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TOWARDS A BROADER SYSTEMS APPROACH TO RESOURCE MANAGEMENT – LOCAL TO GLOBAL AND SHORT-TERM TO LONG-TERM SOLUTIONS

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ABSTRACT

The overall aim of this paper is to holistically address current challenges to WM with the help of a much broader systems view. In order to accomplish this aim, current WM issues are discussed in a global perspective to explore the gaps in current practices on a systemic level. Different examples are used to illustrate the various 'deep root' causes responsible for the current situations by highlighting various aspects related to WM, such as product design, consumer awareness and limited systemic view. The study leads to conclusions that the current efforts, rather isolated, in different systems for WM, waste reduction and resource management are indeed not sufficient in a long term sustainability perspective. The proposed broader systems approach considers production, consumption and WM systems aligned to provide long term sustainable solutions to waste issues.

KEYWORDS

Waste management, broader systems approach, root causes

INTRODUCTION TO THE PAPER

In recent decades, rapid economic development and increasing population in urbanized parts of the world have resulted in a much increased resource use and consequently release of wastes. In the current linear model of resource consumption, resources entering into the human environment are processed, transformed, used and discarded to nature in the form of solid, liquid and gaseous wastes. Nowadays, waste management (WM) is a growing concern of organizations and municipalities due to increasing environmental awareness in society and adverse consequences of unsustainable WM practices. However, only municipal wastes are discussed *globally* in social agendas and wastes due to production activities – resource extraction and manufacturing – are often not highlighted.

Waste issues have been extensively discussed in sustainable development agenda and understanding of WM issues in a systems perspective have been much improved. Significant advancements have been made in WM, such as waste collection, material recovery and treatment and advanced landfilling. Waste reduction and resource management initiatives have been introduced throughout the product's life cycle chain. At the organizational level,

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these approaches include technological improvements, design for environment and cleaner production. Inter-organizational synergies to minimize energy requirements and use industrial wastes as inputs comprise efforts such as Eco-industrial parks (EIPs) and industrial symbiosis. However, these technological improvements have been introduced considering only WM system itself and lacking a systems approach to resource extraction, production, consumption and WM as a whole. The driving factors behind most of these approaches have been to attain financial gains [1] rather than a systems oriented solution to the waste problems. Similarly, efforts such as cleaner production and design for environment have a narrow focus only on a particular product or system. Nonetheless, system changes outside the core system or product are not considered. Additionally, these efforts are carried out in relatively isolated working systems. This isolation give them the effect of 'end of pipe' solutions to the problem rather than a true *long term* system solution (technological and framework oriented), which would be necessary to fulfill combined broader goals instead of just managing waste.

Waste issues have been recognized as a global rather than local environmental problem, because of the significant contribution of waste-related emissions to for example climate change. Indeed, waste-related greenhouse gas (GHG) emissions are estimated to be 5 % of the total GHG emissions and are expected to increase to 9 % in 2020 with business as usual [2, 3]. This calls for an environmentally sound approach to WM which must go beyond the mere safe disposal, or recovery, of wastes that are generated and seek to address the root causes of the problem by attempting to change unsustainable patterns of production and consumption [4]. In this development, it would be pertinent to raise the questions such as:

- *What are the main weaknesses of current resource management system in our society?*
- *Is the current way of conceptualizing waste or resource issues solving the waste issues in 'isolation'?*
- *What are the main barriers and essential changes needed for a transition towards a more sustainable waste/resource management?*
- *In a long term perspective, is the current level of systems' complexity sufficient to deal with WM issues?*

Resource management encompasses numerous aspects - technical, economic, environmental and social - actors, and complex driving mechanisms. For instance, carbon di-oxide emissions from a patch of a waste landfill site rapidly mix with the air regulating the Earth's greenhouse effect; institutional laws at municipal, county or national levels form the "cross-level" interactions (hierarchical levels within a scale); and effects of a policy on the consumers' disposal behaviour creates "cross-scale" (across different scales) interactions. Similarly, "multilevel" (more than one level) and "multiscale" (more than one scale) interactions form inherent structures in the resource dynamics.

Numerous human activities have causes and consequences at different levels along multiple scales. Historically, intended human actions have resulted in unintended consequences due to the failure to completely recognize the cross-level and cross-scale dynamics in the human-environment systems, to name a few examples, such as collapsing fisheries, transboundary pollution problems and human-induced disease outbreaks [5]. Problem-solving efforts for such issues require an approach different than the traditional formulations. Sustainability science [6] proposes four research strategies that would need to differ from the conventional scientific activities. Ness and colleagues [7] have summarized these strategies as follows:

- *"covering the range of spatial scales between diverse phenomena, accounting for temporal inertias and urgency of processes,*
- *dealing with functional complexity resulting from multiple stresses, and*
- *the recognition of a wide range of outlooks equating to usable knowledge in both science and society."*

This paper proposes a broader systems approach to resource management based on the concept of systems thinking and sustainability science. The concept of system thinking has been utilized to illustrate the need to recognize the multitudes of perspectives, cross-scale dynamics and actors' interactions in a broader system - design, production, consumption and WM - for a sustainable resource management in our society. The approach emphasizes the need for clearly defined systems' objectives which further requires shared worldviews on the dynamic link between social, economic, ecological and technical subsystems. This appears to be an unachievable task due to the existing demographic, institutional, operational and economic differences at all the levels. However, there are examples of successful global system-level interventions such as the Montreal Protocol [8], where different communities have shown a great level of cooperation to achieve a shared goal to prevent the ozone depletion. Creation of join visions among actors requires a clearly defined objectives or coordination principles for the transition path toward the system goals. These actors could be global organisations for example United Nations, European Union who could provide a platform for a global policy making for sustainable resource management.

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