FROM 3R TO 3S: AN APPROPRIATE STRATEGY FOR DEVELOPING COUNTRIES

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Editorial

FROM 3R TO 3S: AN APPROPRIATE STRATEGY FOR DEVELOPING COUNTRIES

It is an acknowledged fact that the quality and generation rate of municipal solid waste (MSW) is largely linked to the lifestyle, welfare and cultural level of a society, with a production per capita ranging indicatively from 0.1 kg MSW/d in low income rural areas to 4.5 kg MSW/d in urbanized industrialised areas of the world (The World Bank, 2018). Social and economic development are even more crucial with regards to waste management strategies and related technologies, although a series of other factors may play an important role (availability of land and energy, climate conditions, education, public opinion attitude, etc.).

On an international level, the classification of countries with regard to their economic level of development remains an open issue, largely due to the difficulties in defining concepts such as poverty, financial constraints, and conditions of development. Not wishing to enter into a discussion on these aspects of classification, in this note the Authors focus on areas presenting jointly critical economic constraints and poor waste management systems. These areas are generally characterized by a fast-growing population, high level of urbanization, lack of modern infrastructures, highly inhomogeneous level of education, inadequate public administration, and frequent political instability. Areas featuring these characteristics can be identified with the so-called "Low Income Countries" but also with areas potentially present in countries with a more favourable classification.

In these areas waste management is generally characterized by the following features:

- disposal facilities represented substantially by open dumps or poorly engineered and managed landfills;
- uncontrolled waste burning;
- widespread littering, very low waste collection coverage and precarious waste transport vehicles;
- recovery of valuable waste resources by the informal sector (informal recycling and scavenging).

Under these conditions, environmental and health issues are of high concern (quality of drinking water, air quality, degradation of the urban environment, surface and ground water pollution, GHG (greenhouse gas) emissions, spread of infectious diseases, hazards for the scavengers, etc.).

Similar problems were also encountered in the past in wealthy, industrialized countries, although the situation has changed dramatically in recent decades due to the progressive increase of public awareness and perception of environmental issues, and scientific developments. These developments have focused prevalently on addressing a series of fundamental ecological issues (limited resources, climate change, widespread diffuse contamination, demographic growth, depletion of non-renewable energy sources, availability of land, etc.).

Nowadays, an environmentally-sound waste management system should satisfy the following requirements (Cossu, 2009a):

- decrease in waste production;
- efficient service of collection and disposal;
- optimisation of material resource recovery;
- minimisation of GHG emissions;
- reduction of landfilled waste volumes;
- optimisation of energy balance (reduction of energy consumption/waste to energy options);
- reduction of emissions;
- monitoring of toxicological effects and minimization of health risks, environmental sustainability.

These requirements should represent the conceptual guide for waste management in any corner of the world, irrespective of the level of economic development. Naturally, these requirements will need to be integrated into and evaluated in the various geographic contexts, taking into account economic, social and geomorphologic situations which may exert a strong influence on any choice.

The industrialized countries have attempted to meet the above-mentioned requirements by establishing a wide variety of approaches and technologies. Hierarchical Waste Management, zero-waste, Circular Economy, 3R (Reduce, Reuse, Recycle) are among the most popular concepts which currently contribute towards shaping national regulations. However, the practical application of these approaches has frequently been characterized by demagogueries, contradictory aspects, waste of economic resources, complicated and costly technologies, political speculation, misinformation of the public opinion, etc. (Cossu, 2009b, 2014, 2016, 2018).

Accordingly, the transfer of strategies and technologies from industrialized to developing countries should be carefully managed to avoid failures and mistakes and prevent export of outdated models or inappropriate or obsolete technologies.

Transfer of proper management and technologies are generally hindered by several reasons:

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- low education at different levels, resulting in unskilled technicians and widespread lack of environmental awareness;
- political instability with failure of long-term MSW management actions;
- MSW management is not always a high priority for local and national policy makers and planners;
- a scarce awareness of administrations with regard to the basic needs of the population and a lack of willingness to promote appropriate actions;
- ineffective institutional structures and pervasive corruption;
- inappropriate international funding and loans which support projects in the short-term, thus preventing the successful transfer of the project to the local authorities in the long-term;
- implementation of technologies of the highest standards, the operations of which are subsequently prevented due to lack of spare parts and/or well-trained personnel.

In line with the above considerations, when the circumstances are premature for the application of the 3R concept as part of a Circular Economy strategy, a 3S (Sanitisation, Subsistence economy and Sustainable landfilling) strategy should be implemented. The 3S approach, at variance with the 3R concept, is not perceived as a hierarchical structure, but rather is based equally on all three pillars (Figure 1).

Sanitisation aims to improve the standards of living in the country, achieving basic rules of hygiene in waste management.

In those countries in which people can count on a limited economical availability to support MSW tariffs, health and environmental protection constitutes a priority objective to be pursued beyond material and energy recovery. An inadequate waste disposal on the city streets entails a direct contact between wastes and the population. The population is therefore exposed to health issues including injury, diarrhoea, respiratory disorders and viral conditions, which are exacerbated by surface and groundwater contamination, air pollution from uncontrolled waste incineration, and soil contamination from leaching. The establishing of a stable waste collection system removes the waste from the residential areas, thus avoiding health issues. “Nothing is cheaper than not collecting solid waste” (Hoornweg et al., 1999).

Subsistence Economy is aimed at returning waste to the economy as a resource through the use of appropriate technologies, providing economic profits and new business opportunities and involving the informal sector activity in a remunerated and formalized way.

A robust and sustainable MSW management system should be designed and sized to meet local needs, at least over the medium-term. It should be resilient to political interferences and be flexible to further developments (e.g. market, technology, social). Custom-made technologies in line with social, cultural, economic and local requirements should be identified, being robust and well-proven, suited for management by local people.

Spontaneous recycling practices only occur when economically viable. Waste pickers worldwide are largely informal individual workers who are not supported by the government or included in insurance schemes or social welfare; they create an opportunity for self-employment in very difficult working conditions, strongly dependent on their capacity to sell collected material on a highly precarious market. In the presence of an informal sector, it is fundamental to involve these individuals in the operation of an MSW management system. The role of local authorities is critical in this context as solutions should be discussed and planned with the active involvement of the different stakeholders. Successful initiatives are represented by the organisation of informal recycler cooperatives (Gutberlet, 2015).

Sustainable Landfilling is needed to safely dispose of residues devoid of any economical or technical value.

Open dumps still constitute the most prevalent type of disposal facilities in developing countries, entailing a low level of technology and operational cost requirements. Open dumps are characterised by a lack of barriers for leachate containment and biogas control, uncontrolled waste discharge, presence of scavengers and uncontrolled waste burning to reduce the waste volume. This type of disposal results in environmental and health risks. Although awareness is increasing amongst both the public and politicians with regard to this dangerous situation, it is still insufficient and the achievement of sustainability remains a crucial challenge. Sustainable landfilling should be designed to reduce the emission potential in the long-term and to achieve an acceptable equilibrium with the environment within the span of one generation (30-40 years). In the presence of limited technical and economic situations, the following aspects should be integrated: low cost solutions in terms of development, operation and maintenance; simple, easily-implemented technologies, and maximum utilisation of natural resources and in situ materials (Lavagnolo M.C., 2018).

Sanitisation, Subsistence economy and Sustainable landfilling should be considered as complementary principles, the integration of which is strongly advocated. Saniti-

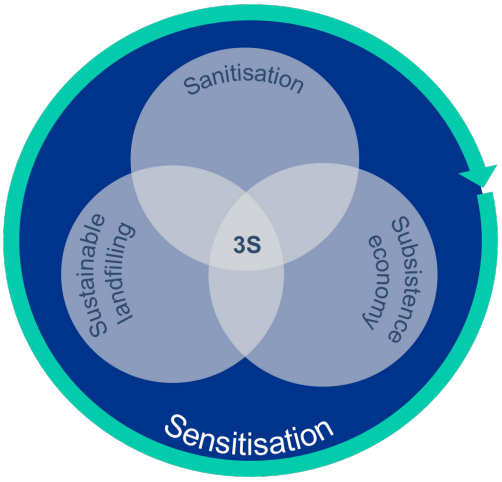

FIGURE 1: Graphical scheme of the 3S model proposed as a strategic tool to address the actual requirements of waste management in areas with economic constraints.

sation cannot be achieved in the absence of safe allocation of the collected waste. The recovery of valuable resources, which are removed from the main waste stream, reduces the volume and improves the quality of the disposed waste (e.g. treatment of food waste by means of composting or anaerobic digestion), thus promoting the landfill sustainability concept. Simultaneously, the safe disposal of worthless materials is ensured by Sustainable landfilling. Waste collection and organisation of the informal sector must be designed so as to achieve both sanitisation and recovery of valuable materials, thus supporting the local trade sector.

Sensitisation is an essential aspect in ensuring the successfulness of the whole strategy, as a sustainable SWM system should above all rely on local human resources.

Sanitisation, Subsistence economy and Sanitary landfilling should not disregard the sensitisation process of all stakeholders, from the public administration to the population. The lack of awareness of the population and administrators leads to the absence of an active participation and to the inevitable failure of any attempt at implementing a sustainable SWM system. An educational program should be carried out throughout the entire process, at different levels (schools, public administration, workers, citizens, etc.) using all media supports in order to reach the highest number of people (educational activities with children, local radio, social media by electronic devices, social events involving the community, seminars, etc.) An example of a successful initiative is represented by the establishment of a literary cafè in Youndé (Cameroun) as a meeting point for the sharing of knowledge and points of view on sustainable waste management (Lavagnolo and Failli, 2018).

Low income countries are in an ideal position to advance the most modern ideas in waste management, particularly by learning from the mistakes of the "developed" world. Indeed, in the near future we might reach the paradoxical realisation that a rich country is in many ways poor and, vice versa, a poor country is in many ways rich.

Maria Cristina Lavagnolo, Valentina Grossule
University of Padova, Italy
mariacristina.lavagnolo@unipd.it

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