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Waste Technology Transfer from Developed to Developing Countries: Challenge

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Abstract

The practices still keep financial and environmental regimes of trade/transfer apart from each other.

Rio+20 Earth Summit framed the "green growth concept"; however, concern about the incompatibility of growth with environmental goals remains. The transfer of greening waste technology from developed to developing countries is becoming a challenge from different perspectives, such as: knowledge, ethics, as well as risks of unsustainability.

This paper is linking sustainable waste management with fair waste management technology transfer, as well as ethically sustainable waste management solutions, taking into account the fragmented trade system. In an environmentally ethical world, it is important to address these issues, taking into account wicked characteristics and the future meaning of waste.

This paper marks the need of deeper understanding of appropriate and tailored waste management solutions and technologies, by mainstreaming sustainable waste management objectives into transition impact assessment (from lower to the higher standards related to end-of-life waste care). The adapted transition impact check list is used, leading to concluded remarks. Special attention is paid to technology transfer producing economic interdependence.

Keywords: Environmental Ethics, Sustainability, Tailored solutions, Technology transfer, Trade system, Waste management

1. INTRODUCTION

Waste prevention refers to "measures taken before a substance, material or product has become waste"[1,2]. Waste prevention is at the top of the waste hierarchy, but progress towards it has so far been relatively limited [3,4,5].

Today we faceunpredictable challenges regarding waste management in the future. Addressing these challenges requires a systematic approach and life cycle thinking. Possible waste prevention tools include:

- removing market failures hampering re-use, recycling and recovery,
- undertaking a life cycle analysis,
- undertaking a chemical flow analysis,

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- implementing and further developing cleaner production processes and products, including addressing the lack of/low reuse and recycling; eco-design, design of resource-efficient products that enable repair, re-use and recycling,
- internalizing the external costs of material extraction and processing, transport as well as waste disposal; international cooperation and technology transfer in the area of resource efficiency, re-use and recycling; international cooperation on combating illegal trade practices,
- facilitating the transition towards cleaner production with social planning, involving workers and communities affected; developing new and innovative public-private partnerships among industries, governments, academia and other non-governmental stakeholders aiming to enhance the capacity and technology for environmentally sound waste management, including waste prevention,
- actively disseminate information to the public and ensure their participation in decision-making,
- providing training and technical and financial support,
- providing better control and enforcement systems.

However, it is the issue of how to measure waste prevention [2,6,7,8].

This paper marks the need of deeper understanding of appropriate and tailored waste management solutions and technologies, as well as to mark technology transfer responsibility in sustainability / un-sustainability development.

1.1. Prologue

The background research base for this paper is previously presented [1,9,10] and concludes with the (future) building blocks:

- The more waste is reclassified as a product, the more natural resources will be saved
- The more waste generation is prevented, the greater improvement in resource efficiency is acquired
- The future meaning of the term "waste" will be substantially different in developed, countries in transition and developing countries (if the same path and timeline remain in improving waste management options):

a) *for EU member countries* – the term waste will become end-of-use-waste, and waste management will propel *towards* resource efficiency / management,

b) *for EU candidate/ accession countries* – the meaning of the term waste will depend on the matrix of waste (and environment) infrastructure preconditions being able to efficiently shift towards sustainable resource management, and

c) *for developing countries* - the term waste will remain as it is now.

Creativity and knowledge based actions are the key for a sustainable world, and innovative approaches will make possible "short-cuts" (from dumping to waste prevention, for example), as well as to adapt the meaning of end-of-life waste to the context. This research, i.e. tough exercise is inspired with an idea to create awareness on the "situation in field" (illustrated with the typical cases noted, *Table 1*) and (possible) un-sustainable solutions.

Table 1 – Noted situations related to waste technology transfer

Possible noted situations	*Offers*
A town with 50000 inhabitants, having registered only a dump site	Delegations to municipality from developed countries, big cities, big companies, etc. "selling" technologies for incineration (often older technologies), "offering" excursions to the places where technology works
Sub-region /region/ city with one/few million inhabitants, having registered only a dump site	Delegations to decision makers from developed countries, big cities, big companies "selling" technologies for different recycling options, without analysis of quantities and availability, "offering" excursions to the places where technology works
	Delegations to decision makers from developed countries, big cities, big companies "selling" "landfills technologies", without analysis of other waste management options, often offering un-appropriate capacities, "offering" excursions to the places where technology works

This analysis is a follow-up to our research positioning waste not purely as an engineering or scientific problem, as presented in Table 2 [1, 11].

Table 2. - Wicked problem characteristics in waste management: related snapshots

Wicked problem characteristrics	*Waste management characteristics*
It is hard, maybe impossible, to measure or claim success with wicked problems because they bleed into one another, unlike the boundaries of traditional design problems that can be articulated or defined; these always occur in a social context.	İt seems that in waste problems, communication and coherence among diverse stakeholders are still a challenge. There are facts, data, studies and reports, but a coherent shared space for crafting and negotiating shared understanding is sometimes difficult to reach (for example to solve the problem - but not at the location next to our living/working place). The wickedness of the problem reflects the diversity among the stakeholders in the problem.
Solutions to wicked problems can be only good or bad, not true or false.	It seems that in particular situations to waste solutions, applicable terms are "better," "worse," "good enough," or "not good enough." This opens the question: are we *improving* rather than *solving* waste issues; s*olutions to waste problems are* simply intending to be *appropriate* (not right or wrong), supports by background research noted
There is always more than one explanation for a wicked problem, with the appropriateness of the explanation depending greatly on the individual perspective of the designer	It seems that more often than not, there is no unique explanation of waste problems (for example see background research dilemmas). It will not be difficult to illustrate the interconnected quality of socio-economic political systems with waste problems, i.e. for example present how a change in education will cause new behavior in waste prevention and care.
Every wicked problem is a symptom of another problem.	For waste, this diagnosis applies. Waste is a "symptom" of living models, GDP/poverty prevention, technology level, etc.

2. TRADE AND TECHNOLOGY TRANSFER PRACTICE

The Rio+20 Outcome Document sets out broad recommendations for transitioning to greener economies, and defines the role that *trade* can play in this context, including "establishing enabling environments for the development, adaptation, dissemination, and *transfer of environmentally-sound technologies*, while noting the role of foreign direct investment, international trade and international cooperation in the transfer of environmental-sound technology"(paragraph 271) [12].

Green economy [13,14] implementing tools include improving international frameworks that regulate international trading system. The transfer of environmentally sound technologies, through trade- and investment-related channels, is also promoting economic and social development in developing countries.

However, the list of World Trade Organizations agreements appears to be most relevant for green economy measures. In addition to the enforceable rules, world leaders recognized in the Doha Ministerial declaration [15,16] that "…under rules no country should be prevented from taking measures for the protection of human, animal or plant life or health, or of the environment at the levels it considers appropriate, subject to the requirement that they are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade, and are otherwise in accordance with the provisions of the Agreements". This language can also be found in Principle 12 of the Rio Declaration 1992: "Trade policy measures for environmental purposes should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade". Similarly, it is present in Article 3.5 of the UN Framework Convention on Climate Change, whereby: "Measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade". This language is also reflected in paragraph 58(h) of the Rio+20 Outcome Document [12,17] .

Trade, when accompanied by appropriate regulation, can facilitate the transition to a green economy by fostering the exchange of environmentally friendly goods and *services* (*including environmentally sound technologies*) and by increasing resource efficiency and generating economic opportunities and employment. A green economy is increasingly seen as a gateway to new opportunities for trade, growth and sustainable development.

There are positive signs that trade-related practices are moving towards more environmental, social and economic sustainability. Many suppliers are greening their practices in order to secure their positions within international supply chains (for example, by the 1500 per cent increase in global ISO 14001 certifications on environmental management between 1999 and 2009).

The interaction between trade and the transition to a greener economy is complex and can be seen as bidirectional: trade has the potential to facilitate the transition to a green economy, and the transition to a green economy has the potential to create new trade opportunities. Sustainable trade, in fact, can facilitate the transition to a green economy by fostering the exchange of environmentally friendly goods and services, including environmentally sound technologies, by increasing resource efficiency, by generating economic opportunities and employment, and by contributing to poverty eradication [18] . Motivation to participate in an environmental law regime (Table 3) depends, to a large extent, on appeal to a sense of ethical and social responsibility, i.e. the financial and environmental regimes have each evolved apart from other [19] .

Table 3 [based on 19] - *Comparison of trading and environment regimes*

Trade	**Environment**
Interest driven: market access and country-based benefits	Public goods approach
Focus on individual benefits; public good in terms of legal security	Focus on the creation of public goods, low priority of individual interests
Reciprocity in terms of political economy	Non-reciprocity
Responsive to domestic and foreign pressure	Responsive mainly to domestic pressures
Excludable nature of trade regulation (benefits limited to participants)	Non-excludable nature of environmental regulation (benefits for the public at large)
Incentives to obtain market access and non-discriminatory treatment	Free riding; Limited incentives to participate
Independent nature of the trade regulation system	Heavy dependence on funding and technical assistance
Strong institution and legalization	Fragmented treaty system and weak compliance mechanisms

3. WASTE TECHNOLOGY TRANSFER: ANALYSIS SNAPSHOTS

Infrastructure environmental services include waste, water and refuse collection and disposal, and services that typically require significant investments, such as the construction and maintenance of physical facilities. Such services are usually characterized as *public goods* and are *often* either managed or regulated by governmental bodies [16]. *Non-infrastructure* environmental *services*, such as the prevention and remediation of pollution, have emerged as a response to environmental problems inherent in modern industrial economies.

Developing/in-transition-economies countries need access to advanced technologies to adapt to the sustainable, environmentally sound solutions and yet at the same time achieve better economic growth and social development without adding the additional problems to be solved. There are significant barriers to the rapid adoption of such technologies, including high costs, import and export restrictions, inadequate government policies and regulations, and a lack of experience and knowledge to operate and maintain the technologies.

The World Trade Organisation Agreement on Technical Barriers to Trade, under Annex 1.2, defines *standards*. Standards are based on state-of-the-art technology, including environmentally sound technologies and management practices, and are often developed by international technical committees composed of leading experts in their respective fields. Properly implemented standards can facilitate sustainable trade by favoring the transfer of environmentally sound technologies. In *Table 4* we present possible priority concerns related waste technology transfer.

Table 4. – Technology Transfer Process [20,21]

Issue		Attention related *waste technology transfer*: 1 – first priority, 3 - medium priority, 5 – consequences of actions under Priority 1 and 3	Issue of Know-how (including know-how ethics, as well as corruption)
Technology justification and selection stage	Wrong selection of technology, based on misjudgements when preparing a business case for technology transfer project	1	
	The cost of buying, installing, operating and manufacturing technology is too high	3	
	The technology selected is too complex for easy understanding and assimilation of the transferee	5	
	The technology needs considerable adaptation to suit	1	

	local conditions		
	Obsolescence of technology while the transfer is in process	1	
Planning phase	Transferor (seller) underestimates the problems in transferring the technology to a developing country setting	1	
	Transferor does not fully understand transferee needs	1	
	Transferee managers are not involved in the planning which is carried out only by the transferor	3	
	Too much attention is paid to the hardware to be purchased and not enough attention is paid to skills and information acquisition	3	
	Overestimation of the technological capabilities of the transferee by the transferor thereby leading to unrealistic expectations on how well the transferee can meet target dates	1	
	Poor market demand forecasting by the transferee of the outputs to be produced by using the transferred technology	3	
	The objectives of the transferor and transferee are not compatible	3	
	Mechanisms chosen for implementing the transfer are not appropriate	5	
Negotiations	Differences in negotiations approaches and strategies	3	
	Lack of trust between the transferor and transferee	3	
	Goal incompatibility during negotiations	3	
	Inability to reach agreements on pricing, product and marketing strategies	5	
	Both parties try to achieve results in an unrealistically short period of time	5	
Technology transfer implementation	Shortage of experienced technology transfer managers	3	
	Lack of trust in transferor developed systems by the transferee	3	
	Inability to achieve quality targets	3	
	Delay in obtaining supplementary materials, needed for quick implementation, from the local environment	3	
	High cost and poor quality of locally available materials needed to implement the technology transferred	5	
	Inadequate tracking of the technology during implementation	5	
	Cost overrun due to poor implementation	5	

4. TRANSITION IMPACT ASSESSMENT AND SUSTAINABLE WASTE MANAGEMENT

The complexity of *international trade* links often makes it difficult to identify the root causes of related environmental impacts. Without *fair policies* to protect the needs of the public, millions of people will remain underrepresented and excluded from important opportunities to connect, contribute and achieve [22]. Seven sources of the *transition impact* includes setting (high) standards for corporate governance and business conduct, as well as *transfer and dispersion of skills* [22, 23].

Managing waste is a complex task that requires changes in consumption and waste production patterns, appropriate technology, organizational capacity, and co-operation among a wide range of stakeholders [24].

National and municipal governments often have insufficient capacity or funding to meet the growing demand for solid-waste management services [25, 26,27]. In developing countries, data on waste generation and composition are largely unreliable and insufficient, seldom capturing system losses or informal activities [28, 29]. Without proper data and/or solid prediction, it might be difficult to design sound strategies or to make wise budget decisions on waste management [30]. It is the challenge how to aggregate up transition impact assessment from project-level experience to consider impacts at higher levels (for example country level, or in waste sector).

4.1. Opening the box: meaning of words and expressions

Trade may serve as a channel for the transfer of environmentally sound technologies and services, and provide consumers with access to a greater variety of environmental goods and services at a lower cost. It is required to further improve tools in order to deal with the waste technology transfer problems.

Vocabulary blocks/core words related to *waste technology transfer*, as the outreach of analysis presented are:

waste technology transfer	trade	environment
fair waste technology transfer	waste technology transfer ethics	gaps in knowledge
tomorrow's recycling	lifecycle thinking	appropriate up-to-date tools
waste management infrastructure	waste management practice	integrated management of resources
know-how transfer	eco-corruption	waste
treaty system	developing country	ethically sustainable solutions

5. IMPORTANT PARAMETERS IN WASTE TECHNOLOGY TRANSFER EQUATION

Technology transfer process includes [19] technology justification and selection stage, planning phase, negotiations and technology transfer implementation. In order to achieve waste management sustainable solutions and ethically sustainable solutions, analysis presented in this paper, lead to initiative / proposal to a list of important parameters to be included in waste technology transfer equation (Table 4).

Table 4 - List of important parameters to be included in waste technology transfer equation

For waste technology seller	*For waste technology buyer*
To pay less attention on individual interests of buyer	Country-based benefits, i.e. full understanding of national waste management strategy/plan and waste management technology to suit local conditions
Practice of fair waste technology transfer, including "offers" of obsolete/second-hand/non-sustainable technologies	To develop / request waste technology, based on knowledge based studies and with enough attention to skills
Responsibility for transition impact of proposed waste technology, i.e. to proper estimate the problems in transferring the technology to a developing country setting	To fully understand how to deal with fragmented treaty system and weak compliance mechanisms, focused on sustainable waste management solutions
To think about perspective: wicked characteristics and future meaning of waste	
To develop appropriate mechanism for implementing the transfer	
High ethical standards related to sustainability of waste management solutions	

6. CONCLUDED REMARKS

Many of the countries that are important net exporters of commodities (including waste management technologies) have short-term economic interests coupled with weak institutional systems for preserving the environment. This paper identifies a number of enabling conditions that can facilitate sustainable *waste technology transfer – environmentally sound trade* opportunities. Even when there is a strong economic, environmental and social case for investing in greening trade, a number of important obstacles remain. These relate mostly to limitations in financial and human resources, weak regulatory frameworks, lack of enforcement mechanisms, and poor economic infrastructure. In addition, the paper is linking sustainable waste management with fair waste management technology transfer, as well as ethically sustainable waste management solutions, taking in account the fragmented trade system.

These issues need to be addressed through concerted efforts at the international, regional, national and local community levels. Through analysis, this paper proposed a list of important parameters to be included in the waste technology transfer equation, especially when transfer is from developed to developing / in transition countries.

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