

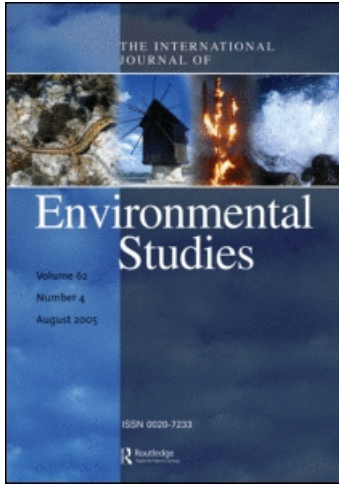
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A policy framework for trans-boundary wastewater issues along the Green Line, the Israeli–Palestinian border

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The annual discharges of municipal wastewater across the Green Line (the Israeli–Palestinian border) are causing a bi-national conflict with political, environmental, and economic dimensions. This paper surveys the current scope of wastewater facilities in Palestinian communities and discusses the immense challenges to achieving sustainable wastewater treatment facilities. Current Israeli water policy hinders effective regional solutions to trans-boundary wastewater issues. This paper proposes a less confrontational approach to solve common problems. The better management of bi-national wastewater resources could establish sustainable trans-boundary sanitation facilities. This would bring a range of benefits to health, the environment, and socio-economic life.

Keywords: Policy framework; Cost sharing; Effluent reuse; Global environmental issues, Green Line; Regional wastewater treatment; Transboundary wastewater

1. Introduction

Trans-boundary water resources include not only freshwater flows, but also return flows (e.g. wastewater), where changes in water quality along any flow pattern affect both the costs and the potential use within the various socio-economic sectors. Sustainable management of all water resources is essential and thus there is a need to develop a policy framework for trans-boundary wastewater and water issues. Several technical and non-technical factors appear to be behind unsustainable Palestinian wastewater treatment facilities. The related research questions are: what are the major constraints behind advancing Palestinian wastewater infrastructures; and how can we devise a policy framework for trans-boundary wastewater issues in a conflict-ridden region; can there be sustainable bi-national wastewater facilities? This paper uses a Palestinian–Israeli case on transboundary wastewater management along the ‘Green Line’, the border of the West Bank of Palestine with Israel, to explore these questions.

The increased population growth rate and rapid expansion of industrial and commercial sites (exacerbated by periodic annual drought periods) have widened the gap between water supply–demand balance in the Occupied Palestinian Territory (OPT), where treated

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wastewater as a non-conventional water source could help bridge the imbalance. Since Israel began the occupation in 1967, the Palestinian people have had limited access to their land and water resources and are dependent on Israel’s prior permissions and foreign donations to establish their water and wastewater treatment facilities. A recent study by the World Bank [1] revealed that about 35% of the Palestinian population has access to adequate sanitation services. The use of cesspits and the discharge of raw sewage over land and into wadis (seasonal dry streams) and the delay in project implementation contribute to serious public health and environmental risks, reduce availability of limited water resources as aquifers are polluted by wastewater, and reduce effective treated effluent use in agricultural irrigation [2–4]. At present, the OPT has eight large urban wastewater treatment plants (WWTPs) including almost 300 onsite treatment plants. These serve mainly urban communities covering an approximately 1.5 million population equivalent (PE), where the current total population of the OPT is slightly more than three million. Al-Sa`ed [5,6] and Al-Sa`ed and Mubarak [7] reported that the current urban and onsite WWTPs (aerated lagoons, hybrid aerobic-trickling filter and constructed wetlands) are unsustainable and overloaded with aging infrastructures. Technical and political constraints have hampered the use of treated effluent for agricultural irrigation. The current practices of wastewater management have potential impacts on public health, and the environment (soil, surface water and groundwater); see figure 1.

Decision-makers must confront questions of water and urban development in a context of conflict; for that is how things are. The challenge is how to provide sustainable wastewater treatment and reuse of treated wastewater in a sustainable way. This becomes more and more complex, controversial and costly. Yet Palestinian officials must strive to meet expectations for socio-economic improvement and cope with the rapid expansion of Palestinian urban

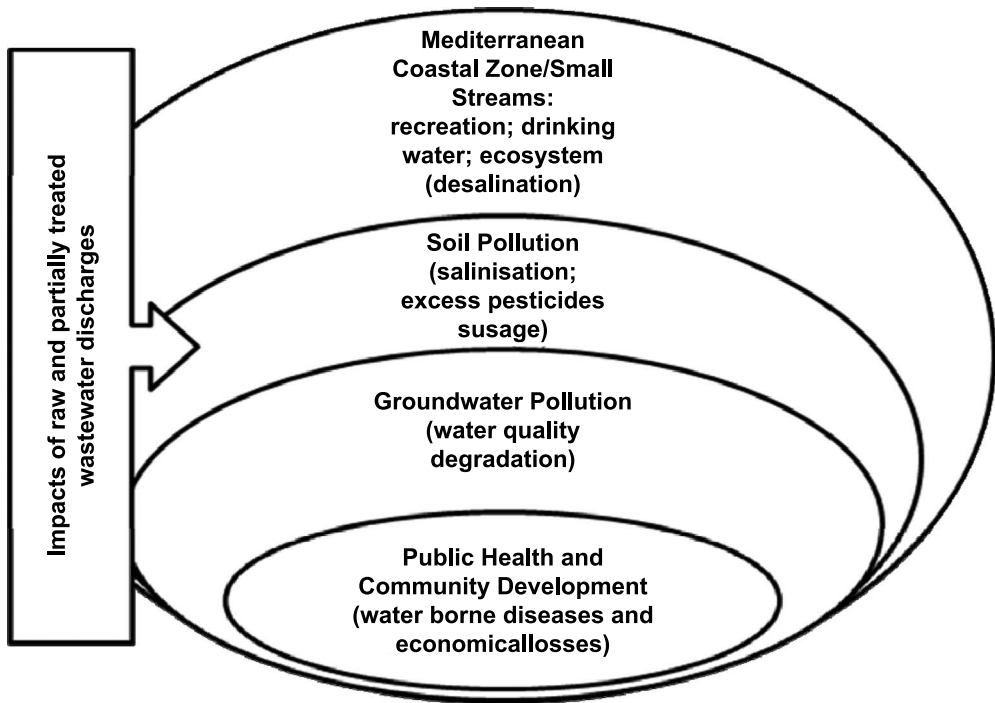


Figure 1. Major impacts of ineffective management of transboundary wastewater in Palestine.

communities. There is limited access to available water resources, and they are overexploited mainly by Israel. Thus, irrespective of the question of water resources mismanagement, the use of reclaimed water, brackish and sea water desalination are core strategic water issues. In addition, trans-boundary management of urban wastewater discharges through viable mechanisms such as recharge and recovery and regional co-operation on major infrastructure needs will become increasingly important. There is an obvious need for a policy framework for trans-boundary wastewater (and water) issues.

Like water, trans-boundary wastewater ignores political borders, and competition over the limited water resources including raw sewage/treated effluent has increased the risk of conflict between Israel and the OPT. Indeed the competition increases the political tension. Therefore, to understand the main challenges to developing a policy framework for adequate wastewater management in the OPT, this study explores the case of Palestinian trans-boundary urban wastewater discharges from the West Bank across the Green Line (into Israel). The study area covers Palestinian urban communities that are situated upstream and are characterised by acute settings of asymmetry and political variability [8–11].

The study begins by considering the current status of wastewater management in Palestinian urban communities. Next, we analyse past and current Israeli water policies, as barriers to sustainable wastewater facilities in Palestine. We discuss the Tulkarem-Emek Hefer regional sanitation initiative as an example of costs and benefits sharing. We discuss the polluter pays principle (PPP), used by Israel as a political offset tool to solve the cost-sharing issues. Finally, we offer conclusions and recommendations pertinent to effective joint co-operation through a regional policy framework for future interventions at the defined Israeli–Palestinian borders of the future.

2. Current status of wastewater management in Palestinian urban and rural communities

Most of the existing wastewater treatment plants (WWTPs) in Palestine do not function very well, with effluent quality exceeding the prescribed national effluent standards. This may simply be due to overloading, but it can often be the result of the various factors associated with improper physical design, faulty construction and insufficient system maintenance [5–7].

Table 1 summarises the historical development of wastewater management (sewerage collection and treatment) under various eras, that is, during the Israeli occupation (1967–1995) and under the rule of the Palestinian Authority (PA, 1995 to present). The development of wastewater treatment facilities in Israel for the period 1948–2008 is in contrast. It is clear that wastewater management in the OPT was fully neglected during the Israeli occupation period (1967–1995), where only 20% of the total population were served centrally by sewer networks and only 5% of collected sewage received physical and partial biological treatment.

All current sewage facilities, except Al-Bireh sewage works, were erected during the Israeli occupation (1967–1995) and under the auspices of the ‘Civil Administration Department’. Regrettably, this has neglected the improvement of quality and access to wastewater infrastructure, has not brought cost recovery and efficiency into their operation and has not promoted any building capacity programs for wastewater services in line with water practices and policies as practised in Israel. A recent World Bank (WB) report explores Israel’s neglect to provide access to safe sanitation services and the adverse impacts associated with this decision [1]. The negative impacts on surface water bodies and annual degradation in ground-water quality were also documented recently by Cohen *et al.* [9] and Hareuveni [10].

Table 1. Historical development of sanitation service coverage under various regimes (Israeli occupation period and under the Palestinian Authority rule^a)

Responsible party	Population served	Years	Service (%) per year
Within Israel (1948–2008)			
Sewerage networks	95%	60	1.6
Centralized WWTPs	90%	60	1.5
Within OPT-WB (1967–1995)			
Sewerage networks	20%	28	0.7
Centralised WWTPs	5%	28	0.2
Legal and administrative bodies			
Mekorot (Israeli Water Company):	Established 1937		Israeli Water Law 1957
Palestinian Authority (1995–2008)			
Sewerage networks	20%	13	1.5
Centralized WWTPs	46% (+33% in Israel)	13	5.8
Legal and administrative bodies			
Palestinian Water Authority (PWA):	Established 1995		Palestinian Water Law 2002

^aIt should be noted that the Palestinian Authority does not have the complete freedom to implement development projects as needed.

During periods of peace and stability, the Palestinian Authority (PA) was able to erect only one urban sewage works in Al-Bireh city, with pre-conditions that the nearby Israeli settlements must be connected to the sewage treatment facility. In this regard, the PA applied three main strategies to promote wide sanitation services coverage and enhance the performance of current wastewater treatment facilities to comply with national prescribed effluent quality standards: *viz.* a) new erection, b) retrofitting and c) upgrading WWT schemes. Table 2 illustrates the efforts made by the PWA to plan, upgrade and rehabilitate the existing WTPs for municipal wastewater treatment in Palestine. The emphasis generally was on integrated pollution control in the upgrading schemes, in which all aspects such as effluent quality standard, sludge disposal, level of technology, ease of upgrading, odour control, land availability, maintenance, cost-effective and other non-financial factors have been considered.

Table 2 shows that 40% (1.5 million) of the total urban population in the OPT have access to central sewer networks, but only 48% of the total annual collected wastewater is being partially treated (secondary treatment) in owned Palestinian sewage works, whereas more than 30% of the annually collected sewage is being treated within Israel. Under the Status column in the table, it is obvious that the current sewage works are either overloaded or under the 'waiting game' for Israeli final approval.

3. Management of trans-boundary wastewater discharges

3.1. Wastewater management in urban communities along the Israeli–Palestinian 'border'

In arid and semi-arid regions, wastewater is a key component of the water cycle that can be treated and reused for a variety of non-potable uses. Treated effluent (water) can be used to water parks, for agricultural purposes, to revitalise heavily polluted streams. In general, this approach conserves the limited quantities of drinkable water available; potable water is not wasted on tasks for which the treated/reclaimed effluent is useful and adequate.

Table 2. Palestinian management efforts to improve wastewater (WW) treatment facilities^{ss}

District	Capita (#)	Served (%)	Capita (#)	WW (m ³ /d)	Treatment system	Year	Status	Activity type
Al-Bireh	50,000	85.8	42,900	4719	Extended aeration	2000	Operational	Upgraded 2008
Ramallah	35,000	74.6	26,110	2872	Aerated Lagoons	1973	Overloaded	Upgraded 2003
Nablus	150,000	82.9	124,350	14,300	Extended aeration	2000	Tendering 09	New WWTP/2020
Hebron	257,000	82.1	210,997	24,265	Conventional ASS ^b	2001	Pending	Regional WWTP
Tulkarm	93,000	68.3	63,519	6352	Aerated Lagoons	1975	Pending	Upgraded 2000
Salfit	25,000	65.6	16,400	1394	Planned ASS ^b	2000	Pending	No funding
Qalqilia	20,000	70.5	14,100	1199	No WWTP	2000	Pending	Regional WWTP
Jenin	52,000	66.5	34,580	3458	Aerated Lagoons	1972	Pending	Upgraded 1994
Beit Lahia	299,000	68.5	204,845	16,341	Aerated Lagoons	1979	Overloaded	Upgraded 2008
Gaza city	545,000	79.0	430,550	48,243	Parallel TFS ^c /EA ^d	1977	Overloaded	Upgraded /86/98
Rafah	184,000	95.3	175,335	20,000	Aerated Lagoons	1978	Overloaded	Upgraded 2009
Bethlehem	84,000	91.2	76,608	8810	No WWTP	2001	Non	No funding
Jerusalem ^a	115,000	80.8	92,920	10,686	No WWTP	2001	Non	No funding
Khan Yunis	120,000	75	90,000	10,350	No WWTP	2000	Non	No funding
Total PE	1,710,000		1,513,214	175,580				

^aJerusalem East; ^bASS: activated sludge system; ^cTFS: trickling filters; ^dEA: extended aeration system.

Figure 2 presents a general view of three locations of small trans-boundary wadis (small streams), that receive wastewater discharges and which cross the Green Line. About 20% of the total population served by central sewer networks reside in Palestinian urban communities having trans-boundary wastewater discharge into Israel. Most of the 15 major rivers

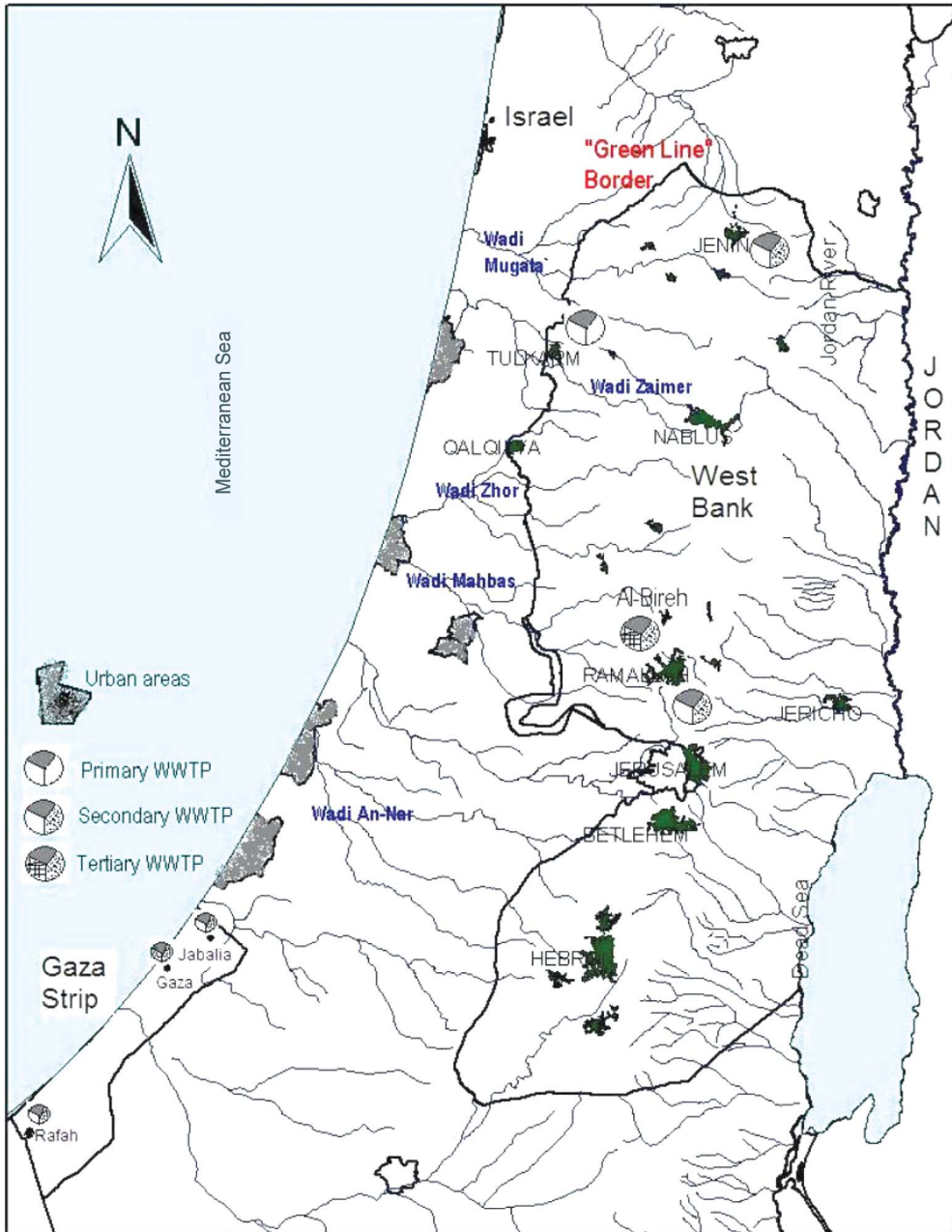


Figure 2. Location of Palestinian WWTPs and receiving surface water bodies.

(streams) in Israel have seasonal tributaries originating in the West Bank, and five of them originate in the West Bank. These are: Wadi Mugata' (Jenin district), Wadi Zaimer (Nablus-Tulkarm districts), Wadi Zhor (Qalqilia district), Wadi An-Nar (Hebron district) and Wadi Mahbas (Ramallah district).

The management of wastewater in the Israeli settlements is not within the scope of this paper. But it is notable that the settlements refuse to share in the capital investment costs or even to pay the wastewater tariff; although they benefit by being connected to the Palestinian sewage works.

If a WWTP proposal is technically approved by the Joint-Israeli-Palestinian Water Committee (according to the Oslo Agreement of 1995), this does not automatically mean direct implementation. Final approval really rests with the 'military orders' granted by the 'Civil Administration', still valid for the West Bank. This body usually takes years to issue a permit for construction; for example, more than 10 years for Nablus and Hebron.

More than 33% of the annual collected urban wastewater (73.7 mcm/year) from Palestinian communities is being treated in Israeli wastewater treatment plants. The treated effluent is further reclaimed for various applications within Israel, mainly for unrestricted agricultural irrigation and water for nature purposes (river rehabilitation and landscape recreation). The Palestinian Authority (PA) has no share in the economic and environmental benefits from the treated or reclaimed effluent that is of Palestinian origin [12].

Schalimtzek and Fischhendler [13] investigated the feasibility of the Polluter Pays Principle (PPP) as a cost sharing tool for the treatment of Palestinian trans-boundary wastewater from the West Bank that crosses the Green Line 'Border' to Israel. They found that under conflict

Table 3. Asymmetry and political conflict on transboundary wastewater management options (modified after Schalimtzek and Fischhendler, 2009)

Background conditions		Effect on suggested/adopted solutions	
International politics	Escalating conflict	Peace process halted and JWC ^a stopped meeting	- Unilateral solutions endorsed - Israeli insistence on PA wastewater treatment despite delayed process approval
		More emphasis on 'high politics'	- Israeli insistence on PPP leading to adoption of extreme PPP regulations - Reclaimed water used by Israel alone
		Unstable security conditions	- Location of wastewater projects inside Israel, and no approval for PWA projects
Internal Politics	Pressure for unilateral actions by Israeli settlements/local agencies Palestinian Authority has no role	- Project first paid by local authorities and next activation of offset mechanism - Cost sharing without benefits; refuses offset - Israeli military orders enacted causing delay in implementation of Palestinian projects	
Economic	Lack of economies of scale	- Separate plants proposed or implemented	
Environmental	Acute need to prevent pollution	- Emergency projects with high treatment standards - Israel deducted operation costs from Palestinian taxation collected by Israel - Inferior downstream solutions (upstream in Wadi An-Nar-Kidron)	

^aJWC: Joint Water Committee.

conditions with strong political and economic asymmetries Israel opted for the extreme form of the PPP. It is evident that lack of a transparent political framework and the immense pressure applied by many Israeli internal actors in the environmental decision-making process have resulted in disagreement between the Palestinian and Israeli sides as to a feasible cost-sharing system.

Table 3 illustrates how Israel's application of the PPP did not achieve environmentally sound solutions on trans-boundary wastewater management. Instead, the current Israeli water practices have advanced environmental alternatives that deviate from a fair PPP under a dominating regional conflict and asymmetrical power conditions.

4. Current practices of effluent disposal into the receiving water bodies

4.1. Regional water treaties between Israeli and Palestinian sides

Tal [13] explored several trans-boundary stream restorations and wastewater treatment standards among five main Israeli/Palestinian trans-boundary streams and analysed the actual capability of current Israeli laws and regulatory tools to resolve them. Among the main 10 Israeli water pollution control laws and orders is the Sewage Effluents Standards (SES). The 1992 SES (Public Health Ordinance) were based on European standards. The SES assumed a considerable degree of dilution in receiving surface water bodies. The standards unfortunately do not take into consideration the site-specific vulnerability of groundwater and the existing water quality of many streams. Yet most of these streams have seasonal water flows, if any, or are composed entirely of wastewater.

With almost 95% sewerage coverage, Israel uses annually about 300 mcm (75% of treated effluent) in agricultural irrigation and has the status of a 'world leader' in reclaimed effluent reuse. The present '20/30' rule for BOD/TSS set for effluent discharge into receiving waters and reuse for agricultural irrigation was effective in health risk reduction. But, Gabbay [14] reported that the recommendations made by the Israeli 'Inbar' inter-ministerial committee entailed efforts to update the current effluent disposal standards. For comparison, Table 4 lists selected major parameters highlighting the huge variations between Israeli and Palestinian Standards for Effluent Disposal for agricultural irrigation and discharge into surface water bodies.

Based on the Israeli security and trans-boundary water management [13], Israeli-Palestinian agreements (or Memoranda of Understanding, MoU) were enacted, constituting the outline of an official water management system [15]. The MoU impose Israeli effluent quality standards with BOD/TSS of the 20/30 rule. The Palestinian WWTP should comply with these standards during the first phase of implementation. But, the WWTPs effluent should comply with more stringent level of standards (10/10) during the second phase of implementation, given a period of five years as a construction phase to erect an advanced filtration stage. This is evident from the approval protocol for the Tulkarm and Nablus-West WWTPs [15]. The adequacy of the standards remains controversial as even the less stringent 'Inbar Standards' remain debatable, due to the huge financial burdens associated with their implementation and the objections to their adoption by the Israeli Ministries of Finance and Interior.

At present, the current 20/30 standard is still valid as the level of treatment required for wastewater treatment in Israel. It would seem that before Israel begins to impose new stringent effluent standards on the Palestinian wastewater management facilities, it should first enact those applying to its own treatment facilities [16]. Because of increased public debates

Table 4. Israeli and Palestinian standards for effluent disposal in various applications

Parameter	Unit	Israeli Standards 2002		Palestinian Standards 2002	
		Unrestricted Irrigation	Surface Water (Rivers)	Unrestricted Irrigation	Surface Water (Rivers)
BOD	mg/l	10	10	20	–
TSS	mg/l	10	10	30	
COD	mg/l	100	70		200
Ammonia-N	mg/l	20	1.5	50	5
Total-N	mg/l	20	10		
Total-P/PO ₄ -P	mg/l	5	0.2	30	5
SO ₄	mg/l	–	–	500	1000
Chloride	mg/l	250	400	500	–
Sodium	mg/l	150	200	200	–
Fecal coliforms	CFU/100 ml	10	200	< 200	<1000
Boron	mg/l	0.4	–	0.7	2
Hydrocarbons	mg/l	–	1	0.002	1
Anionic detergents	mg/l	2	0.5	15	25
Total Oil	mg/l	–	1	5	10
pH	[–]	6.5–8.5	6.5–8.5	6–9	6–9
Dissolved O ₂	mg/l	< 0.5	< 3	> 0.5	> 1

on water policy paradigms [17], the Israeli water policy network has been first adapted during the nineties (1991–1997) to deal with the discrepancy between adverse environmental impacts and the level of Israeli administrative control in order to solve the global (regional) environmental problems. Until late 1994, the ideological dominance of Zionism, the agriculture-affiliated Water Commissioner and the excessive political power of the agricultural sector were institutionalised in the water policy network. On the other hand, Menahem [18] believed that the peace process and the water sector privatisation, both taking place outside the water policy network, might force a change in Israeli water policy. Indeed, the real progress in the peace endeavours between the Israeli and Palestinian governments and their capacity to generate a viable regional water treaty to escape the trap of their current one, should lead to actual change in Israeli water policy.

4.2. Tulkarm-Nablus/Emek Hefer Regional Council: a case on trans-boundary wastewater management

There is a lack of research studies on long-term environmental impacts from the discharge of raw wastewater of upstream Palestinian communities and the possible adverse impacts on the performance of the Yad Hanna wastewater treatment plant (YHWWTP). This fact poses a real challenge due to technical and socio-cultural differences within the Palestinian–Israeli ‘border’ region and the varying powers and responsibilities among local councils and governmental agencies from both countries. The challenge, on the Palestinian side, is depicted in the capacity to erect and manage their own WWTPs as well as the willingness of the Palestinian farmers to accept and pay for the reclaimed effluent. The willingness of the Israeli side is only to share the benefits from the reclaimed effluent and the management of regional WWTPs exacerbates the challenge. To overcome this challenge, there will be the development of an Environmental Management System (EMS) for YHWWTP, where an initial environmental

assessment (IEA) of the discharge of raw sewage from Palestinian urban areas including industrial facilities along Wadi Zaimer shall be made. The IEA should aim at identifying environmental issues and the most likely significant environmental aspects (SEAs); which can have significant impacts (positive or negative) on the receiving environment. Because of the scope and breadth of activities at the JHWWTP, the SEA identification process will reveal a range of environmental aspects from Palestinian communities over which it has little or no control. Since the JHWWTP receives wastewater from Palestinian urban areas, some SEAs identified would be the ones that are not within the control of the WWTP, but which it could perhaps influence (figure 3).

The Israeli government's Sewage Infrastructure Development Administration is the agency charged with determining the charges. It liaises with the Israeli Ministry of Finance's Chairman's office to implement the deductions and make arrangements for them to be transferred to the respective Israeli local authorities. The basis for the deductions appears to be vested in the unilateral decision made by the Israeli Ministerial Committee for Social and Economic Affairs (6/ 01/ 03) that funds should be deducted from the PA for treating wastewater of Palestinian origin that flowed into Israeli territory [13]. Indeed, the PA, the JWC and the PWA did not play any role in the development of this charging system. The Protocol provisions (Article 40, the water treaty signed by the two parties) for charging for water supply services lack such provisions for wastewater services. Schalimtzek and Fischhendler [11] reported that the Israeli government opted in January 2003 for the application of an offset mechanism to balance the treatment costs of wastewater of Palestinian origin, similar to the health and water supply services. This Israeli unilateral action allowed the construction of 'emergency projects'. Currently, the annual capital and operational expenditures for the downstream solutions (e.g. Wadi Zaimer [Alexander river] and Wadi An-Nar-Hebron) are being deducted from the Palestinian taxation money collected and held by Israel [11].

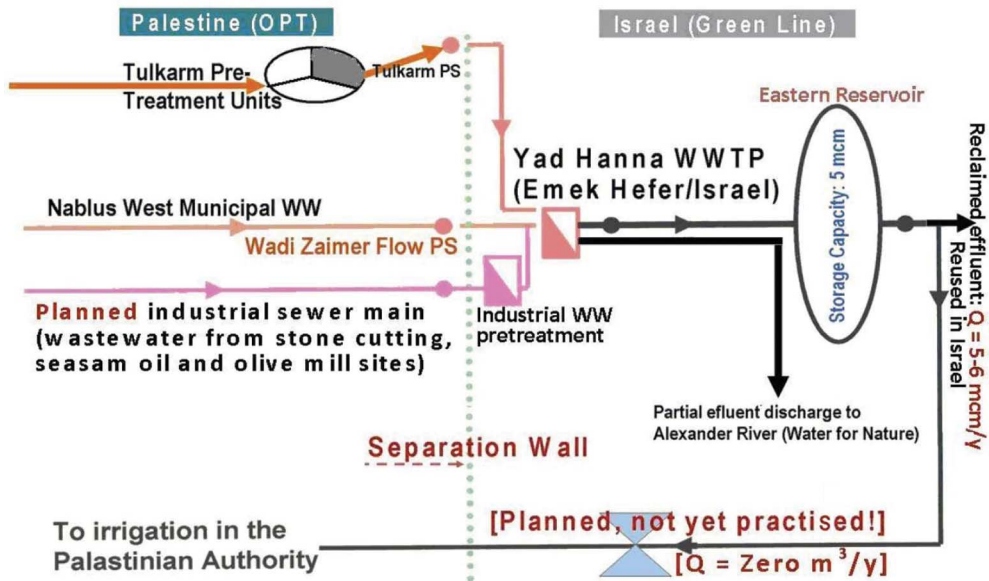


Figure 3. Tulkarm-Nablus/Emek Hefer council a case on transboundary wastewater treatment.

5. Regional wastewater agreements between Israeli and Palestinian sides

A similar case on the development of an Environmental Management System (EMS) is the Nogales International Wastewater Treatment Plant (NIWTP) to deal with the management of the real and potential trans-boundary environmental impacts from Mexico to the USA. The NIWTP was able not only to influence but control the treatment of sewage from Mexico that was found to contain industrial and infectious waste. The EMS teams focused on the inputs of its processes and found proper methods to work with the upstream entities across the USA–Mexico border to manage the SEAs and minimise the pollution loads at the source through cleaner production processes [19].

One specific challenge for the YHWWTP is to meet the Israeli standards for an effluent discharge permit for restricted irrigation use and for discharge into the Alexander River, a surface water body. Of particular concern are the total suspended solids (TSS), ammonium and high oil/grease content of the influent coming from Tulkarem city and Nablus-West (Wadi Zaimer). Because of the strict Israeli regulatory issues (10/10; mg/L TSS and BOD, respectively) and the potential for contaminating the underlying aquifer, treated effluent became a significant factor. Although the effluent has overall a positive environmental impact on the riparian habitat of the Alexander River by providing regular annual flow (water for nature) for what would otherwise be a dry and seasonal small stream bed, the effluent has appeared to limit populations of some wildlife, including invertebrates and fish.

Figure 4 illustrates the annual operational expenditures (OPEX) for the operation, maintenance and repair of the JHWWTP (around US\$4 million for the period 2004–2008). Israel deducts the expenditures from Palestinian tax money. The JHWWTP was erected by the use of Palestinian tax money that Israel should transfer to the Palestinian Ministry of Finance. The installation of advanced pre-treatment units (flocculation/coagulation) to reduce high organic and inorganic pollution loads of the influent is associated with high annual capital and running costs, exceeding 40% of the total OPEX. The PA refused all receipts sent by the Israeli Water and Sewerage Authority for many reasons. The Israeli official authorities' financial claims are not supported by signed bilateral agreements and they do not fulfil legal requirements. The establishment of the JHWWTP, paid with Palestinian taxes of about US\$5 million, was a unilateral Israeli action characterised as an emergency solution (while

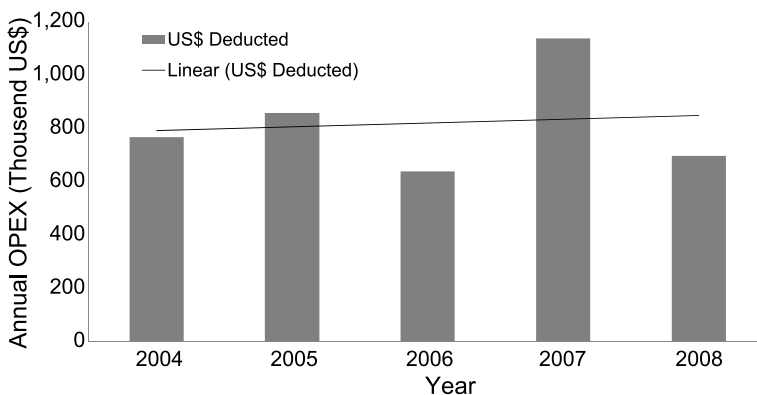


Figure 4. Annual operational expenditures (OPEX) exempted from Palestinian tax refunds collected and controlled by Israel.

currently claimed as a 'status quo'). This forced the Palestinian side to pay for annual trans-boundary wastewater quantities [11–13].

As mentioned above, the costs of water degradation of the Wadi Zaimer (tributary of the Alexander river in Israel) as well as the benefits from the development (erection of JHWWTP on the Israeli side) of the Wadi Zaimer are not evenly distributed among the Israeli and Palestinian sides. Therefore, a bi-national agreement on trans-boundary wastewater management based on an integrated watershed management, with mutual benefits for both sides and developed in an international framework might resolve the current technical and political conflict. Indeed, creation of an atmosphere of increasing concern about the long-term effects of hazardous pollutants and a sensitive public awareness that pollutants cross national boundaries and infiltrate into shared aquifers, might promote the suggested bi-national agreement on cross-border wastewater. Israel has deducted more than \$34 million over the past 14 years (1994–2008). This deduction is made from the reimbursements allotted to the Palestinian Authority paid as custom/trade taxes, that are collected by Israel at all import and export points controlled by Israel. Under the EMS framework, both sides must work towards minimising any environmental impact through programs that increase bi-national cooperation, stakeholder engagement, and best practices to implement environmental management programs.

6. Israeli water policy towards transboundary wastewater management

Environmental policy aims to make environmental standards obligatory for all members of a society. The duty of environmental economists has been to study the most efficient and cheapest way to achieve targets set by others. Israel's environmental policy on sanitation services in general and trans-boundary wastewater management, in particular, has the following economic efficiency criterion: a given target or output has to be achieved by a minimum input at minimum costs. This principle is only useful in cases where clear environmental rules and guidelines can be defined. It is often not possible to determine exactly which interventions into nature are environmentally sound. The relationships between ecological and economic systems from the local up to the global level are too complex to set proper standards for many pollutants.

Additionally, the Israeli water policy does not adapt economic behaviour to principles of ecological system development. Previous studies [18] indicated that in spite of the prevailing severe water crises, the current Israeli water policy prioritises the expansion of agricultural sector (price subsidies on water) over preserving the scarce water resources (decline in water national planning). Yet a dynamic water policy should aim to encourage this kind of adaptation for precautionary reasons. This would depend on the political will to change the present 'economic behaviour'. The Israeli Finance Ministry has tried to reach the maximum financial output, thinking in conventional, limited economic efficiency terms. The focus is not on specific environmental targets that have to be sustainably achieved, but rather on a specific ideology-based development target that will change the economic patterns of local development. This approach maximises a kind of economic advantage, but not a *long-term* advantage; because it fails to consider the ecological principles in the upstream riparian areas where downstream environmental problems arise from economic activities on both sides. In addition, the Israeli environmental policies and management regimes along the Green Line are different and seldom if ever take the Palestinian socio-economic system into consideration in order to facilitate regional acceptance [16].

Figure 5 depicts schematically the current Israeli water (wastewater) policy with the acting influential official institutions and the various tools applied to delay the establishment of

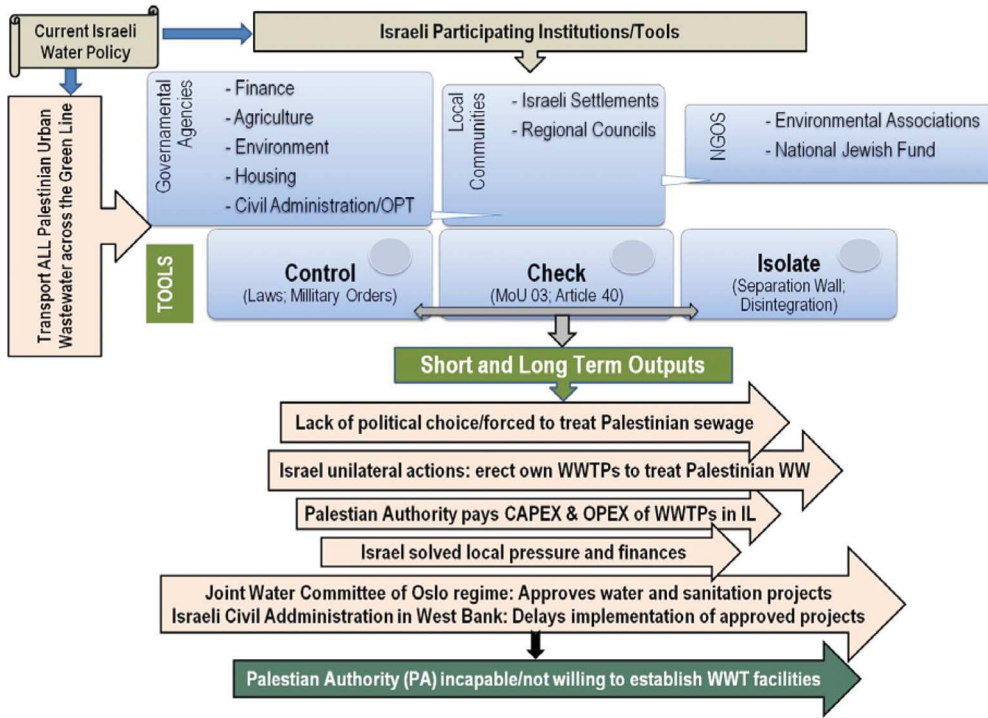


Figure 5. Israeli water policy regarding transboundary wastewater from Palestinian communities.

wastewater infrastructures in Palestine. The associated adverse impacts pertain to socio-economical and community development.

The figure depicts the principle of control, check and isolate (CCI), where Israel has succeeded (both now and in the past) in applying resistance and inflexibility. This policy has cast burdens onto the PA, and NGOs, and donors, thus impeding the provision of adequate sanitation services in the OPT. Figure 5 draws on the methodological issues applied by the current Israeli water policy in the promotion of unilateral actions. The figure also illustrates the main Israeli influential water related agencies and refers to the contexts in which the ICC methodology and tax exception decisions are made. Selby [20] analysed the Oslo II regime regarding the joint management of the West Bank’s water resources, sanitation systems and water supplies; arguing that this regime is evidence of ‘joint mismanagement’, as the structure of the Oslo peace process did not allow promotion of effective institutions and ‘good governance’ in the water and wastewater sectors and thus was not a good model for joint Israeli–Palestinian water management. Israel succeeded in claiming that the PA is not willing or is making no effort to prevent any harm to water resources [1,8,10].

It is argued that lack of governance mechanisms that allow flexibility in the implementation of the current water treaty has fuelled the political conflict between Israel and the PA. This is reflected by the absence of stream-wide planning programmes or regional decision authorities. Indeed, lack of a regional water treaty has caused annual increment in water pollution, environmental degradation and reduction in the quality of water resources. This has adversely affected both human and ecosystem health in both Israel and OPT. Therefore, policy approaches favouring only environmental standards based on analytical data obtained

from short-term scientific research and uncertainty are of little help. They do not sufficiently reflect knowledge of complex interactions in natural systems with seasonal flow, and so cannot determine exactly precise standards, or past and continuing processes. The presence of numerous national and regional authorities (upstream/downstream) along the flow of regional streams with diverse, conflicting interests hampered the development of unified stream quality standards and creates disincentives for cooperative behaviour. Global environmental problems call for an environmental policy that encompasses a process orientation while considering ecological principles of system development [21]. This again points to the need for a joint policy framework on trans-boundary wastewater (water) issues between Israel and Palestine.

6.1. Co-operation for sustainable trans-boundary wastewater management

The intention of this study is to develop a policy framework for managing trans-boundary wastewater by peaceful agreement, rather than to provide comprehensive solutions for regional freshwater disputes among riparians. More detailed scholarly literature on freshwater disputes (conflict and cooperation) and bi-national agreements can be found in, for example, Wolf [22] and Mostert [23]. The use of natural water resources has been the subject of many fruitful joint initiatives with neighbouring countries worldwide (Europe and USA), but not in the Middle East [24]. Trans-boundary projects have enabled efficient management of water courses, improvement of the quality of lakes and rivers, the development of tourism and the preservation of biodiversity. Based on six years' experience in Hungary, Marczin [25] reported that trans-boundary co-operation had included discussion and transforming opportunities for exchange and joint management of natural resources for the well-being of the local population. Any trans-boundary co-operation between Israel and Palestine requires national and regional multi-functional management of the land and water bodies through well-coordinated bi-national institutions. Throughout history, harmonious relationships with one's neighbours have been a prerequisite for the economic, social, environmental and cultural development of any country.

Tal [13] and Caponera [26] have written much about water law and administration but there are still many unanswered questions. Since law is made by legislators – and not really by academic lawyers – there are many difficulties. Indeed, the whole problem of Israel–Palestine relations is not unique, if one considers the potential conflicts over the allocation of the Nile (many African countries), the control of the Ganges (countries in the Indian sub-continent), or even disputes within one country (Australia) over the Murray-Darling river system. Perhaps the Israel-Palestine problem is worsened by the damming of the headwaters of the Euphrates (Turkey) since this will very likely have adverse impacts throughout the region. Here is the challenge for international law, legislators and water lawyers – to develop the legal instruments which will enable nations to carry out such difficult water management policies which include reallocation of water and may involve complex legal issues of ownership and compensation. This is obviously a problem with regard to the Nile.

Establishing a trans-boundary dialogue and mutual trust after 42 years of Israeli military occupation and associated conflicts and enabling local actors to manage shared natural resources in a sustainable way should be the main tasks of any planned regional project in the Israeli–Palestinian areas. Israel has stable human and financial resources but it is surrounded by threats of a variable nature, among which is the dispute on water and wastewater issues with neighbouring countries: Egypt, Jordan, Lebanon, Palestine and Syria. This core threat can be solved through viable partnerships, inter-municipal and fair co-operative agreements [27]. The

outcomes of research and co-operative initiatives [28] will not only provide practical technical solutions to critical wastewater management challenges, but can also ensure a secure and safe livelihood for all nations, a prerequisite for a treaty governing trans-boundary wastewater management [29]. From the Palestinian standpoint, it is not clear that Israel recognises this. There is an impression, conveyed by daily events, that Israel considers it knows enough about all these issues to need no outside help – that is, none from the neighbours – but also that it is immune to any demands which the neighbours may make for what they consider to be fairness, which Israel could always make into *unfairness* from its own point of view.

Co-operative and dynamic policy based on mutual dialogue has to be promoted aiming at involvement of the border towns along the Green Line whose co-operation is a key prerequisite for tackling wastewater management issues in a trans-boundary context. In addition to dialogue between and among countries and communities on the two sides of the Green Line border of the West Bank of Palestine, the integration of local communities into bi-national processes is crucial. Past peace building efforts [8], and current regional wastewater projects [28], aimed at developing legal trans-boundary agreements, can empower ordinary people. The trend to peace can be strengthened by implementing bi-national environmental projects to solve trans-boundary wastewater management. Through the UNDP, wastewater networks will be constructed in three towns: Bartaá Sharqieh, Habla and Baqa Sharqieh, border towns in the northern part of the West Bank. Therefore, not only wastewater management and the wellbeing of people on both sides of the Green Line will be improved, but also dialogue between the Palestinians and Israelis at different levels will be enhanced through knowledge transfer, training activities and public awareness raising.

Reviewing the Greater Sonoran Ecoregion along the US–Mexico border, Morehouse *et al.* [30] suggested the creation of a bi-national centre for science–society collaboration in order to explore socio-ecological flexibility and transformability that would provide foundations for examining interactions between society and nature, and between society and science. This area is where there is a continuous attempt by Hispanics to migrate illegally into the USA. There are armed guards, severe walls, etc, which resemble the conditions that affect Palestine. How much of the Greater Sonoran Ecoregion can be a good example for Israel–Palestine relations?

It seems that in any conflict-plagued region, a science-based mentality is necessary. Certainly, it is needed in order to work towards a policy framework, aiming at promotion of sustainable solutions for the trans-boundary wastewater issues between Israel and Palestine. Yet, asymmetries between the communities along the borders, with different priorities and needs, might create diverging expectations and perceptions in regards to a durable policy framework.

Carius [31] analysed some trans-boundary initiatives for environmental co-operation, mainly in Europe, and found relatively scant information on what form trans-boundary initiatives for environmental co-operation could take, and the conditions under which these could best contribute to conflict prevention, conflict transformation and peace-building. Indeed, little is known about how environmental co-operation can develop into broader forms of political co-operation and generate a social and political dialogue going beyond environmental issues [12]. Nevertheless, doing nothing helps no-one. There should be an endeavour to enhance co-operation between local and national level institutions, and to include cross-border sites in national strategic documents and processes related to the protection of the receiving environment and revitalisation of heavily polluted wadis and streams. There appear to be no obvious precedents for this kind of initiative. This should encourage scientists in both Palestine and Israel to raise their voices with their political masters. The region could become more creative with environmental facts dominating the agenda. The following outputs are possible from the development of a policy framework for trans-boundary co-operation:

- Establishing communication and dialogue among water and sewerage institutions on both sides.
- Enhancing operational cross-border cooperation, promote participatory processes, knowledge transfer and training activities.
- Supporting transboundary cooperation by official cross-border agreements based on sharing principles (costs and benefits).
- Conserving shared natural ecosystems (seasonal streams) through new trans-boundary agreements.
- Sharing by local communities the responsibilities, costs and benefits from concrete cross-border initiatives and products.
- Ensuring joint management of trans-boundary WWT facilities via dialogue at various institutional levels and through formal agreements.

To improve capacities of local stakeholders, several strategies can be suggested, including:

- Disseminating knowledge, raising awareness and increasing the understanding of ecological and cultural values through topic-oriented training for youth and local stakeholder groups.
- Developing site-specific solutions to confront together stream conservation problems by the affected communities and with the application of local resources and knowledge; use of local flora (plants) can promote low-cost bioremediation of heavily polluted streams; reuse of olive mill wastewater diluted with secondary effluent can alleviate pollution and preserve limited freshwater sources.
- Providing information on alternative approaches to the use of natural resources: linking nature conservation with agriculture and rural tourism; the latter has been achieved through a regional peace building project on Wadi Zaimer (Alexander River, Israel), but the Israeli Wall has made this a zero benefit for the Palestinian communities.
- Assisting local border communities in developing their initiatives into concrete projects and in raising additional funds for their implementation.

7. Conclusions and recommendations

A thorough analysis of water and environmental policies revealed that the flow path of wastewater irrespective of its origin – a Palestinian community or an Israeli settlement within the West Bank – is being discharged either untreated or partially into a shared watershed area. These policies are aimed at altering the use of treated effluent to a higher-value use in the agricultural sector, while increasing the economic value of water used, thereby exploiting the raw wastewater that is not usefully recycled within the basin of its origin, reducing the degradation of water and soil quality, and minimising public health hazards. The development of bi-national co-operation on trans-boundary wastewater management would achieve effective public health and environmental protection with additional treated water for all. With co-operation, people on both sides of the Green Line or 'borders' of the future can benefit, live and prosper in a peaceful and sustainable manner. Establishing an international border water commission (IBWC), could help in resolving trans-boundary wastewater issues on the Palestinian–Israeli 'borders'. Applying the trans-boundary treaty (gained from past and current peace building projects), the IBWC could diplomatically resolve trans-boundary wastewater management and its associated infrastructure.

Of equal importance, all related technical issues would be tackled in a way that benefits the social, environmental and economic welfare of all people on the two sides of the boundary and would improve relationships between the two countries. The continuing land and resource confiscation, isolation and restrictions on freedom of movement have created conditions of severe economic hardship for Palestinians. Indeed, many regional water projects and environmental partnership initiatives were established to strengthen, legitimise, and institute the presence of the Israeli occupation in Palestine. Yet the 'joint' Israeli–Palestinian projects do not foster co-operation for sustainable growth, but rather maintain Israeli control over the development of both the Palestinian water and sanitation sectors. The Israeli military and civil administrations are key actors over vital Palestinian development activities pertaining to free access of goods and movement, as well as provision of safe drinking water, adequate sanitation and electricity. The point is to offer a comprehensive understanding which can become a policy framework for a flexible trans-boundary wastewater treaty, aiming at neutralising any potential political conflict between Israel and the PA. Finally, more funds and better selected and managed sanitation programs are needed to establish sustainable sanitation facilities, the achievement of which brings a range of health, environmental, economic, and social benefits.

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