that are bridged and fused together with the help of a concept that is capable of propelling the evolution of a new discipline (see Figure 3).

Figure 3. Conceptual explanation of disciplines considered within a boundary [adopted from Tsetse, (2008)].



The main feature of the transdisciplinary approach is its cross-sectional nature running through all disciplinary domains, which looks at the dynamic interrelationships between domains to generate solutions with maximum synergistic effect. Most importantly, the transdisciplinary view does not dissociate itself from the disciplinary domain but rather works within each domain serving as the synthesizing thread of action in the approach to environmental issues.

Transdisciplinary approach has evolved to address problems as sustainability and environmental governance through the integration of scientific and non-scientific sources (and types) of knowledge in the identification of, formulation and resolution of problems (Necolescu, 1999).

Prime examples of the outcomes of the transdisciplinary approach are the adaptive management approach, system evolution thinking, and resilience thinking in pollution problem identification, opportunity discovery and development of a pollution management strategy.

3. Offspring of the Disciplinary Approaches

This section examines the offspring of the various disciplinary approaches that are relevant for the conceptual development of frameworks.

3.1. Offsprings of the Monodisciplinary Approach

Typical results of the monodisciplinary approach are, for instance, the many dose-effect relationships between human action and the environment established by environmental biology and other natural sciences, the insight in environmental movements gained by environmental sociology and the interpretation of environmental jurisprudence by environmental law. All of this knowledge is of obvious relevance to pollution management but its system level compared to environmental problems as a whole is too low to be expressed in the generic framework that this present study seeks to develop. We therefore move straight to offspring of the other approaches discussed in the previous section.

3.2. Overview Offsprings of Multidisciplinary Approaches

Multidisciplinary approaches have the natural urge to put side by side the contributions of the various disciplines in a systematic manner. Tsetse (2008) presents two of those multidisciplinary overview schemes that are of special relevance for the OPiC framework. The schemes are the CPSH+PR classification of environmental functions and the classification of participatory research methods.

(i) The CPSH+PR Classification of Functions of the Environment

Functions of the environment can be used as a classifying concept to make a systematic analysis of everything the environment means to people and nature in a particular context. Such a classification can support a problem analysis in complex cases (e.g. covering a whole region), or act as a basis for economic valuation of the environment. The classification presented below is adapted from De Groot (1992). It lists the major tasks performed by the environment as a result of contributions from several disciplines. 'CPSH+PR' stands for the first letter of the different functions of the environment which are presented as listed in Table 1. The plus sign in-between indicates that the last two functions causally underlie the first four; care should therefore be taken to avoid double-counting when applying the full list. The CPSH+PR classification should be employed as a tool for pollution problem analysis in any framework for pollution management (Tsetse, 2008).

Table 1. CSPH+PR classification showing contributions from disciplines. (Adapted from De Groot, 1992).

Function	Disciplines	Characteristics
Carrying functions	Anthropology, waste management, construction, transportation etc.	Characterised by the environment providing space and substrate to contain human activities.
Production functions	Fisheries and aquaculture, energy, agriculture and nutrition, water, forestry and agroforestry, medicine etc.	Joint production functions are characterised by that human inputs are a dominant factor. In natural production functions, on the other hand, humans only harvest what the environment produces.
Signification functions	Geology, history, biology, culture, philosophy etc.	The environment produces and human beings are the beneficiaries in the cognitive and spiritual realms. (Science, play, spiritual participation etc.)
Habitat functions	Biology, culture, philosophy etc.	Provides ecological home to non-human valuable inhabitants of the earth.
Processing functions	Geography, biochemistry, hydrology etc.	Relationship in which human beings benefit from the capacity of the environment (e.g. processing, dilution and transformation of waste)
Regulation functions	Hydrology, soil science, entomology, physics etc	Refer to the capacity of the components of the environment to dampen and shield harmful influences from other components of the environment.

(ii) Participatory Rural Appraisal Methods

Participatory rural appraisal (PRA) methods are used to analyse local people's understanding of environmental issues and the way it is managed. Two central characteristics of this method are the pursuit for optimal ignorance and the use of triangulation, emphasising a diversity of sources and means for gathering data. Participatory rural appraisal methods focus on local people's analytical capabilities, local and traditional knowledge systems in environmental management (Mitchell, 2002); see Table 1. Natural sciences such as agronomics and ecology often play a role here too, supporting the development of discussion issues and the understanding of what people are saying.

In participatory rural appraisal methods, the role of the outsider is one of a facilitator rather than one of an expert. Other key features of participatory rural appraisal methods are participatory and empowerment of local people and the development of location action and institutions. Behaviour change and experiential training are the main innovations that result from the use of this method. Participatory rural appraisal methods need to be applied both in the problem identification and opportunity discovery of a framework that will effectively address pollution problems (Tsetse, 2008).

Table 2. Participatory Rural Appraisal methods showing contribution from several disciplines [adopted from Tsetse, (2008)].

Tools and methods	Disciplines	Characteristics
Secondary sources	Anthropology, history, culture, philosophy, environmental ethics, etc.	Include books, journals, reports, maps, news paper stories, project documents, photographs used to identify important issues and potential data sources and key people to contact
Visual models	Mathematics, sociology, anthropology, etc.	Include participatory modelling- local people use ground, paper or other materials to construct social, demographic or resource maps showing ownership, shared uses, existing pattern of uses and capacity of different uses. Other tools are transect walks, seasonal calendars, institutional Venn diagrams etc., identifying important actors and their relationship depicted, timelines and trend/change analysis.
Income and Expenditure Matrix and Wealth Ranking	Economics, sociology, mathematics etc.	Identify and quantify the relative importance of different sources of income and expenditures on basic needs, to investigate perceptions of wealth differences in a community. To identify and understand local indicators and criteria of wealth and well-being, to map the relative position of households in a community.
Semi-structured interviews	Sociology, anthropology etc	Conducted in the usual surroundings of the informant without a questionnaire but key ideas and formation taken. This can be conducted for individuals or groups in the form of focus group discussions.
Workshops	Sociology, anthropology etc.	The data collector meets with informants to examine information collected, share analysis and interpretations, consider opportunities and possible actions and search for preferred initiatives.
Direct observation	Sociology, ecology, anthropology etc	Involves systematic observation of events, processes, relationships and patterns to verify insights obtained from secondary sources and from semi-structured interviews.

3.3. Offspring of Interdisciplinary Approach

The causal chain approach, which typical offspring from interdisciplinarity takes its roots from the law of universal determinism that every event has a cause but the functional relationship between the events is not necessarily deterministic and what is important is when two events belong to one causal chain, the earlier may be said to “cause” the latter (Harpaz, 1996).

Causal chain approach is a typical offspring from interdisciplinarity because the chains connect the disciplinary fields and are understood not merely as one event having one cause, but also as one event having more causes. A causal relationship means that variables at a certain point in time are affected by others, at earlier points in time, in a material flow or behavioural adjustment (Faber and Proops, 1990). Causal chain approaches concentrate on issues that connect the elements into a relationship to help define a link between the cause and effect of events. The most important thing is how or what is the effect or outcome in a particular situation and through what mechanism the causal link works.

Causal chain approaches link the causes of problems to their effects with lines without boundaries in the form of causal ‘stories’ that never end. The application of the causal chain approach in environmental problems analysis identifies two main causal lines, the causal line of facts or effects and the causal line of values or norms (De Groot, 1998), which run parallel to each other and may be compared to assess the environmental problem. Even though the first is empirical and the latter normative, both involve the interpretation of reality. The functional relationship between cause-effect may be either empirical in the form of correlations (associations) or theoretical (causation) in the form of a generic relationship based on knowledge of the phenomena involved. In environmental cause-effect relationships the phenomena are physical and social. For instance, the policies being imposed on developing countries by international donor organisations cause social effects, which influence human land use activities, which also influence environmental parameters and finally human parameters such as health and economy. These, jointly with various values and norms (such as economic values and health standards) determine the character and magnitude of environmental problems.

Causal chain approaches ten to discard the exact ingredients of the meaning of an event since in most cases we fail because of their complexity. This has been the basis for criticizing the causal chain concept in that it ignores the social context where people acquire information about events to determine their meaning. The basis for this critique is first, that the detailed information of the cause of a particular event does not seem to have a critical role to play in the causal connection between events. Second, that the causal chain theory ignores critical thinking since there is no idea that will help verify the event and also contribute to understanding the complex detail of events in the causal chain (Harpaz, 1996). Tsetse, (2008) disagrees with this critique to some extent because as soon as actors are involved in causal chains (i.e. when people respond to environmental change or actions of other actors), their interpretation of these events is exactly what triggers their responses.

A key feature of causal chain approaches is that they do not have defined geographic or system boundaries. This is because the factors influencing responses in the chain are both within and beyond any predefined and bounded ecosystem or society. This therefore, calls for appropriate attention to the movement of people, resources and ideas across to whatever boundaries ecosystem, society, and cultures are thought to have, and may imply dealing with loose, transient and contingent interactions rather than focusing only on system responses (Vayda, 1983).

Causal chain approaches view the world as a series of conversion processes, linked together by inputs and outputs that do not need to address the question of system or geographic boundaries. The causal chain of processes is endless. However, they have the environmental problem at their core position, and cut-off points are usually chosen somewhere causally upstream and downstream of that problem. On the upstream side, it is proposed to distinguish between the normative, physical and social context of the environmental problem (De Groot, 1998) which are necessary to identify the link between causes and effects of pollution.

Since pollution management is concerned with short time and long time horizons, present and future generations, economic growth and environmental processes, it is necessary to consider causal relationships between variables as one of the basis for a holistic approach. In spite of the fact that causal chain theory is not perfect it can help solve lots of pollution problems, which is sufficient for me to adopt this theory, in addition to other ones, as a basis for the development of the framework for pollution management.

Causal chain approaches help to present the context of pollution management in terms of governance, traditions and rules and the objects of pollution management such as communities and industries. Causal chain approaches explain the influence of context based on actors. Here, the focus is on using progressive contextualisation (Vayda, 1983) to analyse problems from both community and individual angles. It involves a procedure that focuses on significant human activities or people-environment interactions by placing them within progressively wider context (Vayda, 1983:265). This means studying specific activities performed by specific people in a specific location at specific times and then trace the causes and effects of these activities outwards, including the factors impinging on them, without defining the boundaries of the system, but through a detail review of the relationship between actors, the action and the underlying factors (Tsetse, 2008).

3.4. Offsprings of Transdisciplinary Approach

System approaches are offspring of the transdisciplinary perspective on environmental problems. The word ‘system’ as used here refers to a whole of interconnected elements with a well-defined boundary and with system level characteristics of its own. Systems may be isolated, closed or open in terms of the relationships that pertain across the boundaries of the system with the surrounding environment. Thus, any scientific thinking that employs a system definition is based on system theory. The following are the two common characteristics of systems (Tsetse, 2008):

- All systems have some structure and organisation, which show some degree of integration.
- There are functional and structural relationships between units of systems which are connected by the flow or transfer of material which is driven by force or sources of energy.

Systems are categorised into three, based on their complexity and randomness. The first type of systems is simple and well organised; these are accessible by traditional scientific assumptions and exclusions. The second type refers to systems that are complex but are sufficiently regular to be studied statistically. The third type of systems are too complex for reductionist simplification and too organised for statistics and can only be understood though system analysis (Weinberg, 1975). Most environmental issues fall under the third class of organised complexity of systems, making them less amenable to reductionist simplicity and statistical treatment.

The concept of system reflects the ability of the human mind to perceive or see things as wholes, which is a collection of parts that are organised in some way, with connections and links between the units. According to system theory, systems analysis should not be limited to the processing of many variables but take into account the dynamics of the variables as well. Senge (1990) pointed out that "mixing many ingredients in a stew involves detailed complexity, as does following a complex set of instructions to assemble a machine, or taking an inventory in a discount retail store. But none of these situations is especially complex dynamically". Dynamic complexity is characterised by factors such as dramatically different effects of an action in the short and long run or actions with one set of consequences and very different set of consequences in another part of the system with obvious interventions producing non-obvious consequences. In this context, one can say that the real leverage in the management of complex situations lies in understanding dynamic complexity, not detail complexity (Senge, 1990; Clayton and Radcliffe, 1996; Shih-Liang Chan and Shu-Li Huang, 2004). An important feature of system approaches is the understanding of a simple concept of "feedback" that shows how actions can reinforce or balance each other. The system thinking builds on the ability to learn to recognise types of structures that occur again and again. Eventually, it forms a rich language for describing a vast array of interrelationships and patterns of change. Ultimately, system theory simplifies life by helping us to see the deeper patterns lying behind the events and details (Senge, 1990).

According to the general mode of organised complexity (Checkland, 1993), there exists a hierarchy of levels of organisations, each more complex than the one below, each system level being characterised by emergent properties at the lower system level. This hierarchy in organisations refers to an arrangement of descending order with the higher levels having control over those directly under them. Thus, properties of a given system have either a horizontal hierarchy or vertical hierarchy. However, this subordination between levels is always incomplete and each level has its own rules of behaviour and its own specific concern. Thus, entities that are whole at one level of the hierarchy simultaneously become parts of the higher level of entities. Thus, a given system exhibits the properties of being a whole and a part at a given time. For instance, an individual person is a whole on his own and a part of a family, which is the higher system in the social hierarchy. Hence, the existence of a specific level in the hierarchy is strictly dependent on the existence of the earlier levels in the vertical and/or horizontal hierarchy. Therefore, horizontal hierarchy depicts the system hierarchy that is divided into ecological, social, and economic subsystems in the order of their precedence and the ecological subsystem is the basis for existence of the whole system, while the economic subsystem is the last element in the hierarchy. The vertical hierarchy on the other hand depicts the hierarchy within the subsystem. This means the output of a system, be it "whole" or "part", has two-dimensional effects both in the horizontal and vertical direction of the system hierarchy that keep the whole system together.

4. Building Blocks for Frameworks for Pollution Management

The approach of the scientific community to environmental challenges started within the disciplinary domains. Disciplinary science based on reductionist views will remain to be the best source of gaining in-depth knowledge about single elements of the broad framework, such as on pollutant dispersal and toxicity and environmental regulation. But when it comes to complex pollution issues, the limitations of the reductionist view come into view. The move from the disciplinary to interdisciplinary approach has been dictated by the inherent limitations of the disciplinary approach in dealing with systems of organised complexity. The limitations of the disciplinary approach again dictate the need to also take up elements from to the transdisciplinary approach in dealing with environmental challenges.

To deal with both simple and complex environmental issues, interdisciplinary and transdisciplinary approaches are the best fit. Pollution is of many kinds and can be managed by adopting an interdisciplinary causal chain approach or transdisciplinary system approach. Coalescing these two, Tsetse, (2008) propose the following building blocks for a framework that will respond effectively to pollution problems should:

- Combine CSPH+PR classification of functions of the environment and participatory rural appraisal methods (from the multidisciplinary approach), progressive contextualisation (from the causal chain approach) and adaptive management, integrated management and material flow analysis (from the system approach) in a framework is aimed at overcoming the epistemological shortcomings of the traditional frameworks for pollution management.
- Use CSPH+PR classification to analyse and explain the intrinsic capacity an ecosystem needs for self-renewal, taking into account the social needs and human goals and the different of the environment. The insight gain from the analysis would assist in the development and operationalisation of the problem identification component of any framework.
- Use participatory rural appraisal methods to identify problems faced by actors (community and individuals); willingness of actors to promote their role in environmental management; the perception of actors about rules, regulations and attitudes, to harness local and traditional knowledge systems for environmental management, and for crafting appropriate policies to stimulate environmentally responsible behavior by actors. Depending on the situation and the task, a combination of methods such as secondary sources, visual models, income and expenditure matrix, semi-structured interviews, workshops and direct observation should be used. This creates an enabling context for the discovery of opportunities and also a major component in the design, implementation, evaluation and monitoring component of the framework.

Tsetse, (2008) in work propose that systems are taken as any organised physical entity with a specific functional purpose and manifestation, which are characterised by uncertain and undistinguishable information embedded in them. System theory is the core foundation on which a learning organization should be built since processes and structure of systems, whether biophysical, economic, social and institutional, are linked and interconnected. With pollution problems being complex and the social systems that are responsible for solving them also show some characteristics of complex systems and are difficult to describe and explain, an adaptive management approach is suitable to deal with the complex systems at any scale and level. The adaptive management approach should be one of the design principles for environmental assessment and management and the development of solutions in the framework. This involves the integration of ecological and participatory research approaches and adaptive management in this sense refers to a structured process of "learning by doing". This involves dealing with ecosystems and their interaction with human society. The main characteristic of complex systems is they tend to be self-regulatory and resilient (Kessler, 2003). Thus, adaptive management turn to release of human opportunities that require flexible, diverse and redundant regulation, monitoring that leads to corrective and preventive action and experimental probing of pollution problems (Tsetse, 2008). This makes adaptive management approach

- Suitable to deal with complex systems at any scale, and allows self-regulation to reach defined management goals through careful and limited guidance;
- Makes use of diversity of complex systems to adapt and be resilient without reducing or controlling the diversity or complexity of the system;
- Characterised with organisational learning and a high responsiveness to contextual changes and societal demands through monitoring;
- Aims at maintaining and/or strengthening human capabilities and sensitivities to respond to signals from ecological and social systems.

The second building blocks from material flow analysis for the development of framework are the prevention of primary resource claims through a reduction of the demand for additional products by an improved use of information and existing hardware and the increase of resource use efficiency on a life cycle wide basis. This includes the reuse, remanufacturing and recycling of products and a shift towards renewable resources. The framework should take material flow management as a pillar as it has the potential to balance the pressures on the different actors and is able to combine upstream and downstream incentives. Thus, the framework use Materials Flow Analysis (MFA), which applies the concepts of industrial or societal metabolism to study how materials and energy flow into, through, and out of a system (Ayres and Simonis, 1994). Here pollution problems are viewed as problems of material and energetic relationship between society and nature and material flow analysis can be classified by the following four criteria (Fischer-Kowalski and Hulter, 1999):

- A comprehensive perspective with focus on a socio-economic system and/or the ecosystem
- A reference system such as biosphere, a national or regional system or function unit, like household or sector
- An examination of material flows in the form of total material metabolism, energy flows or specific materials in the system
- Time aspect of analysis in the form of occurrence of the material flow in a system.

The above criteria guides material flow analysis of environmental problems such as climate change, degradation of nature and wildlife, addressing environmental health issues, preservation of natural resources and waste management by providing insight into the structure and change over time of the physical metabolism of economic systems. Key to this is the use of indicators to determine resource use, productivity and eco-efficiency in the system. It is therefore imperative that any framework for the management of environmental problems focus on controlling the wider burden of the material throughput, to bring it to the level and composition which could be sustained without jeopardizing the quality of life for current and future generations.

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