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Algorithm to select sustainable sanitation options

The urban population in the world will double in the next 50 years, and both existing settlements and virgin land to be settled are included in the agenda for sanitation improvements. The choice of sanitation option is wider for residential areas to be established and allows for new approaches to arrange for safe sanitation. In contrast to previous planning, a "solution" should not only move the dirt further away, but the ambition is to return it safely to nature as a resource.

The Millennium Development Goals (MDG) for sanitation now requires that 2.4 billion additional people have adequate sanitation by the end of 2015 i.e., around 440,00 people per day. Almost all these "urban" people live or will live in periurban slum areas. These figures are very large indeed.

The amount of information of sanitation arrangements is vast and need to be more readily available to professionals. Also there is a need to redistribute responsibilities between stakeholders in order to reach the millennium goals. The selection algorithm suggests how to select an appropriate up-to-date sanitation arrangement, aimed at being environmentally, technically, economically and socially sustainable. This means, among other things, that they are safe and environment-friendly in that the arrangements protect human health and save on water, prevent water pollution, sanitize and recycle the nutrients and organics to restore soil and soil fertility.

A sanitation and water arrangement organises flows of resources to, through, and away from the household and community, and has therefore to adopt a sustainable perspective when being planned. A long-term perspective is to project what will become scarce resources in the future. Here, the focus is on resource issues such as scarcity of water, scarcity of phosphorus, and also scarcity of cheap energy. This in turn will guide us to what resources should be conserved and/or recovered by the proposed sanitation and water arrangement. The broad aim is to organise inputs to the system and the ensuing output in such a way that sustainability is ensured.

Sanitation arrangements must apply to a wide array of local physical, cultural and economic conditions. Physical conditions may vary from sloping to flat, rocky to sandy, inundated to dry, water rich to water scarce, high density to low-density settlements etc. One kind of system cannot be feasible to all situations, and a major emphasis in the following presentation is that of combining arrangements instead of trying to enforce a uniform one for a whole city.

In the last decades the focus has shifted from providing water (based on water as a human right) to enhancing its use in households (household responsibility for good use), so called demand management. The new, emerging water policy focus is to improve the quality of discharged used water and nutrients from the households. We identify three main principles for water and sanitation arrangements, particularly in urban areas.

Principle 1: "*Start the planning from what is acceptable to reuse or to discharge to nature*".

A water and sanitation arrangement receives a wide range of products that have been used by residents. In a society with few and harmless consumer products the sanitation arrangement can be made simple. However, in the emerging chemical society where thousands of chemical compounds are part of the goods we consume, more varied and sophisticated arrangements are needed, to ensure that nature does not suffer. The policy should be proactive and include that manufacturers are requested to replace harmful compounds in their products (P in detergents etc.) or that consumers boycott harmful products.

Principle 2: "*Adjust the water and sanitation arrangement to the material flows*".

The quality of the effluent and other residues should be of as good quality as possible in order to be easy to reuse or harmless when returned to nature. We may compare with manufacturing a car. The design of cars includes how to compose it in order to make the disassembling easy by the time the car is to be scrapped. The idea is to facilitate the collection of different parts for reuse (metal, plastic, rubber, etc.) or for final destruction. This principle does not limit the quality of the car. Similarly, different water and material flows should not be mixed but kept separate to facilitate a cost-effective treatment and reuse, without reducing the comfort for the users.

Principle 3: "*Manage the arrangements at the most resourceful level*".

Financial resources and manpower are common constraints. Residents manage the part of the arrangement in the home and yard, and may call on an entrepreneur for a new installation and repairs. Decision-makers and professionals are responsible for regulations and they monitor the water and sanitation system. Any arrangement requires a partnership between the two actor groups, and there are a number of tasks that can be taken on either by residents, a CBO, utility, or private business. An arrangement should be designed in order to save on scarce management resources in the community/society.

The proposed algorithm starts with issues of environmental policies and wastewater quality, leading over to how to evaluate option according to the above principles and issues of physical, environmental, cultural, and economic sustainability, and leading up to various reuse possibilities.