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Institute for Integrated Management of Material Fluxes and of Resources

WATER, SOIL AND WASTE

DRESDEN NEXUS CONFERENCE

DNC 2015 | GLOBAL CHANGE SDGs NEXUS APPROACH

POSITION PAPER – Extended Summary

Implications of the Nexus Approach when Assessing Water and Soil Quality as a Function of Solid and Liquid Waste Management

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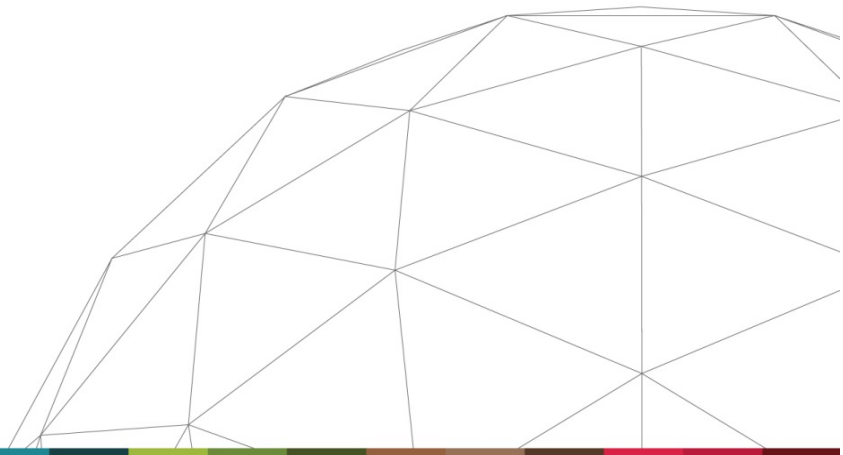

Day 3 | Population Growth

Implications of the Nexus approach when assessing water and soil quality as a function of solid and liquid waste management

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Summary

The Nexus approach is highly valuable when screening the overwhelming number of disciplinary publications on water, waste and soils as it allows a focus on linkages between the three constituting elements. To be most effective the elements should have a comparable degree of detail and linkages should also be expressed in terms of Ecosystem Services and the UN Sustainable Development Goals to express impacts beyond the local. Solid and liquid waste are well defined in terms of properties and of generation and characterization processes. Three approaches when handling waste (*reduce, reuse and recycle)* have been well developed and are increasingly being applied. Regional water regimes can be expressed by widely available hydrological models in which, however, the soil component is usually poorly represented. Unsaturated conditions in soils, where the soil also contains air, are crucial for the incorporation of compost in the soil, increasing the organic matter content by biological activity. But unsaturated conditions, associated with low flow rates of water, are also crucial for disposal and purification of liquid waste, the latter either on the surface or in subsurface seepage beds for on-site waste disposal from septic tanks. Hydropedology faces the challenge to better define unsaturated flow processes in soils , associated with solid and liquid waste disposal, which is now a missing link in the Nexus. Of particular concern are flow processes in heterogeneous soils with e.g. swelling and shrinking properties, particular soil horizons and macropores. A basic conflict exists between having relatively small seepage areas with high fluxes, short travel times of wastewater and poor purification versus larger fields with relatively low fluxes, longer travel times and more effective purification. Every soil has a characteristically different unsaturated flow regime that is insufficiently known at this time as the term "soil permeability" is associated with saturated conditions. Generation compost from urban waste is increasing worldwide, offering attractive opportunities for soil quality improvement. Succesful application of liquid waste to soil can not only benefit agriculture by contributing nutrients but particularly by irrigation which becomes increasingly important as climate change will lead to longer drought periods in many areas. At the same time, when irrigation rates exceed plant uptake it is also a contribution to groundwater supplation, while more vegetative development after irrigation is effective as a method for erosion control. Overall, the potential to utilize liquid and solid waste to improve the productive capacity of soils is quite significant and can be realized by better defining relevant soil properties and dynamic moisture regimes of natural soils in the field, needed to develop suitable management procedures for handling wastes of different composition and quality. More recognition is needed for different processes in different types of soil that determine their effectivity when incorporating waste products. Seven case studies are analysed, illustrating widely varying experiences obtained with waste disposal on soils: (i) waste disposal scenario's for Kampala City (Uganda); (ii) waste disposal procedures presented at the recent Istanbul 3W congress; (iii) subsurface septic tank disposal; (iv) soil application of olive-mill wastewater; (v) wastewater research by IWMI, the International Water Management Institute; (vi) applying dairy wastewater on New Zealand soils, and (vii) wastewater management in rural areas of Hungary and in the EU. Attention is also paid to successful and quite promising solid waste management seperation procedures in Edmonton (Canada),

Quatar and Istanbul yielding high quantities of compostable materials. Infiltration of municipal wastewater has successfully been applied in several areas, with activities in Braunschweig, Germany, as a unique long-time example. Long-duration interaction between scientists and stakeholders is crucial to arrive at positive results in practice. The study of waste application to "Jaar"soils in Senegal is an excellent example of such a "joint learning "experience.

Incorporation of solid and liquid waste in the soil as part of regional and local soil water regimes, does not just present technical problems but also has an emotional dimension. The concept of waste being a : *"resource out of place "* is not yet universally embraced. Specific examples of succesful waste recycling systems, where soil water regimes in particular types of soil play a crucial role, need to be further developed and widely communicated.

Keywords: compost, septic tanks, unsaturated flow, interdisciplinarity, transdisciplinarity.

After his study of soil science at Wageningen University, the Netherlands, finished *cum laude* in 1966 , and obtaining a PhD on soil management in 1969 at the same University, **Johan Bouma** departed to the University of Wisconsin in Madison to take a postdoc position, working on soil disposal of septic tank effluent. In 1973 he was appointed tenured Associate Professor. For personal reasons he returned with his family to the Netherlands in 1975, to become head of the soil physics department of the Netherlands Soil Survey Institute (Stiboka) and in 1983 deputy director of the institute. In 1986 he was appointed professor of soil inventarisation and land evaluation at Wageningen University. He retired from this position in 2002. From 2002 to 2004 he was scientific director of the Environmental Sciences Group of Wageningen University. From 1998 through 2003 he was a member of the Scientific Council for Government Policy (the WRR) (a think-tank in the prime minister's office) where he chaired working groups and presented reports on development cooperation, environmental policy, sustainable development and future studies.

Bouma published some 400 articles, including 260 in internationally reviewed journals. He contributed chapters to 28 books, including 10 of which he was the main editor. His h (irsch) factor was 40 (september 2010). He supervised 40 PhD students covering water movement in structured soils (4); spatial variability and GIS (5); land evaluation, focusing on developing countries (24); precision agriculture (4) and biological agriculture and global change (3).

Bouma is fellow of the Soil Science Society of America (1985); he was invited to present the Brady lecture in 2009 at the yearly meeting of the Soil Sci.Soc of America and the Hubbell lecture in 2010 at the University of Florida in Gainesville. He received the President's award of the Soil Science Society of America in 2014.

He is Honorary member of the International Union of Soil Sciences (2006) and of the Dutch Soil Science Society (2010); He is an elected member of the Royal Dutch Academy of Sciences, Arts and Letters, section earth sciences (1989). He is Officer in the Order of Orange Nassau (2001). In recent years he presented keynote addresses at conferences and symposia in Germany, Scotland, Portugal, Sweden, Denmark, Italy, Finland, South Africa, Kenya, Brazil and Australia.