Green Energy and Technology

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Vakur Sümer *Editors*

# Sustainable Water Use and Management

## Examples of New Approaches and Perspectives

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ISSN 1865-3529 ISSN 1865-3537 (electronic)
Green Energy and Technology
ISBN 978-3-319-12393-6 ISBN 978-3-319-12394-3 (eBook)
DOI 10.1007/978-3-319-12394-3

Library of Congress Control Number: 2014957149

Springer Cham Heidelberg New York Dordrecht London
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Printed on acid-free paper

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# Preface

In the second half of the twentieth century and particularly in its last quarter, the need for sound use and protection of freshwater resources, coupled with due consideration to the needs of different interest groups, have become more and more obvious. It is understood that less than 0.5 % of the world's water resources is freshwater available for human use, and that around one-third of the world's population lives in areas where water is scarce or extremely scarce. Moreover, by 2025, that number is expected to grow to two-thirds. Therefore, the second half of the twentieth century witnessed the increasing prominence of concerns over water management issues, which is now very present.

With regard to the water crises summarized above, the problem can be solved not only by implementing new technologies, but also through changes in water use practices and water resources management. In this sense, the primary reasons that water problems afflict developing countries are accepted to be of political and institutional nature, and not technical ones. In this respect, the Global Water Partnership concluded that "the water crisis is mainly a crisis of governance." It is accepted that sectorial regulation of water resources management leads to "splintered and uncoordinated" water use and hinders the organization of water protection mechanisms. One of the ways to find reasonable solutions to water-related problems in these countries is to implement the principles of integrated water resources management. There is also a need for ever-efficient water technologies, improving the situation in respect of excessive water use in agriculture. It should be noted that agriculture is the biggest water consumer worldwide. Apart from technological innovations aiming at "more crop for every drop," demand management tools is also another proposed solution for increased water efficiency which could also lead to increase in improved water productivity in the agricultural sector.

The issue of "sustainability" in terms of water use lies at the heart of this dynamic debate. Taking it more broadly, sustainability means not only seeking a balance between today's and tomorrow's needs, but also working towards a balanced view of water with consideration of intertwined relationships among all stakeholders, namely policymakers, water users, water service providers, and others, all competing water needs (of industry, energy sector, households, irrigation, recreation, ecological flows), and all relevant economic sectors (manufacturing, tourism, agriculture, water services sector, etc.). Reaching food security, particularly under the shadow of climate change, has become one of the utmost priorities for many countries adding further complications to existing equations of competition.

This book is located at the crossroads of two key phenomena: sustainability and water use. These themes should be taken in their width, meaning that the axis of sustainability and water use brings together academic research and discussions on water efficiency, new technologies, water-agriculture nexus, transboundary cooperation towards river-basin management, pricing issues, participatory water management, role of women in sustainable water use, and other themes. It is divided into two parts:

Part I deals with approaches in sustainable water use and management and offers users an overview of the theoretical basis and elements which have been guiding the implementation of sound approaches to use water resources.

Part II contains a set of case studies in sustainable water use and management, where ongoing projects and initiatives are demonstrated in practice.

Consistent with its editorial objectives, this publication aims to contribute to this growing debate with discussions of new approaches, methods, concepts, arguments, and findings. We hope that not only water experts but also readers from different backgrounds and disciplines will benefit from this volume.

In the process of preparing this edited volume, we, the editors, were supported both financially and logistically by our own respective institutions, namely Hamburg University of Applied Sciences, Manchester Metropolitan University, UNC—Global Research Institute, and Selcuk University, Konya, in Turkey. We would like to acknowledge their support. Special thanks are due to Erika Glazaciavoite, for helping to produce this book. And, last but not least, we would like to thank our families for their continuous support and patience all through the research and writing process.

Autumn 2015

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# Part I
# Approaches in Sustainable Water Use and Management

# Ethics, Sustainability, and Water Management: A Canadian Case Study

**Ingrid Leman Stefanovic**

**Abstract** This paper argues that values, perceptions, and attitudes affect decision making in water management and that a better understanding of water ethics will ensure more reliable management practices. A Canadian case study, focusing on the City of Toronto's Biosolids and Residuals Master Plan (BRMP), illustrates the importance of values in water management practices. In 2007, the author served as one of a seven member expert peer review panel to evaluate the model used by consultants to recommend biosolids management upgrades at each of the city's four wastewater treatment plants. Both the decision-making model as well as community reactions to the model and master plan revealed value judgments that ultimately affected the management process and implementation of recommendations over recent years.

**Keywords** Ethics · Values in sustainability · Biosolids and water management · Perceptions and attitudes in decision making

## 1 Introduction

According to the United Nations (2012: 1), more than 50 % of the global population now resides in cities. Within these urban areas, sanitary sewage and stormwater drainage often constitute the biggest source of pollution to surface water. Given that the United Nations (2012: 1) projects a global population increase of more than 2 billion people from 2011 to 2050, the development and management of efficient and flexible wastewater treatment systems constitute a clear priority for city planners and politicians worldwide.

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W. Leal Filho and V. Sümer (eds.), *Sustainable Water Use and Management*, Green Energy and Technology, DOI 10.1007/978-3-319-12394-3_1

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In any advanced wastewater treatment plant, untreated solids that are removed from the sewage treatment process are referred to as "sludge." The biological treatment of sludge and wastewater produces a nutrient-rich material called "biosolids." A central element, therefore, of wastewater control includes a strategy for biosolids management as well. It is expected that over the coming years, "biosolids management is likely to become even more challenging due to external forces such as the need for energy conservation, increased regulations on greenhouse gas emissions, tighter regulations on contaminant emissions to water and air, higher national standards for trace inorganic and organic contaminants in the land application of biosolids, greater urbanization, and more competition for taxpayer dollars" (Ehl Harrison Consulting Inc and Genivar 2008).

This chapter draws upon a Canadian example of a planning effort for long-term wastewater management. More specifically, it describes how a number of values and assumptions drove the development of a Biosolids and Residuals Master Plan (BRMP) for Canada's largest metropolis, the City of Toronto. A description of the methodology employed within the plan will be followed by a discussion of how ethics and value systems affected both the drafting of the plan as well as community responses. The case will be made that water management decisions are hardly value free. The final section of the paper offers recommendations on how to enhance sustainable water management by addressing the impact of ethical judgments upon decision making.

## 2 Case Study: Managing Toronto's Wastewater Biosolids

While both provincial and federal governments in Canada have a number of supervisory functions, the majority of wastewater systems are municipally owned and operated. (Johns and Rasmussen 2008: 83). In Ontario's capital city, "Toronto Water" holds responsibility for providing high-quality drinking water, as well as for all phases of water transmission and distribution, wastewater and storm-water collection and treatment (AECOM 2009: 1). Together with a series of pumping stations and forcemains, a sewer system stretching over a length of 9,000 km conveys 1.3 million cubic meters of wastewater to four separate treatment plants daily. As much as 174,000 wet tonnes of wastewater biosolids are generated annually (City of Toronto 2013).

More than 2.7 million people reside in Toronto, the province of Ontario's capital city. In fact, over 30 % of all recent immigrants to Canada find their home here. (City of Toronto 2012). Ontario's population growth, through both immigration and births, is expected to be higher than the national average over the coming decades as the province absorbs an increasing proportion of the national population overall (Statistics Canada 2012).

Anticipating continued metropolitan growth, officials have recognized the need for long-term wastewater and biosolids management planning. Historically, disposal of biosolids occurred through incineration or landfills. While some land application has occurred in Ontario since the 1970s, a 1996 Great Lakes Water Quality Agreement caused the province to update regulations 2 years later. In the same year, 1998, the amalgamation of seven municipalities resulted in the creation of the new City of Toronto. Almost immediately, interest began to be expressed by councillors and planners in developing a long-term program of 100 % beneficial use of biosolids, in place of incineration or landfill disposal.

Today, there is a diversity of biosolids management options that the City of Toronto utilizes. On the one hand, "Beneficial Use Options" are said to profit from the soil-conditioning features of biosolids when they are applied as compost, pellets or dewatered cake to agricultural lands, tree farms, land rehabilitation needs, and other agricultural and horticultural locations. Other options, however, continue to be thermal reduction and incineration, landfill disposal, co-management with municipal solid waste, or green bin composting disposal, as well as market sales for use as a fuel product or proprietary fertilizer (City of Toronto 2009).

In order to plan ahead and navigate among these management options, the City's BRMP was developed in 2002 to provide guidance to the year 2025. The principal decision-making method utilized in the plan was a multi-criteria analysis (MCA) weighted scoring model, considered to be "the most common" approach used by engineers involved in significant biosolids management decisions (Osinga 2011).

It is also a method that aims to ensure that "rational, quantitative conclusions" are developed for large-scale planning decisions (Osinga 2011). Such a weighted scoring model is:

> a tool that provides a systematic process for selecting projects based on many criteria. The first step in the weighted scoring model is to identify the criteria important for the project selection process. The second step is to assign weights (percentages) to each criterion so that the total weights add up to 100 %. The next step is to assemble an evaluation team, and have each member evaluate and assign scores to each criterion for each project. In the last step, the scores are multiplied by the weights and the resulting products are summed to get the total weighted scores. Projects with higher weighted scores are the best options for selection, since "the higher the weighted score, the better" (Lessard and Lessard 2007: 27).

As was to be expected, the BRMP was developed in fulfillment of all provincial planning requirements stipulated in Ontario's Environmental Assessment Act as well as the Municipal Engineers Association Class Environmental Assessment process. Key components of this process (Osinga 2011) included:

- Stakeholder consultation
- Consideration of a "reasonable range" of alternatives
- An evaluation of the environmental effects of each alternative
- Systematic evaluation of each option
- Clear documentation and a transparent decision-making procedure

Despite this careful planning process, the issue of the draft Master Plan in September, 2004, generated serious public concern when released for a 30-day comment period. Approximately 200 responses were received, many of them from residents who objected to a recommendation that favored a fluidized bed incinerator in their neighborhood. Consequently, in March 2005, two city councillors requested that a formal peer review be undertaken to evaluate the methodology utilized within the plan. Following a consultation process with other municipalities, industry, and scientific experts, "it was determined that the most objective way to undertake a peer review would be by forming an expert panel with selected, qualified, independent panel members whose expertise matched the specific needs of the project" (City of Toronto 2008: 3). The author of this chapter was one of the seven members selected for the peer review panel.[1]

## 3 The Peer Review Process and Its Findings

The panel was not charged with reviewing the biosolids management *technologies*. Instead, its task was to assess the appropriateness of the decision-making model, its criteria, and its scoring process. Overseen by Toronto Water and Toronto Public Health staff, the work of the peer review panel was coordinated and directed by Ehl Harrison Consulting Inc, together with Genivar, an environmental engineering firm specializing in integrated urban and environmental planning solutions. The peer review process included several meetings, public presentations, question and answer sessions, and preparation of a final written response to the draft Master Plan.

The panel concluded that the decision-making model utilized in developing the Master Plan was an example of those "commonly used" in generating both master plans and environmental assessments and, to that extent, it was "not unreasonable." Nevertheless, the panel did find "shortcomings in its implementation and suggested improvements, as well as additional tools that could be used to add rigor to the decision-making process" (Ehl Harrison Consulting Inc and Genivar 2008).

Specifically, five problem areas were flagged: (1) There was a lack of detail and clarity in the BRMP documentation; (2) there was "limited reach" of both the consultation and the tools that were utilized; (3) there was insufficient recognition and incorporation of public risk perceptions; (4) the process of weighting and scoring alternatives was unclear; and (5) a mediation agreement that was drawn up between one local community and the city to respond to concerns of the Master Plan was itself problematic. That agreement sought to allay concerns around the proposed incineration technology, and yet portions of the agreement were "ambiguous" and indeed appeared to be "contradictory," implying that incineration might be an option even as the spirit of the document recommended against it.

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[1] Other members of the Peer Review Panel were Dr. Ida Ferrara, York University; Mr. Paul Kadota, P.Eng., Greater Vancouver Regional District; Mr. Mark C. Meckes, United States Environmental Protection Agency; Dr. David Pengally, McMaster University; Dr. Lesbia Smith, University of Toronto; and Dr. Paul Voroney, University of Guelph. Ms. Tracey Ehl, MCIP, and Ms. Fredelle Brief of Ehl Harrison Consulting Inc., chaired the deliberations of the panel.

In the end, the following major recommendations for improvements to the Master Plan and decision-making process were presented by consensus of the panel to the city staff (Ehl Harrison Consulting Inc and Genivar 2008):

- *Enhance detail and overall clarity*: A number of elements in the decision-making model and mediation agreement were not readily understandable. The panel called for further "elaboration of definitions, and step-by-step descriptions of the calculations behind some of the outcomes" (Ehl Harrison Consulting Inc and Genivar 2008).
- *Broaden stakeholder consultation*: The panel felt that some members of the public—for instance, rural communities impacted by agricultural land application or landfill disposal—had not been properly consulted. Additionally, it felt that "the City engaged a relatively small number of individuals in the various stakeholder groups, who, for the most part, may not be statistically representative of their communities" (Ehl Harrison Consulting Inc and Genivar 2008). Consequently, it was suggested that additional tools be utilized to capture broader stakeholder input that was statistically valid.
- *Acknowledge the significance of public perceptions of risk*: While recognizing that no technology is risk free, the panel recommended that a risk assessment framework be a more explicit part of the Master Plan. The public's perception of health risks associated with incineration, for instance, was a primary factor behind many stakeholder responses to the plan. A diversity of risk assessments to address uncertainties and identify best practices was suggested (Osinga 2011).
- *Improve process for developing weighting criteria and scoring alternatives*: The Master Plan presented findings but did not provide clear explanation as to the reasoning behind the numbers in the weighted scoring model. The panel suggested the need for a review of the criteria and their weightings, together with clear documentation of the calculation process so that results could be easily replicated by others and the public could better understand elements of the decision-making process.
- *Consider additional, alternative decision-making models*: While a weighted scoring model was understood to be reasonable, the panel suggested that additional methods be utilized for decision-making purposes. Such methods could include risk assessments, public opinion surveys, and a triple-bottom-line decision-making model that focused on minimizing environmental, social, and economic impacts (Osinga 2011).
- *Re-assess scoring priorities*: Rather than privileging financial, technical, operational, and managerial elements, the panel suggested that higher values needed to be placed upon community concerns, public health, and environmental considerations (Osinga 2011).
- *Establish a longer term perspective on biosolids management*: Since there is a need to continually update the public about biosolids options, the panel suggested a long-term strategy and resource commitment to ensure public education programs. Additional quantitative surveys and qualitative research were

proposed in order to "help to set the planning context for future projects" to a 50—rather than 25 year—planning horizon (Ehl Harrison Consulting Inc and Genivar 2008).

The peer review panel's recommendations were presented to the City of Toronto in February, 2008. Following a number of public information sessions, the city initiated a Biosolids Master Plan (BMP) Update in 2008. AECOM—a consulting engineering firm—was hired to finalize the Master Plan which was approved by city council in 2010 and provides a blueprint for biosolids management to the year 2055.

A number of improvements to the original draft Master Plan were made, following the peer review process. Key changes reported by the City of Toronto (2009) included the following:

- Evaluation criteria and categories were revised in the weighted scoring model to ensure that they were more easily understood and legible to a lay audience.
- Quantitative surveys were conducted by telephone and focus groups organized to obtain statistically relevant public feedback about biosolids management options and decision-making criteria.
- Rather than providing a single, universal set of recommendations for such a large metropolis with a diversity of community expectations, options were evaluated with respect to the specific needs of each of the four wastewater treatment facilities, within the context of the city's overall needs.
- How each management option was scored was explained in greater detail, ensuring that information was provided about the meaning of each criterion and why it was used in the decision-making process.
- Information was updated with respect to developments in biosolids technologies and management opportunities.
- A more holistic accounting of impacts and opportunities was utilized, drawing from a "triple-bottom-line" approach that addressed environmental, social, and economic concerns of the city.
- While weightings are often evenly distributed in such cases of decision making, in this instance, the final plan weighed the environmental and social indices more heavily than cost indices, reflecting community values (AECOM 2009: 12).
- The overall strategy was now to maximize programs that encourage beneficial use of biosolids cake, relying upon landfill disposal purely as a "contingency measure" (AECOM 2009: 16).

Seven years of consultants' reports, peer review panel deliberations, focus groups, surveys, and public workshops have resulted in the final approval in December, 2009, by city council of a BMP for the City of Toronto. Certainly, the Master Plan management process has required a significant commitment to date, both financially as well as in terms of human resources.

One cannot help but wonder however: might the process have been more streamlined, had underlying values and judgment calls been more explicitly addressed? What were some of those values and ethical assumptions that affected the process of decision making? The following section looks at those questions specifically.

## 4 Values, Judgments, and Ethical Assumptions

It is common to perceive the role of ethics as a matter of clarifying universal moral principles to provide a theoretical framework for complexities of decision making. Through such a top-down model of justification, the expectation is that ethics consists simply of "applying a general rule (principle, ideal, right etc.) to a particular case that falls under the rule" (Beauchamp 2005: 7).

As appealing as such a model may be to some, others argue that ethics is more than a top-down intellectual exercise of applying theories and principles to specific situations. Rather, ethics is better understood as a bottom-up process of deciphering implicit values that underlie decision-making practices. Moral principles, on such a reading, are derivative, informed by the vagaries of each particular case, rather than intellectually conclusive, foundational, and resolved in advance of engaging with lived experience (Beauchamp 2005: 8).

To be sure, the fact is that "sometimes we do not *know* what our actual beliefs and values are" (Hinman 2013: 5). Values are often deeply embedded in our daily decisions and, in that respect, are implicit or even operate at a subconscious level (Stefanovic 2012). In that regard, the task for philosophers is perhaps less one of creating grand, speculative theories than of serving as "stand-in interpreters" who help communities to clarify and critically evaluate those values that impact in a significant way upon important decisions (Morito 2010).

When it comes to the case of biosolids management within the City of Toronto, values infused the decision-making process from the very start and on a number of different levels. Let me draw upon a few salient examples in order to then explore how they impacted upon the long process of evolving a master plan.

Consider the decision taken by engineers to base the original draft of the Master Plan on a quantitative, weighted scoring model. The 2004 report points out that, given the complexity of biosolids and residuals management processes, "experience in other communities has shown that developing a *systematic, stepwise method* for making decisions at the start of the project helps to focus and clarify decision making" (KMK Consultants 2004: 80. Italics added). Employing such a logical model is indeed common when it comes to large-scale planning projects, precisely because it is seen to set a framework "for a *systematic, rational and replicable* environmental planning process" (KMK Consultants 2004: 7 Italics added). Employing such an apparently "rational" and "replicable" model of decision making was intended to enable the identification of "actual benefits and impacts of the specific option" by way of "a quantitative comparison of one alternative to another" (KMK Consultants 2004: 83).

The language utilized here reflects a positivist paradigm that is characteristic of the mainstream western understanding of modern water management which begins, as some ethicists point out, "with humanity as the main focus of moral concern, separate from and generally understood to be superior to the rest of the world" (Brown and Schmidt 2010: 268). The decision-making model was intended to ensure a process that was intended to be *objective, quantitative, systematic,* and

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