

# Transboundary wastewater governance - Options based on an uncertainty perspective

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Rens de Man

## Abstract

Joint governance of the shared water resources of Israelis and Palestinians is limited through a range of political disputes. One of the disputes concerns wastewater, which presents both a source as well as an environmental nuisance. In this article the following question is addressed: *which uncertainties can be identified that hinder transboundary cooperation on wastewater in and across the West Bank?*

The article shows that, due to these uncertainties, a quantification of flow and impact of wastewater is difficult to establish. Sources of uncertainty include: intrinsically variability of flows; limited measurements; assumptions made in modelling; and estimates of water usage based on contested population size figures. In addition, high-politics constrains the effective operation of wastewater treatment plants, through disputes about settlements and operation in Area C, tariffs and water quality standards.

Effective cooperation should be based on the recognition of the uncertainties, but recommendations should follow the political realities, which means that fact-finding initiatives are slowed down in times of political turmoil. Nevertheless, concrete follow-up steps should include the identification of: problem and solution framings; uncertainty characteristics; and information needs. Next, precautionary actions are highly necessary. Implementation can be stimulated by outlining what the costs and benefits are of preventive action compared to a 'business as usual'-scenario. Finally, in the phase leading up to a two-state solution, interim arrangements need to be established. These arrangements should recognize the uncertainties and be based on a just distribution of costs and benefits.

Keywords

Israel, Palestine, Transboundary cooperation, Wastewater, Uncertainty



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## About the Author

Drs. Rens de Man works on water diplomacy and climate governance. He acquired profound knowledge and skills in (mutual gains) diplomacy and negotiation to address social and environmental conflicts around the use of natural resources. Topical and Regional Expertise: Water Diplomacy; Negotiation; Food Security; Hydrology; Nuclear Security; Cambodia; Costa Rica; India; Israel; Palestine; Yemen.

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## 1. Introduction

Israel and Palestine are mutually dependent on shared water resources, as ground and surface water flows in a natural manner from the higher parts of the West Bank into Israel. However, joint governance of the shared water resources of Israelis and Palestinians is limited through a range of political disputes in which water has, unfortunately, become part and parcel of the wider political context<sup>1</sup>. The water conflict centers on a number of specific issues (see the summary below), but is amplified due to the perceived injustice felt by Palestinians with regards to inequality in access to water<sup>2</sup> and the size of the current water allocation (see section 4). Joint water management between Israel and Palestinians in the West Bank is constrained due to disagreement on the following issues:

- Water rights: Technical approach to water is needed (Israel) *versus* Water rights need to be agreed upon before technical issues can be discussed (Palestinians). This discussion focuses on, among others, the degree to which mutual obligations with regard to water share redistribution, as agreed in the Oslo agreements, have been fulfilled<sup>3</sup>.
- Efficient use: Enough water is given/ Israel has proven that water can be efficiently used (Israel) *versus* the Palestinians. The water given is not enough to sustain livelihoods. This discussion focuses on the exact amount of water used<sup>4</sup> and the wastewater produced<sup>5</sup>. The main bone of contention here is the actual population size in the West Bank<sup>6</sup>.
- Competence: (Implicit) The other party is not competent enough: unaccounted-for losses are extreme and a lot of water is stolen (Israel) *versus* the Palestinians. As long as we are not independent, we cannot build a good infrastructure/ Based on the area-division, the Civil Administration and Israeli Defense Forces (IDF) are blocking many projects and prohibit efficient working/ PA closes illegal wells and connections, but people need to drink (Palestine)
- The role of the JWC: Joint Water Council (JWC) is working according as agreed through the Oslo-agreements (Israel) *versus* JWC institutionalizes an unequal process (Palestine). The issue of the JWC as part of larger issues of power disparity and cooperation has been researched by a range of scholars (see for example <sup>7</sup>).

<sup>1</sup> Since 1991, water is one of the six key issues on the formal Middle East peace agenda. Next to water, no agreement has been reached on the other topics: the finite borders between Israel and Palestine; return of refugees; illegal settlements on the West Bank; the status of Jerusalem and the security guarantees demanded by Israel.

<sup>2</sup> Clive Lipchin, "A future for the Dead Sea Basin: Water culture among Israelis, Palestinians and Jordanians." *Fondazione Eni Enrico Mattei Working Papers* 97 (2006).

<sup>3</sup> Water Authority Israel, "The Issue of Water between Israel and the Palestinians." *Report* (State of Israel, 2009); Water Authority Israel, "The water issue between Israel and the Palestinians: Main facts." *Report* (State of Israel, 2012).

<sup>4</sup> M. M. Mansour, D. W. Peach, A. G. Hughes and N. S. Robins, "Tension over equitable allocation of water: estimating renewable groundwater resources beneath the West Bank and Israel." *Geological Society, London, Special Publications* 362 (2012): 355-361.

<sup>5</sup> Haim Gvirtzman, "The Israeli-Palestinian Water Conflict: An Israeli Perspective." *Mideast Security and Policy Studies* 94 (The Begin-Sadat Center for Strategic Studies, Bar-Ilan University, 2012); ARIJ, "Water resource allocation in the Occupied Palestinian Territory: Responding to Israeli claims." *Position Paper* (Applied Research Institute Jerusalem, 2012); Zecharya Tagar, Tamar Keinan, Gidon Bromberg, "A Seeping Time Bomb: Pollution of the Mountain Aquifer by sewage." *Investigative Report Series on Water Issues* 1 (Tel Aviv: Friends of the Earth Middle East, 2004).

<sup>6</sup> Bennett Zimmerman, Roberta Seid and Michael L. Wise, "The Million Person Gap: The Arab Population in the West Bank and Gaza." *Mideast Security and Policy Studies* 65 (The Begin-Sadat Center for Strategic Studies, Bar-Ilan University, 2006).

<sup>7</sup> Zecharya Tagar, "Water, Power, Institutions and Costs: Cooperation and lack thereof in protecting shared Israeli-Palestinian water resources." (MA thesis, Hebrew University of Jerusalem, 2007); Jan Selby, "Cooperation, Domination and Colonisation: The Israeli-Palestinian Joint Water Committee." *Water Alternatives* 6-1 (2013): 1-24.

- Cost of wastewater treatment: The wastewater from across the Green Line is polluting essential Israeli water resources (Israel) *versus* We are forced to pay for treating our own water, but do not get it back (Palestine).

This study focuses on the issue of wastewater. Wastewater is produced in Israel, in Palestinian villages and towns and in the settlements. Wastewater flows from Israel into the West Bank, from the West Bank into Israel and from the settlements into Palestinian territory. Along the way, part of the water is taken up by plants and evaporates and part of it enters the aquifers, while the remaining water is collected in the (increasingly) polluted wadi's. Eventually, some of the wastewater is treated in wastewater treatment plants (WWTP) within or outside the West Bank.

Wastewater presents both a potential new source of water as well as an environmental nuisance. This duality is made apparent when the wastewater crosses the boundary (the Green Line) between the West Bank and Israel: when wastewater enters and pollute existing freshwater bodies<sup>8</sup> but is also captured and treated for irrigation purposes<sup>9</sup>. Reaching agreement on the distribution of costs (treatment costs, impact on human health and environment) and benefits (investment savings, treated water) is difficult<sup>10</sup>. However, through the prevailing high stakes and far reaching impacts of (non-) decisions and range of physical, economic, social, institutional and political uncertainties, the issue becomes a *complex* societal problem. In this article the author addresses the question of *which uncertainties can be identified that hinder transboundary cooperation on wastewater in and across the West Bank?* And, based on these findings, *which policy recommendations can help to address the complex transboundary wastewater management problem?*

Chapter two, the conceptual framework, elaborates on the fundamentals of uncertainty in decision-making. In chapter three, the analytical framework is elaborated on as a means to identify and assess uncertainties in transboundary wastewater management. In chapters four and five, the key issues with regard to transboundary wastewater governance are further analyzed, based on a review of available literature. In chapter four, the author explores, based on the available data, to which extent the different parties in the West Bank are contributing to the volume of wastewater and to where this water flows. In chapter five, the uncertainties related to pollution are discussed. These include the actual impact of wastewater, the current treatment and treatment levels, as well as the costs involved of treating polluted water. Finally, the main sources of contention with regard to constructing wastewater treatment plants are explored.

The issues are characterized by a number of specific points of disagreement and uncertainty. These uncertainties are often driven by lack of data and biases in data collection and decision-making, which both complicate the current situation, but also offer entry points for further reconsideration (chapter six). By doing so, the author outlines options to improve transboundary wastewater management in chapter seven.

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<sup>8</sup> Zecharya Tagar, Tamar Keinan, Gidon Bromberg, "A Seeping Time Bomb: Pollution of the Mountain Aquifer by sewage." *Investigative Report Series on Water Issues 1* (Tel Aviv: Friends of the Earth Middle East, 2004); Btselem, "Foul Play: Neglect of Wastewater Treatment in the West Bank" *Report* (Btselem, 2009).

<sup>9</sup> Water Authority Israel, "The water issue between Israel and the Palestinians: Main facts." (State of Israel, 2012); P. Glueckstern, M. Priel, E. Gelman, N. Perlov, "Wastewater desalination in Israel." *Desalination* 222 (2008): 151–164; D. Lavee, "Is the Upgrading of Wastewater Treatment Facilities to Meet More Stringent Standards Economically Justified: The Case of Israel." *Water Resources* 41-5 (2014): 564–573.

<sup>10</sup> Itay Fischhendler, Shiomi Dinar and David Katz, "The Politics of Unilateral Environmentalism: Cooperation and Conflict over Water Management along the Israeli-Palestinian Border." *Global Environmental Politics* 11-1 (2011): 36-61; Adam Schalimtzek and Itay Fischhendler, "Dividing the cost-burden of environmental services: the Israeli-Palestinian wastewater regime." *Environmental Politics* 18-4 (2009): 612–632.

## 2. Conceptual framework

### Complexity and uncertainty

Governing a system of water resources is difficult due to the intricate coupling of water issues within the natural, societal and political domains, as well as geographical and temporal scales<sup>11</sup>, often resulting in complex feedback loops on the water issue itself. These feedback loops contribute to uncertainty as the exact causal relationships are not fully understood. The uncertainties influencing a policy problem<sup>12</sup>, such as transboundary water governance, stem from a range of sources<sup>13</sup> such as:

- Physical and technical uncertainties (predicting the flow of the Jordan River, extreme weather events, actual risk to technical failures);
- Economic uncertainties (actual cost of desalinated water from the Red Sea-Dead Sea-project<sup>14</sup>, cost effectiveness of different wastewater treatment options);
- Social uncertainties (what pricing is acceptable for drinking water?);
- Institutional uncertainties (viable options for shared maintenance, inspections, data exchange, etc.);
- Political uncertainties (acceptance of shared treatment plants), etc.

The substantive uncertainties of this list fall within two categories<sup>15</sup>: Uncertainties that can be reduced through measurements (by e.g. by installing flow meters) and facts that are intrinsically uncertain through their variable behavior<sup>16</sup>. This variable behavior can be non-linear or even chaotic (e.g. how will climate change affect the geographical and temporal rainfall distribution in the West Bank?).

### Sense-making: assumptions and interests

However, facts are filtered and interpreted in a process of sense making. Cilliers<sup>17</sup> concludes that the characteristics of complex systems automatically direct us to a post-modern, deconstructive perspective, since due to our human limitation we are unable to fully grasp the dimensions and implications of complexity. People strive to a coherent framing of the world around them. As their world is filled with complex issues and issues they don't know about, people make assumptions ('framings') to fill the gaps in their knowledge and to reduce the complexity<sup>18</sup>. These assumptions make that "physical phenomena cannot be rigidly separated [...]"

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<sup>11</sup> Shafiqul Islam and Lawrence E. Susskind, *Water diplomacy: A negotiated approach to managing complex water problems* (New York: RFF Press/ Routledge, 2013).

<sup>12</sup> Judith Mathijssen, Arthur Petersen, Paul Besseling, Adnan Rahman and Henk Don, *Dealing with uncertainty in policy making* (The Hague: CPB/MNP/ RAND Europe, 2007).

<sup>13</sup> Bruna De Marchi, "Uncertainty in environmental emergencies: A diagnostic tool." *Journal of contingencies and crisis management* 3-2 (1995): 103-112; Shafiqul Islam and Lawrence E. Susskind, *Water diplomacy: A negotiated approach to managing complex water problems* (New York: RFF Press/ Routledge, 2013).

<sup>14</sup> Under the Red Sea-Dead Sea project, Jordan and Israel, together with the World Bank aim to build a desalination plant in the Gulf of Aqaba. The desalinated water from this plant is distributed to Israel (40MCM/y), Palestine and Jordan (40MCM/y). The brine (300MCM/y), which is a by-product of the desalination, is transported over 180 km to revive the Dead Sea.

<sup>15</sup> Judith Mathijssen, Arthur Petersen, Paul Besseling, Adnan Rahman and Henk Don, *Dealing with uncertainty in policy making* (The Hague: CPB/MNP/ RAND Europe, 2007).

<sup>16</sup> Fritjof Capra, "Complexity and Life." *Theory, Culture & Society* 22-5 (2005): 33-44.

<sup>17</sup> Paul Cilliers, "Complexity, Deconstruction and Relativism." *Theory, Culture & Society* 22-5 (2005): 255-267

<sup>18</sup> Michel J.G. van Eeten, "Tales from Riverland: Policy narratives about flooding and dike improvement." *Beleid en Maatschappij* 14-1 (1997): 32-43; Donald A. Schön and Martin Rein, *Frame Reflection: Toward the Resolution of Intractable Policy Controversies*. (New York: Basic Books, 1994).

from the meanings collectively assigned to them"<sup>19</sup>. Hajer and others shows that specific ensembles of concepts are transformed in practices through which meaning is given to physical and social realities<sup>20</sup>. Similarly, Lipchin<sup>21</sup> finds that in water and natural exploitation studies, those collective meanings (as reflected in cultural and ethnic discourses) have been identified as a key indicator of attitudes and behavior. In addition, critical constructivist approaches point to the important role of individual and organizational interests that steer the selection and interpretation of facts and their representation in discourse<sup>22</sup>.

Since lobbyists, scientists, policy advisors and decision-makers are informing and steering the decision-making process, implicit assumptions are made<sup>23</sup>: Boundaries are drawn around the problem ('which actors are relevant to the problem, which are not?'); the full heterogeneity of the problem is reduced to a limited set of sub-problems ('let's restrict our focus to the real problems'); individuals are thought to act in predictable and often rational ways ('to solve the problem we changed the protocol'); and processes are assumed to run without friction ('nothing unexpected will happen').

### Competing interpretations

In effect, as different people create different frameworks of assumptions for the world around them, an additional layer of uncertainty about beliefs and personal and organizational strategic interests is generated, thus hindering the definition of a shared vision on the actual problem and the identification of solutions. This resembles what Green refers to as 'decision uncertainty'<sup>24</sup>. This becomes relevant when urgent problems, like wastewater, need to be solved within the context of a decision-making process in which stakeholders with varying backgrounds and interests meet and different frameworks collide.

The complexity of a (water) conflict is increased through differences among the stakeholders in framing and interests which steer the selection and interpretation of (uncertain) facts. Based on the agreement on facts and values, societal policy problems can be classified<sup>25</sup> according to the degree of complexity. This is useful, as it helps to outline different options to approach the problem. One useful categorization is the following<sup>26</sup>:

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<sup>19</sup> Bruna De Marchi, "Uncertainty in environmental emergencies: A diagnostic tool." *Journal of contingencies and crisis management* 3-2 (1995): 103-112.

<sup>20</sup> Maarten Hajer and Hendrik Wagenaar, *Deliberative Policy Analysis: Understanding Governance in the Network Society*. (Cambridge, UK: Cambridge University Press, 2003); Vivien A. Schmidt, "Taking ideas and discourse seriously: explaining change through discursive institutionalism as the fourth 'new institutionalism'." *European Political Science Review* 2-1 (2010): 1-25.

<sup>21</sup> Clive Lipchin, "A future for the Dead Sea Basin: Water culture among Israelis, Palestinians and Jordanians." *Fondazione Eni Enrico Mattei Working Papers* 97 (2006).

<sup>22</sup> James Ferguson, "The anti-politics machine: "Development" and bureaucratic power in Lesotho." *The Ecologist* 24-5 (1994): 176-181; Lyla Mehta, "Whose scarcity? Whose property? The case of water in western India." *Land Use Policy* 24 (2007): 654-663.

<sup>23</sup> Peter Allen, "What is complexity science? Knowledge of the limits of knowledge." *Emergence* 3-1 (2001): 24-42.

<sup>24</sup> Colin H. Green, R. Nicholls and C. Johnson, "Climate Change Adaptation: An Analysis of Decision-Making in the Face of Risk and Uncertainty." *Report* 28 (London: National Centre for Risk Assessment and Options Appraisal, Environment Agency).

<sup>25</sup> Jianguo Liu, Thomas Dietz, Stephen R. Carpenter, Marina Alberti, Carl Folke, Emilio Moran, Alice N. Pell, Peter Deadman, Timothy Kratz, Jane Lubchenco, Elinor Ostrom, Zhiyun Ouyang, William Provencher, Charles L. Redman, Stephen H. Schneider, William W. Taylor, "Complexity of coupled human and natural systems." *Science* 317-5844 (2007): 1513-1516; Shafiqul Islam and Lawrence E. Susskind, *Water diplomacy: A negotiated approach to managing complex water problems* (New York: RFF Press/ Routledge, 2013).

<sup>26</sup> Matthijs Hisschemöller and Rob Hoppe, "Coping with intractable controversies." In *Knowledge, Power and Participation in Environmental Policy Analysis*, ed. Matthijs Hisschemöller et al. (*Policy Studies Annual Review* 12. New Brunswick: Transaction Publishers, 2001).

- a) Simple, technical problems for which there is no conflict (e.g., optimal design of a wastewater treatment plant) are easily solvable;
- b) Untamed technical problems are problems ‘where everyone agrees they must be solved, but for which there are no agreed upon technical solutions’ (e.g., finding a cure for HIV/AIDS);
- c) Untamed political problems, ‘where technical solutions are available, but where their application meets with societal conflict’ (e.g., renewable energy production through windmills, but ‘Not In My Back Yard’, (NIMBY));
- d) Wicked<sup>27</sup> (or unstructured<sup>28</sup> or complex<sup>29</sup>) problems, ‘where there is neither agreement on the facts, nor the problem definition’ (e.g., human contribution to climate change; carbon dioxide reduction measures; use of GMO to improve agricultural production etc.). In addition, Funtowicz and Ravetz<sup>30</sup> point to the high stakes and urgency of decisions and far-reaching impact of a complex policy problem.



Figure 1: Different degrees of complexity of societal problems (based on<sup>31</sup>)

The above classification adheres to the situation in which all stakeholders behave as if a problem is ‘simple’ or ‘wicked’. That, however, is a simplification of the dynamics at different levels within, and between, stakeholder groups within a country, but also between stakeholders across a boundary dealing with a mutual problem. According to Warner<sup>32</sup> it is important to interpret the problem definitions as social constructs, meaning that problems can be framed and reframed into different categories, leading to different strategies to engage with the ‘other’.

<sup>27</sup> Rittel and Webber, 1973. Rittel and Webber oppose Wicked to Tame problems. According to their definition wicked social problems cannot be definitively described because in pluralistic society there are no objective definitions of public good or equity with consequently no optimal solutions. Wicked problems are therefore ill-defined, ambiguous and associated with strong values; Horst W.J. Rittel and Melvin M. Webber, “Dilemmas in a General Theory of Planning.” *Policy Sciences* 4 (1973): 155-169.

<sup>28</sup> Sylvio O. Funtowicz and Jerome R. Ravetz. 1993. “Science for the Post-Normal Age.” *Futures* 25-7 (1993): 739–755.

<sup>29</sup> Matthijs Hisschemöller and Rob Hoppe, “Coping with intractable controversies.” In *Knowledge, Power and Participation in Environmental Policy Analysis*, ed. Matthijs Hisschemöller et al. (*Policy Studies Annual Review* 12. New Brunswick: Transaction Publishers, 2001).

<sup>30</sup> Sylvio O. Funtowicz and Jerome R. Ravetz. 1993. “Science for the Post-Normal Age.” *Futures* 25-7 (1993): 739–755.

<sup>31</sup> Matthijs Hisschemöller and Rob Hoppe, “Coping with intractable controversies.” In *Knowledge, Power and Participation in Environmental Policy Analysis*, ed. Matthijs Hisschemöller et al. (*Policy Studies Annual Review* 12. New Brunswick: Transaction Publishers, 2001).

<sup>32</sup> Jeroen Warner, “Emergency River Storage in the Ooij Polder—A Bridge too Far? Forms of Participation in Flood Preparedness Policy.” *International Journal of Water Resources Development* 24-4 (2008): 567-582.

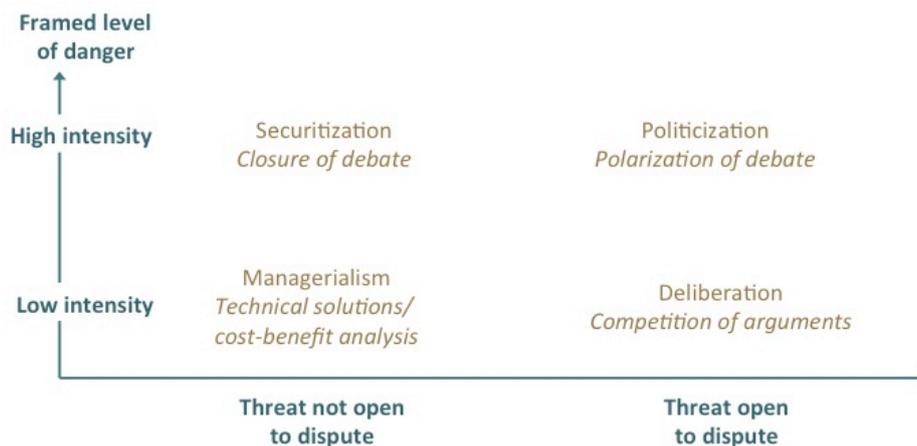


Figure 2: Framing and reframing of disputes (based on<sup>33</sup>)

As these problems can be framed and reframed, it also implies that different stakeholders can pertain to different categorizations and will attempt to ‘move’ the debate in a certain direction. Generally speaking, civil society organizations, through their particular set of resources, will profit from voicing their opinions in a more open, political arena. Governments might profit from closing the debate (discursive closure) and proceed to act, as they seem fit.

### 3. Analytical framework

In the case-study at hand, and based on the above discussion of concepts, the author aims to identify and assess the main points of contestation due to uncertain facts, as well as what measures are needed to address these uncertainties. The approach in this study is based on a desktop review of academic sources, reports and classified documents made available to the author. Based on these sources, a number of themes could be identified in which both parties used conflicting claims and arguments. These main themes are:

- The volumes of wastewater produced in settlements, in Palestinian villages and towns, and the flows from and into the West Bank
- Interaction of pollution with groundwater and the longer-term impact on environment and human health
- Uncertainty why enforcement (to comply with the agreed terms in the Water Agreement) seems absent in settlements
- Uncertainty whether treatment facilities can be successfully operational in the West Bank, especially in Area C
- Conditions under which the Polluter Pays Principle can successfully be implemented

Within each theme, the author attempts to summarize the findings of the different studies from Israeli and Palestinian and international sources. If deemed necessary, the differences in opinion are made explicit. Per theme, a descriptive summary of the uncertainties is given, in relation to the theme at hand as well as how these uncertainties are impacting on the joint management of wastewater.

<sup>33</sup> Jeroen Warner, “Emergency River Storage in the Ooij Polder—A Bridge too Far? Forms of Participation in Flood Preparedness Policy.” *International Journal of Water Resources Development* 24-4 (2008): 567-582.

One useful approach to the identification of uncertainties is the framework developed by Van der Sluijs<sup>34</sup>, based on the work of, amongst others, Walker<sup>35</sup>, which is called the *Guidance for Uncertainty Assessment and Communication*. This framework focuses on the *Location* of uncertainties, the *Level* of uncertainty, the *Nature* of uncertainty, the qualification of the *Knowledge base* and the *Value-ladenness*<sup>36</sup>. This framework is developed for the purpose of identifying policy-relevant uncertainties in environmental studies. The approach is limited, however, to the extent that it focuses on the stakeholders within one country on issues which are less embedded in high-politics.

In this study we will use the core-elements of the above framework while adding one element to make a fit with our research topic. This is the degree of embedding into the wider political context and linkages with other (political) issues. The political 'linkedness' influences the degree to which uncertainties can be addressed from the perspective of wastewater management alone, as through the linkages with deeper interests and values the political uncertainties continue to fuel disagreement.

## 4. The wastewater flows into the environment and across borders

In this section, the author explores, based on the available data, to which extent the different parties in the West Bank are contributing to the volume of wastewater and to where this waste flows.

### 4.1 About the volumes of surface and groundwater

Due to a lack of (publicly) available flow data, uncertainties exist about the size of (transboundary) flows. Exact data on wastewater flows are important to verify claims on both sides, most notably the financial claims for the offset mechanism (see next sections). The figures below, on the surface and groundwater flows, provide the contours for discussing amounts of wastewater produced and treated. There are about 33 transboundary wadis between Israel and the West Bank<sup>37</sup>; 16 of them have their tributaries originating in the West Bank and flow into Israel.

<sup>34</sup> Jeroen P. van der Sluijs, Arthur C. Petersen, Peter H.M. Janssen, James S Risbey and Jerome R. Ravetz, "Exploring the quality of evidence for complex and contested policy decisions." *Environmental Research Letters* 3-2 (2008).

<sup>35</sup> W.E. Walker, P. Harremoes, J. Rotmans, J.P. van der Sluijs, M.B.A. van Asselt, P. Janssen, M.P. Kraye von Krauss, "Defining Uncertainty: A Conceptual Basis for Uncertainty Management in Model-Based Decision Support" *Integrated Assessment* 4-1 (2003): 5-17.

<sup>36</sup> (1) The dimension location "indicates where uncertainty could manifest itself in the problem configuration at hand. It distinguishes five categories": Context, Data, Model, Expert judgement, Outputs. (2) The dimension level of uncertainty "expresses how a specific uncertainty source can be classified on a gradual scale, running from 'known for certain' to 'unknown' ": Statistical uncertainty, Scenario uncertainty, Recognized ignorance. (3) The dimension nature of uncertainty, "expresses whether uncertainty is primarily a consequence of the incompleteness and fallibility of knowledge ('knowledge-related', or 'epistemic' uncertainty) or that it is primarily due to the intrinsic indeterminate and/or variable character of the system under study ('variability-related', or 'ontic' uncertainty). (4) The qualification of the knowledge base refers to "the degree of underpinning of the established results and statements". (5) The dimension Value-ladenness "denotes whether a substantial amount of 'value-ladenness' and subjectiveness is involved in making the various – implicit and explicit – choices during the study" See also: [http://www.pbl.nl/sites/default/files/cms/publicaties/PBL\\_2013\\_Guidance-for-uncertainty-assessment-and-communication\\_712.pdf](http://www.pbl.nl/sites/default/files/cms/publicaties/PBL_2013_Guidance-for-uncertainty-assessment-and-communication_712.pdf)

<sup>37</sup> Btselem, "Foul Play: Neglect of Wastewater Treatment in the West Bank" *Report* (Btselem, 2009).



Figure 3: West Bank streams (source: Btselem, 2009)

*Table 1: Surface water resources in the catchment area of the West Bank<sup>38</sup>*

Wadis flowing westward to the Mediterranean Sea	122.7mcm/y (16 wadis)
Wadis flowing eastward to the Jordan Valley	20.6mcm/y (9 wadis)
Wadis flowing eastward to the Dead Sea	21.5mcm/y (8 wadis)
Total amount of surface runoff	164,8mcm/y

In the wadis, part of the water will evaporate, while another fraction will quickly seep through the fractured karstic underground into the Mountain aquifers, where it is mixed and returned to surface water streams and springs. Table 2 provides modelled estimates for the groundwater recharge into the Western Aquifer, providing a range from 318 to 430 million cubic meter (mcm) per year.

*Table 2. Recharge estimates for the Western Aquifer Basin*

Source	Recharge (mcm/yr)	Comment
Goldschmidt and Jacobs, 1955, p. 8.	318	Mass balance, based on low outflows from the main springs: Ras al Ain and Timsah.
Bachmat, 1995.	330, 332	Coastal Plain flow model (Goldschmidt/Jacobs).
Assaf et al., 1993, in Hughes et al., 2008, p. 848.	350	-
Sabbah and Miller, 2012.	350	Based on the 10-year (2001-2010) average.
HSI, 2008, p. 221.	358	Estimate for the period 1970-2007.
Israel and the PLO, 1995.	362	So-called "aquifer potential"; method not specified.
HSI, 1999, in Hughes et al., 2008, p. 4.	366	Rainfall recharge over outcrops.
EXACT, 1998, p. 22.	366	Sum of outflows.
Abusaada, 2011.	385	Estimate for the period 1970-2006 based on water-level fluctuation/storage change.
Messerschmid, 2008, p. 20.	389	Water-level fluctuation, mass balance calculation.
PWA and UNuT, 2004, p. 16.	408	Maximum perennial yield (calibrated steady state and transient models).
PWA and UNuT, 2003b, p. 86.	410	Water budget calculation for Steady State Model.
Hughes et al., 2008, p. 853.	430	Modelled with wetting threshold and soil moisture deficit.

Source: UN-ESCWA and BGR, 2013<sup>39</sup>

<sup>38</sup> PWA, "National water and wastewater strategy for Palestine: Toward building a Palestinian state from water perspective." *Final copy* (Palestinian Water Authority, 2013).

<sup>39</sup> UN-ESCWA and BGR, 2013. "Inventory of Shared Water Resources in Western Asia." (Beirut: United Nations Economic and Social Commission for Western Asia; Bundesanstalt für Geowissenschaften und Rohstoffe, 2013). <http://waterinventory.org>

#### 4.2 About the volumes of transboundary wastewater

Wastewater (in general) is produced in Israel, in Palestinian villages and towns and in the settlements. Wastewater flows from Israel into the West Bank, from the West Bank into Israel and from the settlements into Palestine territory. Eventually some of the wastewater is treated in wastewater treatment plants (WWTP) within or outside the West Bank. Wastewater is clearly a transboundary issue, though not all wastewater crosses the border between Israel and Palestine but remains within the respective territories.

The following table attempts to structure some frequently mentioned figures from both sides. The figures differ depending on the source of information. This is partly caused by differences in time periods in which data was collected and by differences in data collection methods and ways in which estimations are made about the missing data. This makes a real comparison difficult. Noticeable are the different estimates about the contribution of the settlements to the wastewater volume in the West Bank. These estimations are particularly relevant in order to understand the magnitude of treatment (and related costs) in the West Bank and Israel.

*Table 3: Quantities of wastewater generated*

	Israeli literature	Palestinian literature
Total volume of wastewater in the West Bank	60mcm/y <sup>40</sup>	97,5mcm/y=35 +62,51 <sup>41</sup> , 36mcm/y <sup>42</sup>
Total volume of wastewater produced by Palestinians in the West Bank	52mcm/y <sup>43</sup> , 45mcm/y <sup>44</sup> , 56mcm/y <sup>45</sup>	62.51mcm/y <sup>46</sup> , 29mcm/y <sup>47</sup>
Total volume of wastewater produced by Israeli settlements in the West Bank	15-17,5mcm/y <sup>48</sup>	35mcm/y <sup>49</sup> , 38mcm/y <sup>50</sup>

<sup>40</sup> Y. Meir, "Interior and Environmental Sub-Committee, Protocol of Meeting on the Mountain Aquifer Pollution from Sewage." (Hebrew, 2004). In: Itay Fischhendler, Shiom Dinar and David Katz, "The Politics of Unilateral Environmentalism: Cooperation and Conflict over Water Management along the Israeli-Palestinian Border." *Global Environmental Politics* 11-1 (2011): 36-61.

<sup>41</sup> PWA, "National water and wastewater strategy for Palestine: Toward building a Palestinian state from water perspective." *Final copy* (Palestinian Water Authority, 2013).

<sup>42</sup> ARIJ, "Status of the environment in the occupied Palestinian Territory." *Report* (Applied Research Institute Jerusalem, 2007).

<sup>43</sup> Water Authority, "The issue of water between Israel and the Palestinians." *Report* (State of Israel, 2009).

<sup>44</sup> Y. Meir, "Interior and Environmental Sub-Committee, Protocol of Meeting on the Mountain Aquifer Pollution from Sewage." (Hebrew, 2004). In: Itay Fischhendler, Shiom Dinar and David Katz, "The Politics of Unilateral Environmentalism: Cooperation and Conflict over Water Management along the Israeli-Palestinian Border." *Global Environmental Politics* 11-1 (2011): 36-61.

<sup>45</sup> Btselem, "Foul Play: Neglect of Wastewater Treatment in the West Bank" *Report* (Btselem, 2009).

<sup>46</sup> PWA, "National water and wastewater strategy for Palestine: Toward building a Palestinian state from water perspective." *Final copy* (Palestinian Water Authority, 2013).

<sup>47</sup> ARIJ, "Status of the environment in the occupied Palestinian Territory." *Report* (Applied Research Institute Jerusalem, 2007).

<sup>48</sup> Y. Meir, "Interior and Environmental Sub-Committee, Protocol of Meeting on the Mountain Aquifer Pollution from Sewage." (Hebrew, 2004). In: Itay Fischhendler, Shiom Dinar and David Katz, "The Politics of Unilateral Environmentalism: Cooperation and Conflict over Water Management along the Israeli-Palestinian Border." *Global Environmental Politics* 11-1 (2011): 36-61.

<sup>49</sup> PWA, "National water and wastewater strategy for Palestine: Toward building a Palestinian state from water perspective." *Final copy* (Palestinian Water Authority, 2013).

<sup>50</sup> ARIJ, "Status of the environment in the occupied Palestinian Territory." *Report* (Applied Research Institute Jerusalem, 2007).

Of the wastewater in the West Bank only 48% of the collected wastewater is being partially treated (secondary treatment) in Palestinian sewage works, whereas around 30% (74 mcm/year) of the collected wastewater flows through wadis to Israel where it receives treatment<sup>51</sup> (which implies that around 22% of the wastewater receives no treatment at all). Some of the wastewater streams are being treated in Israel in WWTPs designed to treat wastewater from the West Bank. For example, the wastewater from Wadi Zaimer is treated in the Yad Hanna WWTP. Part of the untreated wastewater is thus transported through sewerage networks to Israel; another part of the wastewater from the West Bank flows through wadis to their drainage points.

Table 4: Cross-boundary wastewater

Wastewater entering the West Bank	17,5mcm/y <sup>52</sup>
Wastewater exiting the West Bank to Israeli WWTPs	14.97mcm/y <sup>53</sup> , 14mcm/y <sup>54</sup> , 74mcm/y <sup>55</sup>

Some information is available on the flow of wastewater, but this information is not monitored on a regular basis and does not cover all streams. This uncertainty continues to exist since basic data on flows are not fully disclosed (or monitored). Next, data on which basic consumption could be calculated (population) is contested. This is despite the attempts of various international-led projects to increase the amount of scientific data available (e.g. EXACT<sup>56</sup>, SUSMAQ<sup>57</sup>, UN-ESCWA<sup>58</sup>). The uncertainty is likely driven by the political need to protect current claims to water shares and to prevent claims about treatment costs. In this sense, the issue at hand (regarding the amount of wastewater) is directly related to the other identified issues of the required treatment level, the ownership of treated wastewater and the costs for wastewater treatment.

## 5. The quality of water returning to surface and groundwater in the West Bank

In this chapter, the uncertainties related to pollution are discussed. First, what are the sources of pollution and what are its impacts? Second, what are the incentives and disincentives present that influence the construction of effective wastewater treatment plants? Third, according to which standards should wastewater from the West Bank be treated?

### 5.1 Impact of wastewater

Sources of wastewater which impact humans and the environment are: domestic and industrial activities in Israel, the West Bank and the settlements in the West Bank. Notable contaminating industries in the West

<sup>51</sup> Rashed Al-Sa'ed, "A policy framework for trans-boundary wastewater issues along the Green Line, the Israeli-Palestinian border." *International Journal of Environmental Studies*, 67-6 (2010): 937-954; Rashed Al-Sa'ed, Ahmad M. Al- Hindi, "Challenges of transboundary wastewater management for Palestinian communities along the Green Line – The Israeli-Palestinian border." (Chapter 13: 203-220) in *Shared Borders, Shared Waters: Israeli-Palestinian and Colorado River Basin Water Challenges*, ed. Sharon B. Megdal et al. (Leiden: CRC Press-Balkema, Taylor & Francis Group, 2013).

<sup>52</sup> Of this amount, 10.2mcm are raw wastewater that flows into the Kidron Basin, in southeast Jerusalem, and 7.3mcm flow into the Og Reservoir facility north of the Dead Sea, near Nabi Musa (Btselem, 2009).

<sup>53</sup> PWA, "National water and wastewater strategy for Palestine: Toward building a Palestinian state from water perspective." *Final copy* (Palestinian Water Authority, 2013).

<sup>54</sup> Water Authority, "The issue of water between Israel and the Palestinians." *Report* (State of Israel, 2009).

<sup>55</sup> Rashed Al-Sa'ed, "A policy framework for trans-boundary wastewater issues along the Green Line, the Israeli-Palestinian border." *International Journal of Environmental Studies*, 67-6 (2010): 937-954.

<sup>56</sup> Executive Action Team (EXACT) Multilateral Working Group on Water Resources. <http://www.exact-me.org/>

<sup>57</sup> SUSMAQ, <http://www.hwe.org.ps/Projects/Research/SUSMAQ/Brochure.pdf>

<sup>58</sup> UN-ESCWA and BGR, 2013. "Inventory of Shared Water Resources in Western Asia." *Report* (Beirut: United Nations Economic and Social Commission for Western Asia; Bundesanstalt für Geowissenschaften und Rohstoffe, 2013). <http://waterinventory.org>

Bank are leather tanning factories and stone cutting workshops<sup>59</sup>. Other sources of pollution are: solid waste landfills, agricultural practices (including inorganic fertilizers, pesticides and herbicides) and irrigation with untreated sewage water. The Kishon, Alexander-Nablus, Modiin, Kidron and Hebron streams (figure 3) are the most seriously affected<sup>60</sup>. The pollution restricts the water use and drinking water supply wells had to close because of this pollution<sup>61</sup>. Wastewater represents a potentially valuable resource after treatment for irrigation, particularly in the arid region of the Middle East which is increasingly affected by climate change<sup>62</sup>.

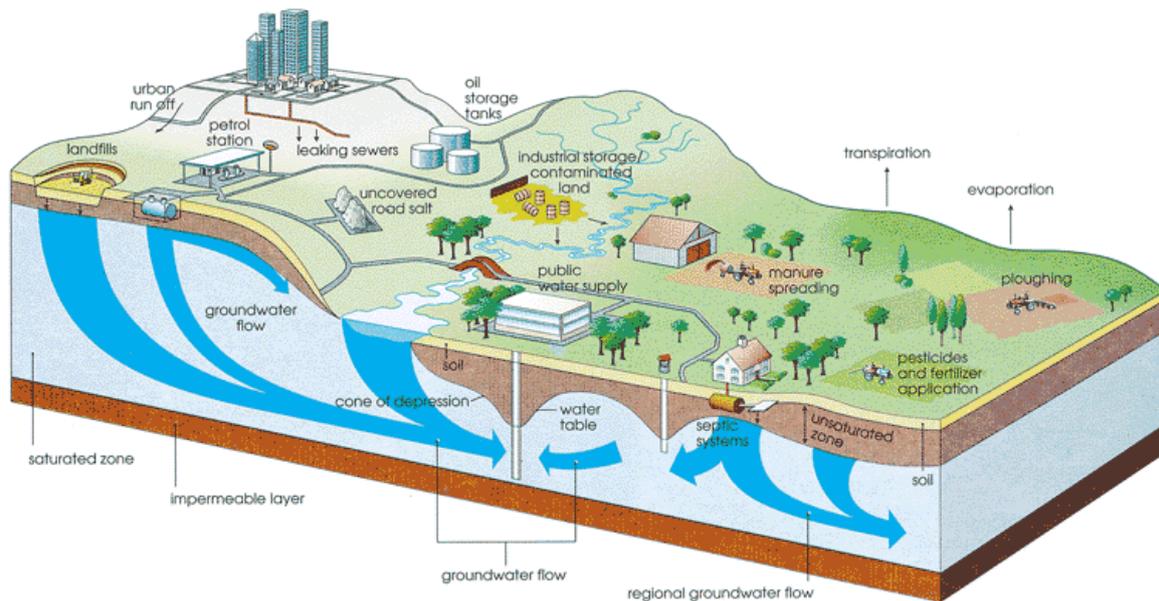


Figure 4: The hydrological cycle with groundwater pollution risks (source: UNEP)

According to the World Bank, around 25mcm of *untreated sewage* in over 350 locations in the West Bank is discharged into the environment each year<sup>63</sup>.

Table 5: Wastewater entering the natural environment in the West Bank

	Israeli literature	Palestinian literature
Entering the surface water		6.38mcm/y <sup>64</sup>
Entering the groundwater	34mcm/y <sup>65</sup>	41.17mcm/y <sup>66</sup>

<sup>59</sup> ARIJ, "Status of the environment in the occupied Palestinian Territory." Report (Applied Research Institute Jerusalem, 2007).

<sup>60</sup> Water Authority Israel, "The Issue of Water between Israel and the Palestinians." Report (State of Israel, 2009).

<sup>61</sup> Examples are the "Beit Fajjar well (owned by the Municipality of Bethlehem), three wells in the Jerusalem area (Ein Karem 13, 17, and Al Azzariya 1), and wells in the Jordan Valley area (Mitzpe Jericho well 6 and Naaran 2)." (Water Authority Israel, 2009)

<sup>62</sup> OECD, "Water and Climate Change Adaptation: Policies to Navigate Uncharted Waters." OECD Studies on Water (Paris: OECD Publishing, 2013). DOI: <http://dx.doi.org/10.1787/9789264200449-en>; J. Lelieveld, P. Hadjinicolaou, E. Kostopoulou, J. Chenoweth, M. El Maayar, C. Giannakopoulos, C. Hannides, M.A. Lange, M. Tanarhte, E. Tyrilis and E. Xoplaki, "Climate change and impacts in the Eastern Mediterranean and the Middle East." *Climate Change* 114 (2012): 667-687.

<sup>63</sup> World Bank, "Assessment of restrictions on Palestinian water sector development." Report 47657-GZ (World Bank, 2009).

<sup>64</sup> PWA, "National water and wastewater strategy for Palestine: Toward building a Palestinian state from water perspective." Final copy (Palestinian Water Authority, 2013).

<sup>65</sup> Water Authority, "The issue of water between Israel and the Palestinians." Report (State of Israel, 2009).

<sup>66</sup> PWA, "National water and wastewater strategy for Palestine: Toward building a Palestinian state from water perspective." Final copy (Palestinian Water Authority, 2013).

Despite disagreement on many water governance related issues, there is common concern on the detrimental impact of wastewater on human health, (through the drinking water and agricultural produce) and on ecosystem health. Wastewater has a severe impact, particularly in the context of the West Bank, where pollution quickly seeps to deeper aquifers through the fractured karstic underground. A recent study, for example, estimates that the springs in the area around Ramallah – Jericho, exhibited a wastewater borne flow fraction between 0% and 20%<sup>67</sup>.

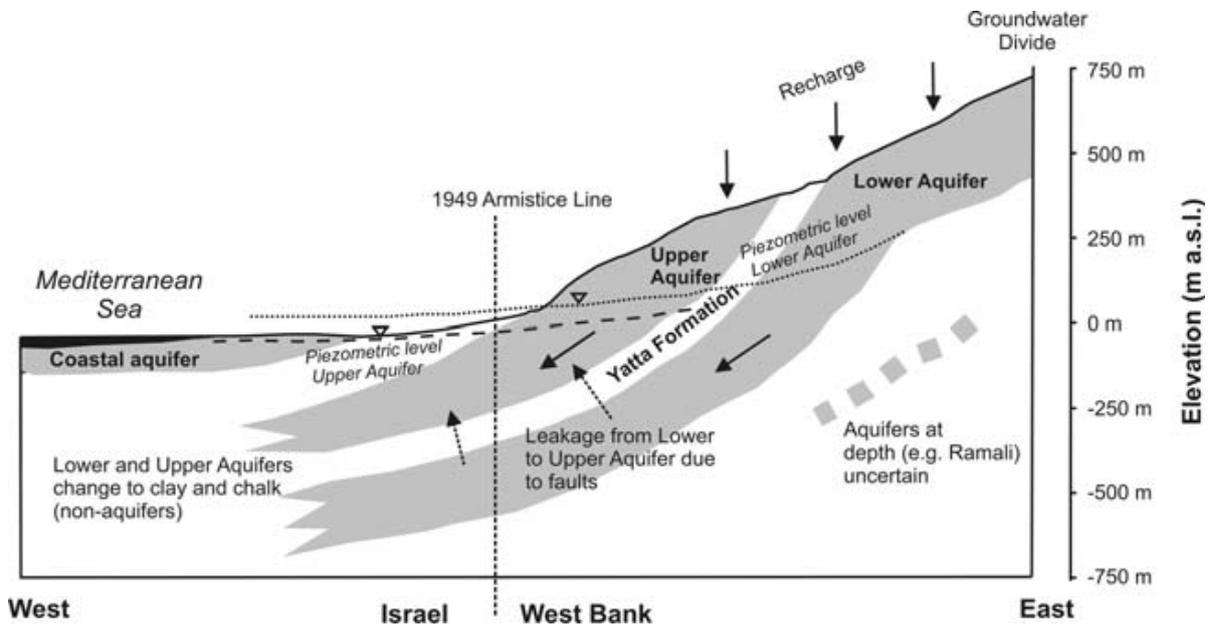


Figure 5: Groundwater in Israel and the West Bank (source: Mansour et al., 2014<sup>68</sup>)

However, what is the impact of pollution on the human health and the environment in the long term? Due to a lack of structural measurements, it is uncertain how the pollution degrades and interacts in surface water streams and in the deeper aquifers<sup>69</sup>. This influences the choice and location for specific treatment methods and the options for reuse. Some detailed modeling has been done, but continued measurements need to be carried out.

<sup>67</sup> Sebastian Schmidt, Tobias Geyer, Amer Marei, Joseph Guttman, Martin Sauter, "Quantification of long-term wastewater impacts on karst groundwater resources in a semi-arid environment by chloride mass balance methods." *Journal of Hydrology* 502 (2013): 177-190.

<sup>68</sup> M. M. Mansour, D. W. Peach, A. G. Hughes and N. S. Robins, "Tension over equitable allocation of water: estimating renewable groundwater resources beneath the West Bank and Israel." *Geological Society, London, Special Publications* 362 (2012): 355-361. DOI: 10.1144/SP362.20

<sup>69</sup> Sebastian Schmidt, Tobias Geyer, Amer Marei, Joseph Guttman, Martin Sauter, "Quantification of long-term wastewater impacts on karst groundwater resources in a semi-arid environment by chloride mass balance methods." *Journal of Hydrology* 502 (2013): 177-190.

## 5.2 Wastewater treatment within the West Bank

### Settlements

Wastewater treatment in the settlements is limited: local facilities are absent, and they are of limited capacity for the increased number of settlers - or they are not well maintained<sup>70</sup>. The consequence is that raw or partially treated sewage flows into the wadis. According to a study in 2008, 81 of 121 settlements in the West Bank were connected to wastewater treatment facilities<sup>71</sup>, resulting in 12 mcm of treated wastewater, while 5.5 mcm from settlements flows as raw wastewater into West Bank streams<sup>72</sup>. The quality of the treatment differs and also depends on the type of pollution and the rate of dilution.

### West Bank Palestinians

Estimates of the number of West Bank Palestinians still relying on septic tanks/ cesspits for their wastewater disposal vary greatly: 69%<sup>73</sup> to 48,1%<sup>74</sup>. The same goes for estimates of West Bank Palestinians with a sewerage connection: 20%<sup>75</sup>, 31%<sup>76</sup> to 50%<sup>77</sup>. Permeable cesspits will allow raw wastewater to seep into the ground (though they tend to become water tight after some years after which they need to be emptied as well). Tight cesspits need to be emptied by a tanker which transports the sludge to a regional treatment plant. Having a cesspit emptied, however, is costly. A regular cesspit in the West Bank has a capacity of 15 to 25 CM, which can store sewage for about a month. The cost per cubic meter is 2€, or 40€ for a typical home in the West Bank. As a consequence of these high costs, the raw sewage is sometimes released into the environment. Sewerage networks transport the sludge to either basic (rural) facilities or to regional wastewater treatment plants (WWTPs). The efficacy to treat increasing larger volumes to required standards is varying.

In the West Bank, there are five major wastewater treatment plants (WWTP): Nablus West, Al Bireh, Tulkarem, Ramallah, and Jenin<sup>78</sup>. But only the plant in Al Bireh is functional<sup>79</sup>, the other plants are not in operation or their effluent quality is poor as they are outdated, and are incapable of handling the current amount of wastewater that they receive. Next, Japan has through UNDP funded three wastewater collection systems in Israel on the border with the northern part of West Bank (Barta'a Sharqieh, Habla and Baqa Sharqieh). Three WWTPs are currently under construction in Jericho, Hebron and Nablus East.

<sup>70</sup> Btselem, "Foul Play: Neglect of Wastewater Treatment in the West Bank" *Report* (Btselem, 2009).

<sup>71</sup> The Kana stream conduit is the only conduit that carries the wastewater from six settlements (Karne Shomeron, Emmanuel, Oranit, Sha'are Tikva, Yakir, and Nofim) to the Nir Eliahu regional treatment plant inside Israel. (Btselem, 2009)

<sup>72</sup> World Bank, "Assessment of restrictions on Palestinian water sector development." *Report 47657-GZ* (World Bank, 2009).

<sup>73</sup> World Bank, "Assessment of restrictions on Palestinian water sector development." *Report 47657-GZ* (World Bank, 2009).

<sup>74</sup> EMWIS, "Euro-Mediterranean Information System on Know-how in the Water sector" *Country Report Palestine* (EMWIS, 2005).

<sup>75</sup> Eyal Hareuveni, "Foul play: Neglect of wastewater treatment in the West Bank." *Report* (Btselem, 2009). This report cites in one footnote: ARIJ, "Status of the Environment in the Occupied Palestinian Territory." *Report* (Applied Research Institute Jerusalem, 2007): 118; UNEP, "Desk Study on the Environment in the Occupied Palestinian Territories" *Report* (UNEP, 2002): 52; Ariel Cohen, Yuval Sever, Avi Tzipori, and Dina Fiman, "West Bank Streams Monitoring – Stream Pollution Evaluation Based on Sampling during the Year 2007." *Report* (Environmental Unit, Israel Nature and Parks Authority, 2008): 14 (in Hebrew).

<sup>76</sup> World Bank, "Assessment of restrictions on Palestinian water sector development." *Report 47657-GZ* (World Bank, 2009).

<sup>77</sup> EMWIS, "Euro-Mediterranean Information System on Know-how in the Water sector" *Country Report Palestine* (EMWIS, 2005).

<sup>78</sup> In addition to: around thirteen small WWTPs, more than 700 on site small scale WWTPs and the treatment of wastewater in Israel.

<sup>79</sup> Palestinian Bureau of Statistics, *Wastewater statistics*. (Palestinian Bureau of Statistics, 2000).

Table 6: Wastewater treated within the West Bank

	Israeli literature	Palestinian literature
Wastewater treated in Palestinian WWTPs	4mcm/y <sup>80</sup>	1.83mcm/y <sup>81</sup>
Wastewater treated in WWTPs in settlements	12 mcm/y untreated <sup>82</sup>	5.5 mcm

According to the Water Agreement<sup>83</sup>, the wastewater is to be treated before it is released into the environment. In 2003, a Memorandum of Understanding was signed by the JWC<sup>84</sup>, defining the mode of wastewater treatment and standards. Palestine was given more time to reach the required standards for WWTPs. After an initial period of five years (in which secondary treatment is required), treated wastewater will need to go through a tertiary treatment, making it directly suitable for irrigation or for discharge into wadis and streams. During the initial period, wastewater was not allowed to contain more than 20 milligrams per liter of biological oxygen demand (BOD), and 30 milligrams per liter of total suspended solids (TSS) (the '20/30 standards')<sup>85</sup>. These quality standards of the effluent were increased to a BOD of 10 mg/l and a TSS of 10 mg/l (the Israeli Inbar Commission's 10/10 standards for effluent discharge into streams)<sup>86</sup>.

Considering the state of sewerage infrastructure in the West Bank, and the time it will take to develop the infrastructure, gradual development of treatment standards seems best. The tertiary treatment standards are not yet in effect in wastewater treatment plants in Israel and they are being implemented gradually to eventually cover all existing wastewater treatment plants in Israel. However, the Israeli authorities regard the delays as unduly<sup>87</sup>, as cited in a report of the Knesset on bilateral cooperation over water<sup>88</sup>.

### 5.3 The costs of water usage and treatment

Whittington<sup>89</sup> provides the following comparison of the costs associated with providing a household with modern water and sanitation infrastructure services.

<sup>80</sup> Water Authority, "The issue of water between Israel and the Palestinians." *Report* (State of Israel, 2009).

<sup>81</sup> PWA, "National water and wastewater strategy for Palestine: Toward building a Palestinian state from water perspective." *Final copy* (Palestinian Water Authority, 2013).

<sup>82</sup> World Bank, "Assessment of restrictions on Palestinian water sector development." *Report* 47657-GZ (World Bank, 2009).

<sup>83</sup> Interim Israeli Palestinian Agreement (Oslo II), Article 40, Water and Sewage, September 18, 1995.

<sup>84</sup> Water Authority Israel, "The water issue between Israel and the Palestinians: Main facts." (State of Israel, 2012).

<sup>85</sup> HWE and AUD, "Understanding and analysing the current Israeli wastewater practices for transboundary wastewater management from Palestinian." (House of Water and Environment & Austrian Development Cooperation, 2012).

<sup>86</sup> Itay Fischhendler, Shiomi Dinar and David Katz, "The Politics of Unilateral Environmentalism: Cooperation and Conflict over Water Management along the Israeli-Palestinian Border." *Global Environmental Politics* 11-1 (2011): 36-61.

<sup>87</sup> Water Authority Israel, "The Issue of Water between Israel and the Palestinians." *Report* (State of Israel, 2009).

<sup>88</sup> Ori Tal-Spiro, "Israeli-Palestinian Cooperation on Water Issues: Presented to the internal affairs and environment committee." *Report* (The Knesset, The research and information center, 2011): "The Israeli Water Authority is very critical of its Palestinian parallel, claiming that the Palestinians try to avoid responsibility regarding significant decisions that have been agreed, fail to purify wastewater and to recycle it for agricultural use, create difficulties and seek future solutions that will be at Israel's expense."

<sup>89</sup> Dale Whittington, W. Michael Hanemann, Claudia Sadoff and Marc Jeuland, "The Challenge of Improving Water and Sanitation Services in Less Developed Countries." *Foundations and Trends in Microeconomics* 4-6 to 7 (2008): 469-609.

*Table 7: The economic costs of providing a household with modern water and sanitation infrastructure services are the sum of seven principal components*

Cost component	US\$ per m <sup>3</sup>	% of total
1. Opportunity costs of diverting raw water from alternative uses to the household (resource rents)	0.05	3
2. Storage and transmission of untreated water to the urban area	0.10	5
3. Treatment of raw water to drinking water standards	0.10	5
4. Distribution of treated water within the urban area to the household	0.60	30
5. Collection of wastewater from the household (pipeline transport)	0.80	40
6. (Secondary) treatment of wastewater	0.30	15
7. Any remaining costs or damages imposed on others by the discharge of treated wastewater (negative externalities)	0.05	3
Total	2.00	100

Source: Whittington, et al., 2008

As the figures in table 6 shows, the largest water use cost is the distribution of water to a household and transport of to a treatment plant (but compare the 0,80\$ with the 2\$ for cesspit emptying). Centralized treatment may offer the economy of scale, but, consequently, the place of a treatment plant largely determines the final cost. This might support the search for options to increase the wastewater treatment capacity within the West Bank. Note that Salem and Abouzaïd<sup>90</sup> estimate that secondary treatment costs \$0.16 to \$0.60 per cubic meter (which aligns with the figure in the table), while tertiary treatment increases the treatment costs to \$0.32 to \$1.00 depending on the desired standards. Currently, the treated wastewater is used for irrigation purposes; though several sources provide an indication of the costs associated with the use of treated wastewater for irrigation in Israel<sup>91</sup>, uncertainties remain about the exact costs (and benefits).

As a significant amount (30%<sup>92</sup>) of wastewater from the West Bank is treated within Israel, Israel applies an offset mechanism to compensate its treatment costs. This offset mechanism is, however, unilaterally applied, based on a decision by the Ministerial Committee for Social and Economic Affairs (6/01/03). This offset mechanism is based on the Polluter Pays Principle (PPP) and is used by Israel to setup the required wastewater treatment facilities. Shalimtzek and Fischhendler<sup>93</sup> provide a detailed account of the introduction of the Polluter Pays Principle (PPP) in the West Bank.

The Polluter Pays Principle (PPP) is internationally recognized as a guiding principle in, for example, the Rio Declaration and Environment and Development<sup>94</sup> and in various policies of the OECD<sup>95</sup> to cover the costs

<sup>90</sup> Btselem, "Foul Play: Neglect of Wastewater Treatment in the West Bank" Report (Btselem, 2009).

<sup>91</sup> D. Lavee, "Is the Upgrading of Wastewater Treatment Facilities to Meet More Stringent Standards Economically Justified: The Case of Israel." *Water Resources* 41-5 (2014): 564–573; Nava Haruvy, Sarit Shalhevet, Israela Ravina, "Financial and managerial analysis of irrigation with treated wastewater in Israel." *Journal of Financial Management and Analysis* 16-2 (2003): 65-73.

<sup>92</sup> Rashed Al-Sa'ed, Ahmad M. Al- Hindi, "Challenges of transboundary wastewater management for Palestinian communities along the Green Line – The Israeli- Palestinian border." (Chapter 13: 203-220) in *Shared Borders, Shared Waters: Israeli-Palestinian and Colorado River Basin Water Challenges*, ed. Sharon B. Megdal et al. (Leiden: CRC Press-Balkema, Taylor & Francis Group, 2013).

<sup>93</sup> Adam Schalimtzek and Itay Fischhendler, "Dividing the cost-burden of environmental services: the Israeli-Palestinian wastewater regime." *Environmental Politics* 18-4 (2009): 612–632.

<sup>94</sup> Principle 16: National authorities should endeavor to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution,

arising from removing pollution. Economic instruments, which aim to control pollution by harnessing the power of market incentives, are thought to offer a more cost-effective and flexible form of regulation than conventional command and control measures. According to the PPP, the water user who caused the pollution, exceeding the set limits for the watercourse, should therefore clean the watercourse and bear the costs for it, or the next user downstream may clean the watercourse, while charging the user upstream for the expenses it incurred directly related to the pollution. In order to arrive at a clear implementation of the PPP, four questions can be posed to provide some direction for further analysis of the uncertainties within the context of the PPP: a) What constitutes pollution? b) Who are the polluters? c) How much must the polluters pay? d) To whom must they make the payment<sup>96</sup>?

Though the Palestinian Authority does accept the PPP<sup>97</sup>, the offset mechanism is contested<sup>98</sup>. The first reason often mentioned is the unilateral character of the offset mechanism. Second, the contestation increases as Palestinians do not receive the treated water and are restricted in building their own sewerage and wastewater treatment plants<sup>99</sup>. Third, the disagreement is magnified due to the lack of clarity over which costs exactly are included in the offset price:

- How many WWTP in Israel treat wastewater from the West Bank?
- What is the exact flow (mcm/ year) from the settlements and Palestinian territory?
- What is the flow received by the Israeli WWTP? Without more information on quantities and qualities it becomes difficult to derive actual costs for wastewater treatment.
- According to what standards is the wastewater treated and sold?
- In a presentation on costs of drinking water and wastewater<sup>100</sup> it is mentioned by the Israeli Water Authority that different (escalating) tariffs are used for different user groups, while prices fluctuate on the water quality. But the exact tariffs used for the treatment of one cubic meter of wastewater inside Israel remain unclear<sup>101</sup>.

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*with due regard to the public interest and without distorting international trade and investment.* (source: [www.un.org/documents/ga/conf151/aconf15126-1annex1.htm](http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm))

<sup>95</sup> The OECD reinterprets the PPP to Extended Producer Responsibility. This is a concept “*where manufacturers and importers of products should bear a significant degree of responsibility for the environmental impacts of their products throughout the product life-cycle, including upstream impacts inherent in the selection of materials for the products, impacts from manufacturers’ production process itself, and downstream impacts from the use and disposal of the products. Producers accept their responsibility when designing their products to minimise life-cycle environmental impacts, and when accepting legal, physical or socio-economic responsibility for environmental impacts that cannot be eliminated by design.*” (source: <http://www.oecd.org/env/waste/factsheetextendedproducerresponsibility.htm>)

<sup>96</sup> Roy E. Cordato, “The Polluter Pays Principle: A Proper Guide for Environmental Policy.” (Institute for Research on the Economics of Taxation, 2006). <http://iret.org/pub/SCRE-6.PDF> Consulted 5-11-2014

<sup>97</sup> See page 14 of PWA, 2013. National water and wastewater strategy for Palestine: Toward building a Palestinian state from water perspective. Final copy. Palestinian Water Authority.

<sup>98</sup> HWE and AUD, “Understanding and analysing the current Israeli wastewater practices for transboundary wastewater management from Palestinian.” (House of Water and Environment & Austrian Development Cooperation, 2012).

<sup>99</sup> HWE and AUD, “Understanding and analysing the current Israeli wastewater practices for transboundary wastewater management from Palestinian.” (House of Water and Environment & Austrian Development Cooperation, 2012); Rashed Al-Sa’ed, Ahmad M. Al- Hindi, “Challenges of transboundary wastewater management for Palestinian communities along the Green Line – The Israeli- Palestinian border.” (Chapter 13: 203-220) in *Shared Borders, Shared Waters: Israeli-Palestinian and Colorado River Basin Water Challenges*, ed. Sharon B. Megdal et al. (Leiden: CRC Press-Balkema, Taylor & Francis Group, 2013).

<sup>100</sup> Gilad Fernandes, “Economics aspects in Water Management in Israel: Policy & Prices.” *PowerPoint presentation* (Water Authority Israel, State of Israel, 2012).

<sup>101</sup> HWE and AUD, “Understanding and analysing the current Israeli wastewater practices for transboundary wastewater management from Palestinian.” (House of Water and Environment & Austrian Development Cooperation, 2012).

The Israeli Sewage Infrastructure Development Administration determines charges for wastewater treatment. Together with the Ministry of Finance's Chairman's Office it implements deductions on Palestinian tax transfers (custom and trade taxes collected by Israel). These deductions are based on the annual capital and operational expenditures of the downstream wastewater treatment in Wadi An-Nar Hebron and Wadi Zaimer. Over the period of 1994-2008 this amounted to 34 million USD. The reclaimed effluent of around 5-6 mcm/year is partly applied to irrigated agriculture in Israel and partly used to restore the environmental flow of the Alexander River (Water for Nature).

However, in order to decide who is the polluter and who should pay and be paid, one first needs to know who has rights<sup>102</sup> to the polluted resource. This depends on the jurisdiction of the area at hand. In the West Bank, however, where wastewater streams from settlements mix with wastewater streams from Palestinian villages and towns, it is often unclear who the polluter is, and who is to pay for costs made by downstream users.

It is questionable whether, apart from the direct costs associated with treatment, opportunity costs should be included in the costs for wastewater treatment: it is difficult to establish an objective base. For example, what will the temporal and spatial boundaries be that should limit opportunity costs? And how should these be measured?

With regard to the Polluter Pays Principle, these uncertainties make it difficult to use the *impact on the environment* as a base for establishing payments. Instead, it seems more feasible to only charge for cleaning the *source of pollution*: i.e. treating the wastewater (according to a certain standard, which is related to a certain purpose).

#### 5.4 Building effective WWTPs

The costs made according to the PPP should provide incentives to the polluter to reduce its pollution and/ or clean its own effluent or to undertake preventive action. However, the polluter should be able to deploy the necessary incentives. The Israeli authorities reproach<sup>103</sup> the Palestinian authorities for not building new treatment plants or maintaining existing ones, though substantive donor money is available. Next, they point to the mutual responsibility to treat wastewater, to which both parties agreed in the Water Agreement<sup>104</sup>.

The PA responds that they face a number of negative incentives to reduce their pollution:

- New WWTPs are scheduled, but: "It is unclear if all these projects will be completed by the due date, as the Israeli administration (through the JWC or the ICA) is hindering and constraining the construction of these WWTPs."<sup>105</sup>
- In some cases pressure was exerted onto the PA to connect Israeli settlements to Palestinian WWTPs. However, the Palestinian Authority will not treat water from the settlements, as this implies that they would recognize the settlements in the West Bank<sup>106</sup>.

<sup>102</sup> Interestingly, as water passes through the various parts of the hydrological system (vapor, rainfall, runoff/ surface water, interflow, groundwater, sea) it is subjected to different legal regimes and ownership claims. While a surface water pond most likely falls under a private property regime, the same water, when it enters an aquifer, becomes common property. In the current situation, water is taken from the environment, used for drinking, cultivation, industry etc. In this process, some water is taken away ('virtual water' in crops) and some is released back into the environment with a certain amount of pollution. Next, the water may be used again for other purposes.

<sup>103</sup> Water Authority Israel, "The water issue between Israel and the Palestinians: Main facts." *Report* (State of Israel, 2012).

<sup>104</sup> Interim Israeli Palestinian Agreement (Oslo II), Article 40, Water and Sewage, September 18, 1995.

<sup>105</sup> PWA, "National water and wastewater strategy for Palestine: Toward building a Palestinian state from water perspective." *Final copy* (Palestinian Water Authority, 2013).

<sup>106</sup> Btselem, "Foul Play: Neglect of Wastewater Treatment in the West Bank" *Report* (Btselem, 2009).

By not treating the wastewater within the West Bank, however, Palestine loses the opportunity to profit from the treated wastewater which originates there. According to HWE<sup>107</sup>, Palestine could increase the volume of agricultural water by 12% if they treated the wastewater themselves.

Though the quality of the wastewater treatment within the settlements is questionable, the building of new (and the improvement of existing) sewage infrastructure in the settlements in the West Bank has been delayed. Under Israeli law, municipalities are responsible for wastewater treatment. For this purpose, the government provides 100% loans to the municipalities, including the settlements<sup>108</sup>. However, most settlements have not used the loans to construct new infrastructure and new settlements are being built without proper WWTPs. Although the Israeli government is successfully enforcing the environmental laws within Israel, the municipalities of the settlements in the West Bank undertake little action to address the wastewater problem. This appears to be caused by the lack of authority Israeli government ministries, like the ministry of environmental protection, have in the West Bank.

## 6. Discussion

This article has shown how the high stakes, the far-reaching impact of (non-) decisions and the range of uncertainties create a complex problem. Both parties clearly make different assumptions to support their claims, which continue to distort the cooperation between Israel and Palestinians in the West Bank on transboundary wastewater management. Per theme the study discusses the underlying uncertainties, based on the analytical framework.

### *1. The volumes of wastewater produced in settlements, in Palestinian villages and towns, and the flows from and into the West Bank*

As the article demonstrates, it is hard to compile a hydrological balance, including the wastewater flows, based on the different estimates. The uncertainty has different sources:

- Water flows are intrinsically variable as they are dependent on a range of physical and climatological dynamics acting on different temporal and geographical scales.
- Continuous flow measurements are limited (or not made publicly available).
- Modeling surface and groundwater flows involves making assumptions about static parameters and variables, like surface roughness, soil moisture content, etc. Despite being based on expert judgment, all these assumptions are subject to uncertainty, to a greater or lesser extent.
- Estimates of water usage and wastewater production, based on the population size in the West Bank, are strongly contested by both parties (“The Million Person Gap”)<sup>109</sup>.

### *2. Interaction of pollution with groundwater and the longer-term impact on environment and human health*

The above-identified uncertainties are partly applicable to the impact of the wastewater pollution:

- The amount of water also determines the grade of dilution and biological breakdown of pollution.
- Continued flow and water quality measurements are limited (or not made publicly available).
- Modeling dilution, breakdown and dispersion of pollutants involves making numerous assumptions, which are, to a greater or lesser extent, subject to uncertainty.

<sup>107</sup> HWE and AUD, “Understanding and analysing the current Israeli wastewater practices for transboundary wastewater management from Palestinian.” (House of Water and Environment & Austrian Development Cooperation, 2012).

<sup>108</sup> Zecharya Tagar, Tamar Keinan, Gidon Bromberg, “A Seeping Time Bomb: Pollution of the Mountain Aquifer by sewage.” *Investigative Report Series on Water Issues 1* (Tel Aviv: Friends of the Earth Middle East, 2004).

<sup>109</sup> Bennett Zimmerman, Roberta Seid and Michael L. Wise, “The Million Person Gap: The Arab Population in the West Bank and Gaza.” *Mideast Security and Policy Studies 65* (The Begin-Sadat Center for Strategic Studies, Bar-Ilan University, 2006).

### 3. Preventive action

Preventive action, despite being agreed in the Water Accords (the "no harm" principle of Oslo II), is constrained by political and institutional uncertainties:

- Israel is of the opinion that it has fulfilled its obligations with regard to the Oslo-agreement and that Palestinians are breaching the agreement as 'their sewage flows freely in the streams'<sup>110</sup>, while *sufficient technical solutions are available*. At the same time, little attention is being paid to the pollution caused by the settlements due to inadequate treatment plants, despite the financial support available and the legislation, which is strictly applied in Israel itself. An adequate explanation of the reasons why environmental enforcement in the settlements is inadequate seems unsatisfactory. As such, the problem is framed as a technical one which is not open to dispute (*Managerialism*).
- While all parties agree it is a necessity to reduce the detrimental impact of wastewater on the environment and human health, the conditions under which treatment plants can be effectively built in the West Bank (especially in/across Area C) are less clear-cut<sup>111</sup>. In the Palestinian (waste) water management discourse, Israel and Israeli policies are negatively framed and blamed for its adverse impact on Palestinian water management. On the other hand, institutional weaknesses within the Palestinian Authority that hinder good governance of wastewater management facilities, are not that openly addressed<sup>112</sup>. As such, the way the (waste) water management problem is framed in such a way that it is part and parcel of the larger political issue of Palestinian independence (*Politicization*).

### 4. Conditions under which the Polluter Pays Principle can successfully be implemented

- Lack of clarity (about the tariff composition the off-set mechanism, applied water quality standards, and wastewater flow received by Israel) hinder the cooperation between the two parties, but these 'uncertainties' seem merely politically motivated rather than constituting fundamental uncertainty.
- Clearly, cost-sharing through the Polluter Pays Principle is just part of the larger political puzzle: Shalimtzek and Fischhendler<sup>113</sup> conclude that "asymmetrical conditions accompanied by political turmoil, the cost-sharing principle serves political needs for the hegemonic party even at the price of adopting environmentally inferior solutions in the form of non-comprehensive and end-of-pipe solutions."

<sup>110</sup> Water Authority Israel, "The Issue of Water between Israel and the Palestinians." *Report* (State of Israel, 2009).

<sup>111</sup> Palestine claims that, while financial resources are available for construction, the role of the Civil Administration is a formidable constraint to get projects implemented (IBRD/World Bank, 2009). While the construction of premises and transport pipes are subject to normal planning procedures of the Civil Administration, it lacks Palestinian participation and is heavily influenced by Israeli (security) concerns.

<sup>112</sup> IBRD/World Bank, "West Bank and Gaza: Assessment of Restrictions on Palestinian Water Sector Development." *World Bank Report* 47657-GZ (IBRD/World Bank, 2009).

<sup>113</sup> Adam Schalimtzek and Itay Fischhendler, "Dividing the cost-burden of environmental services: the Israeli-Palestinian wastewater regime." *Environmental Politics* 18-4 (2009): 612–632.

The following table summarizes the above discussion.

*Table 8: Uncertainty matrix based on the author’s interpretation of the degree and characteristics of the main uncertainties regarding transboundary wastewater management*

Description of uncertainty	Location of uncertainty	Level of uncertainty	Nature of uncertainty	Qualification of knowledge base	Value-ladenness	Political linkedness
The volumes of wastewater produced in settlements, in Palestinian villages and towns, and the flows from and into the West Bank	<ul style="list-style-type: none"> <li>Context (environmental short and long term dynamics)</li> <li>Data (limited number of continued flow measurements, population size in the West Bank)</li> <li>Model (choice of water flow model parameters)</li> </ul>	Statistical uncertainty	Knowledge related	Poor to fair	Medium to high	High
Interaction of pollution with underground/ Longer-term impact on environment and human health	<ul style="list-style-type: none"> <li>Context (environmental short and long term dynamics)</li> <li>Data (limited number of continual measurements)</li> </ul>	Statistical uncertainty	Knowledge related	Poor	Low	Low
Preventive action: (enforcement in settlements – treatment facilities in West Bank)	<ul style="list-style-type: none"> <li>Context (political support)</li> </ul>	Scenario uncertainty (range of possible outcomes)	Variability related (inherent unpredictability)	Poor to Fair	? to High	? to High
Conditions under which the Polluter Pays Principle can successfully be implemented	<ul style="list-style-type: none"> <li>Context (political support)</li> <li>Data (on tariff composition off-set mechanism, applied water quality standards, wastewater flow received)</li> </ul>	Scenario uncertainty (range of possible outcomes)	Variability related (inherent unpredictability)	Poor to Fair	High	High

Source: Based on Van der Sluijs<sup>114</sup>

<sup>114</sup> Jeroen P. van der Sluijs, Arthur C. Petersen, Peter H.M. Janssen, James S Risbey and Jerome R. Ravetz, “Exploring the quality of evidence for complex and contested policy decisions.” *Environmental Research Letters* 3-2 (2008).

## 7. Recommendations

This article illustrates how uncertainties create problems when people need to address a common obstacle, such as the governance of shared waters. Access to clean and safe water is of utmost importance in the Middle East, not only for human health, the environment and economic development, but also for sustaining peace and stability. At the same time, water binds the two parties together as they are dependent on shared water resources, and where ground and surface water flows in a natural manner from the higher parts of the West Bank into Israel.

Cooperation on water issues by the Israelis and Palestinians could offer a golden opportunity to establish trust. It is essential to find a different modality of cooperation, which should be based on the identification and recognition (by both parties) of the various sources of uncertainty: A robust approach to a water-related conflict would not only have to include the best available scientific knowledge, but also respect and include the local understandings of reality and related uncertainties (social/cultural/economic conditions and political contexts). The involvement of stakeholders from multiple levels and sectors is therefore needed, notwithstanding all political difficulties.

Sensible recommendations should, however, follow the current political realities, which result in fact-finding initiatives, like EXACT, being slowed down in times of political turmoil. But multi-party fact-finding processes in trusted environments continue to be necessary. Therefore, based on the ongoing processes and outcomes of processes, the characteristics of the uncertainties should be further identified and addressed through a number of concrete steps:

### *Phase one: Reducing the prevailing uncertainties:*

1. A neutral should help with identifying the stakeholders which have an import impact on the transboundary wastewater and are able to exert influence on its governance<sup>115</sup>. It is important to approach and involve these stakeholders, as they can help in identifying the no-regret measures and/or situations of mutual gain in the second phase.
2. As was discussed in the conceptual framework, facts are filtered and interpreted in a process of sense-making. Therefore, a neutral should identify the different storylines of the stakeholders on the basis of individual interviews:
  - How do stakeholders frame the problems, the consequences and possible solutions; and,
  - What are the consistencies and controversies between the framings?
 Running this analysis supports the identification of a shared language; a shared language in return helps to reduce the prevailing uncertainties.
3. Next, through a series of unilateral and bilateral meetings, on the basis of previous analysis, the uncertainties should be identified and characterized. The following questions serve as guidance:
  - Which information is needed for proper transboundary wastewater governance and what information is currently available?
  - What are the uncertainties; where are they located; what is the level of uncertainty; are they knowledge related; what is the qualification of the knowledge base; to which extent are choices subjective and to which degree are they embedded in high-politics?

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<sup>115</sup> These include, for example, (industrial) polluters, wastewater treatment operators, representatives from the PWA, and Israeli civil and military administration in the West Bank.

4. After these most important steps, parties can decide to invest together in research and monitoring, in order to reduce current uncertainties. As sharing data is extremely difficult under the current political circumstances, the structural involvement of an international third party is worth exploring. A number of international initiatives have already been referred to. Notable alternative approaches are developed by civil society organizations, which focus on trust building through joint research and learning and are explored by Lipchin<sup>116</sup>, the Geneva Initiative<sup>117</sup>, EcoPeace and others. These approaches are hopeful but their impact is limited in terms of funding and scalability.

*Phase two: Planning measures*

5. *On preventive action:* Although it is understood that some Palestinian negotiators fear that taking no-regret measures reduces the urgency of a 'two-state' solution, precautionary actions are strongly needed to limit the current and future detrimental impacts of wastewater on the surface and groundwater flows.

The Precautionary Principle is an internationally recognized legal principle, which can be used to support preventive action. The precautionary principle became mainstream through the Rio Declaration on Environment and Development<sup>118</sup>. This definition places emphasis on the responsibility of a state to take all precautionary measures in case scientific evidence on the consequences of action is missing. This is also reflected, but elaborated for the case of water, in article 21 of the UN Water Courses Convention<sup>119</sup>. Although Palestine is not fully recognized as a state, to which this legal principle refers, it can adopt voluntary measures or insist that Israel adopts it, given it is the state in charge of the territories.

The implementation of these options can be stimulated by clearly outlining what the costs and benefits are of preventive action compared to a 'business as usual'-scenario.

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<sup>116</sup> Jennifer Holzer, Tamee Albrecht, Natasha Westheimer and Clive Lipchin, "Leveraging environmental data to promote cooperation toward integrated watershed management in the Hebron/Besor watershed." *Palestine-Israel Journal* 20-1 (2014): 56-67

<sup>117</sup> See for example the work done in cooperation with The Hague Institute for Global Justice: <http://www.thehagueinstituteforglobaljustice.org/projects/water-as-a-permanent-status-issue-in-the-israeli-palestinian-negotiations/#content>

<sup>118</sup> Principle 15: *In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.* (source: <http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm>)

<sup>119</sup> UN, "Convention on the Law of the Non-navigational Uses of International Watercourses 1997." Entered into force on 17 August 2014. See General Assembly resolution 51/229, annex, Official Records of the General Assembly, Fifty-first Session, Supplement No. 49 (A/51/49): Article 21 on 'Prevention, reduction and control of pollution' lists the following:

1. For the purpose of this article, "pollution of an international watercourse" means any detrimental alteration in the composition or quality of the waters of an international watercourse which results directly or indirectly from human conduct.
2. Watercourse States shall, individually and, where appropriate, jointly, prevent, reduce and control the pollution of an international watercourse that may cause significant harm to other watercourse States or to their environment, including harm to human health or safety, to the use of the waters for any beneficial purpose or to the living resources of the watercourse. Watercourse States shall take steps to harmonize their policies in this connection.
3. Watercourse States shall, at the request of any of them, consult with a view to arriving at mutually agreeable measures and methods to prevent, reduce and control pollution of an international watercourse, such as:
  - (a) Setting joint water quality objectives and criteria;
  - (b) Establishing techniques and practices to address pollution from point and non-point sources;
  - (c) Establishing lists of substances the introduction of which into the waters of an international watercourse is to be prohibited, limited, investigated or monitored.

6. *On interim-agreements:* In a two-state solution, new treatment plants need to be built in the West Bank. This would require several years for completion. During the transition-period wastewater requires treatment, in order to prevent further (irreversible) damage to the environment and precious drinking water stocks. Therefore, interim agreements need to be arranged for the treatment of (part of the) wastewater from the West Bank in Israel. These arrangements should be based on a just distribution of costs and benefits (based on a reliable data).
7. *On interim-measures:* Until a functional wastewater governance regime, based on the PPP is fully implemented, it is recommended that the following options are considered (which are less ideal):
  - Make site-specific agreements if no agreement can be reached about common principles<sup>120</sup>.
  - Although settlements might not be directly under ministerial control of Israel, considering the no-harm/ preventive action principles, it is extremely important to instigate preventive measures. For example, stimulating the use of small-scale low cost treatment plants within the settlements can enhance the operationalization of these regulations, and by doing so separate Israeli wastewater from Palestinian wastewater. The remaining wastewater streams are consequently originating from Palestinian territory, for which the Palestinian Authority bears responsibility.
  - Transboundary wastewater from the Palestinian territory could be framed as ‘water export’ for which the party exporting the water receives adequate compensation, based on the average value of water at the point of application, after deduction of treatment costs. This can be established either by receiving the treated water at a reduced rate or if re-importing the treated wastewater is too costly, the party could be financially compensated (or receive compensation through an increased fresh water quota). This option is also explored in various drafts of the wastewater protocol<sup>121</sup>. During the transition period, it could be instrumental to develop shared specific realistic minimum standards for wastewater quality for reuse.

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