C O M M E N T

# COMPLIANCE MODELS FOR OFF-GRID WASTEWATER TREATMENT AND REUSE

by Avital Li and Taylor Lilley

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Throughout the world, people struggle to gain access to stable sources of clean water. According to United Nations Water, more than two billion people currently live in countrieazs experiencing high water stress.[1] In these countries, more than 70% of available water resources are being withdrawn for use by all sectors.[2] While this statistic is troubling enough on its own, current science suggests that the impacts of climate change and environmental degradation will only exacerbate the problem.[3] While there are increasingly innovative solutions being developed, many communities simply do not have access to efficient, centralized wastewater management systems, and as a result, face difficulty finding reliable sources of water for daily use.

In light of this, there is a great need to implement novel systems that can fill the gap, especially for isolated or "off-grid" communities. One particular system that exhibits particular potential in alleviating access challenges is greywater reclamation. "Greywater" is defined as any water that drains from a household, excluding toilet water.[4] This includes water used for bathing, washing dishes, or laundering clothes. After simple filtration, greywater can be safely recycled for reuse in agriculture and irrigation, and is a promising option for water-stressed communities that are not on a centralized water grid.[5]

In order to gain a better understanding of these systems and their application in off-grid contexts, the International Network for Environmental Compliance and Enforcement (INECE) organized a Compliance Conversation on the topic. Held across two sessions on February 15 and March 1, 2019, this conversation brought together policymakers, practitioners, and stakeholders to discuss what opportunities and obstacles are involved in the implementation of greywater reclamation systems in off-grid communities. The audience included participants from 21 countries. In bringing these entities together, INECE hoped to create a forum to share experiences and collaborate on evaluating solutions to current challenges in the field. This Comment synthesizes the results of this collaboration, and offers a comparative look at greywater systems in California.

The Compliance Conversation focused particularly on the case of introducing greywater reclamation systems into off-grid communities in the West Bank. Though the legal circumstances surrounding Palestine and Israel provide a unique context, the case also offers valuable and exportable insights on greywater reclamation and its usefulness to isolated communities at large.

The Comment first frames the discussion by exploring common governance considerations for off-grid, decentralized water systems and examining the roles of key stakeholders. It then discusses the unique challenges and opportunities for greywater reclamation systems in the West Bank. Finally, it includes important considerations for implementing greywater systems in off-grid communities. Examples of greywater regulations and codes in California provide a model of comparison for Palestine, contrasting a more developed regulatory model in a U.S. state that has similar pressing needs for water conservation.

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1. United Nations Water, *Water Scarcity*, https://www.unwater.org/water-facts/scarcity/ (last visited Mar. 22, 2020).
2. Food and Agriculture Organization of the United States, Coping With Water Scarcity: An Action Framework for Agriculture and Food Security 1-2 (2012).
3. *See* Peter Burek et al., Water Futures and Solution: Fast Track Initiative 3 (International Institute for Applied Systems Analysis, Working Paper No. 16-006, 2016), http://pure.iiasa.ac.at/id/eprint/13008/1/WP-16-006.pdf.
4. The Law Dictionary, *Graywater*, https://thelawdictionary.org/gray-water/ (last visited Mar. 22, 2020).
5. Greywater Action, *About Greywater Reuse*, https://greywateraction.org/greywater-reuse/ (last visited Mar. 22, 2020).

## I. Off-Grid and Decentralized Water Systems

### A. Governance in Off-Grid and Decentralized Communities: Defining "Off-Grid"

The "grid" comes in many different forms, which makes defining it a challenge.[6] In this Comment, the "grid" referred to is the "water grid," as opposed to the traditional energy grid. The water grid is a publicly or privately provided engineered hydrologic system that provides water services to residents.[7] This can include water collection, treatment, storage, pumping, and transportation of sewer water and water received from a faucet.[8]

While there is no legal definition of "off-grid," it is inferred to mean "not connected" to the managed utilities, including water.[9] The term describes a range of experiences, including situations where infrastructure is present but resources are unavailable, resources are obtained by traveling to the grid and bringing back water, or natural sources of water are gathered or reused without public or private utilities' involvement (including greywater).[10] Much of the world looks at Israel, a dry country that is a world leader in water management, as an example of a successful water grid.[11] However, some Israelis still live off-grid, which is defined by an Israeli-based research organization to mean *not connected* to major sewerage infrastructure, wastewater treatment, and recycling systems.[12] Palestine embraces a similar definition of off-grid as cut off from utilities such as water.[13] The local definitions show the difference in source and approach to being off the water grid.

This definition does not offer nuance in the extent to which or reason that someone is off-grid. Being off-grid can be a voluntary choice, even a popular one, but it is not a choice for everyone around the world. In California and other states with extensive, inclusive, and accessible water systems, the motivation to go off-grid more often is driven by sustainability, evading government regulation, or financial considerations.[14] However, in more developing or water-scarce parts of the world, like Palestine, being off-grid is more often an imposed condition due to lack of water, infrastructure, governmental investment, and/or long-standing regional disputes.[15]

### B. Characteristics of Decentralized Water Systems

Decentralized water management systems may be able to deliver large benefits to a wider population than just subsistence farmers and isolated communities. An emerging body of literature implies that, depending on design and accompanying regulations, decentralized systems can operate more efficiently, at lower costs, and with greater social benefit than centrally managed ones.[16] Further, a study of wastewater management in peri-urban areas of low-income countries found that use of decentralized management systems offers increased opportunity for community participation in both the planning stages and in future decisionmaking.[17] The study also found that decentralized systems allow citizens to more easily reuse and recover water.[18] Likewise, other studies have affirmed these findings, commenting on decentralized systems' ability to increase community cohesion and resilience.[19]

These systems may also reduce overall costs of water management in certain types of communities.[20] A model running simulations of 20-year scenarios concerning different water management schemes found that decentralized systems would be more economical in the long term than centralized systems for communities that are spatially scattered.[21]

Despite their benefits, there remain many obstacles to instituting such systems. Most studies note that for such systems to work, they require a strong focus on capacity-

6. *See* John Platt, *Going Off the Grid: Why More People Are Choosing to Live Life Unplugged*, MNN, Nov. 14, 2012, https://www.mnn.com/lifestyle/responsible-living/stories/going-off-the-grid-why-more-people-are-choosing-to-live-life-un.
7. *See* Guillermo A. Irazola, *The Fog Catchers: The Rise of Property Beyond the Cost-Benefit Approach*, 21 U. Denv. Water L. Rev. 237, 241 (2018).
8. Value of Water Canada, *How Do Our Water Systems Work?*, http://www.valueofwater.ca/water-facts/how-do-our-water-systems-work/ (last visited Mar. 22, 2020).
9. Merriam-Webster, *Off-Grid*, https://www.merriam-webster.com/dictionary/off-grid (last visited Mar. 22, 2020).
10. *See* Zafrir Rinat, *International "Off-Grid" Eco Effort Boosts Palestinian Locales' Infrastructure*, Haaretz, Nov. 21, 2016, https://www.haaretz.com/science-and-health/.premium-int-l-off-grid-eco-effort-boosts-palestinian-locales-infrastructure-1.5464259.
11. *See Maharashtra Govt. Seeks Israel Help to Design Water Grid for Marathwada*, Times India, Jan. 17, 2018, https://timesofindia.indiatimes.com/city/mumbai/maharashtra-govt-seeks-israel-help-to-design-water-grid-for-marathwada/articleshow/62531449.cms (Maharashtra, India, government signs memorandum of understanding with Israeli state-owned company to help develop a water grid in drought-stricken area).
12. Katarina Alharmoosh et al., American University School of International Service, Graduate Practicum—Water, Cooperation, and Peace: The Peacebuilding Impact of Joint Israeli-Palestinian Wastewater Projects 4 (2014), https://www.american.edu/sis/gep/upload/water-peace-and-cooperation-2014_final-report-compressed.pdf.
13. *See* Rinat, *supra* note 10.
14. Platt, *supra* note 6.
15. *See* Rinat, *supra* note 10 (Auja is one of many Palestinian villages to lack proper sewage infrastructure and purification systems because of the high expenses and have found help in groups to install septic tanks and utilize greywater); *see also* Amira Hass, *For Six Months, These Palestinian Villages Had Running Water. Israel Put a Stop to It*, Haaretz, Feb. 22, 2019, https://www.haaretz.com/israel-news/.premium-why-doesn-t-israel-want-palestinians-to-have-running-water-1.6959524 (Israel cuts off water to 2,600 Palestinians).
16. *See* K. William Easter & Robert Hearne, *Water Markets and Decentralized Water Resources Management: International Problems and Opportunities*, 31 J. Am. Water Resources Ass'n 9, 19 (1995), *available at* https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1752-1688.1995.tb03359.x.
17. *See* Jonathan Parkinson & Kevin Tayler, *Decentralized Wastewater Management in Peri-Urban Areas in Low-Income Countries*, 15 Env't & Urbanization 75, 80 (2003), *available at* https://journals.sagepub.com/doi/pdf/10.1177/095624780301500119.
18. *See id.*
19. *See generally* Hwee Hwang et al., *Decentralized Water Reuse: Regional Water Supply System Resilience Benefits*, 70 Procedia Engineering 853 (2014), *available at* https://www.sciencedirect.com/science/article/pii/S1877705814000952; Easter & Hearne, *supra* note 16.
20. *See* Grace Chung et al., *A General Water Supply Planning Model: Evaluation of Decentralized Treatment*, 23 Envtl. Modelling & Software 893, 904-05 (2008), *available at* https://www.sciencedirect.com/science/article/pii/S1364815207002022.
21. *Id.*

building.[22] While decentralized systems generally present lower capital costs than centralized systems, the costs of development, monitoring, and maintenance may still be prohibitive when costs are borne by individuals or communities.[23] Depending on the status and preference of the community, support from external organizations or even the state could be helpful in overcoming technological barriers, as discussed below. To ensure community buy-in and project sustainability, partners should seek to build capacity among community members to take on system maintenance and operation as much as possible.[24] It is essential for external actors to build a partnership with the community over time through transparency, openness, and discussion.

## II. The Case Study

Due to the complex realities of water governance in Palestine, many communities are excluded from access to centralized water management systems. Currently, only 45% of households in the West Bank are connected to any sort of sewage collection system, and 75% of the wastewater collected from these households is discharged directly into the environment with no form of treatment.[25] More than 50% of the wastewater not connected to a sewage system is dropped into unlined cesspits.[26]

The use of cesspits poses great risks, both to individuals and the environment. One of the largest concerns regarding cesspits is the high risk of groundwater contamination. Groundwater from aquifers, wells, and springs is the primary source of freshwater for Palestinians, providing 90% of the water supply in the region.[27] When untreated wastewater is dumped into unlined pits, microbial and chemical pollutants can seep through the porous sediment layer and enter groundwater aquifers.[28]

It is common practice for each household to have its own cesspit, which means that contaminants can penetrate the ground and subsoil water from multiple points rather than being concentrated in a single, more easily managed access point.[29] As a result, entire communities are likely to be exposed to these contaminants.[30] There are well-documented reports of health effects including diarrheal disease, eye disease, vomiting, hepatitis A, and typhoid in the West Bank.[31]

The pollution caused by the use of cesspits also has noticeable impacts on the environment. The dumping of fecal matter into these pits creates nitrate pollution in soil and water, which has been linked to additional human health impacts, especially for infants.[32] It is also tied to a host of environmental issues including eutrophication in water bodies and soil quality degradation.[33]

### A. Agriculture in Palestine

As part of the Fertile Crescent, agriculture has been part of Palestinian tradition since its inception. This historical importance is evident in modern Palestinian practices. Today, 70% of all treated water in Palestine is used for agricultural purposes.[34] By formal counts alone, 15% of Palestinians are employed in the agricultural sector.[35]

As of 2011, the agricultural sector represented 5.5% of Palestine's gross domestic product, representing a notable decrease from the 18.8% share it held in 1987.[36] Lack of access to viable water management and resulting pollution from the use of cesspits are noted causes for this decline.[37] Despite the downward trend in its economic importance, however, agriculture remains a staple of Palestinian culture. Indeed, the declining viability of farming in Palestine may be leading to a resurgence in its cultural significance.[38] In the face of persistent Israeli occupation, and as access to water and land continues to dwindle, the ability to cultivate land has taken on important symbolic significance to many Palestinians.[39] The ability to create and sustain themselves is a symbol of the resilience of their communities.[40]

Many off-grid communities are made up of subsistence farmers and similarly maintain a strong connection with their farming practice.[41] The importance of introducing feasible water management systems therefore takes on added importance, as they may be an avenue to preserving not only individuals' health and livelihoods, but also their sovereignty, culture, and community cohesion.

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22. Parkinson & Tayler, *supra* note 17, at 88.
23. *Id*. at 85-88.
24. *See id*. at 88-89.
25. Laurie S. McNeill et al., *A Sustainable Approach for Reusing Treated Wastewater in Agricultural Irrigation in the West Bank—Palestine*, 248 Desalination 315, 315 (2009), *available at* https://doi.org/10.1016/j.desal.2008.05.070.
26. *Id*.
27. Tariq Judeh et al., *Assessment of Water Governance in the West Bank, Palestine*, 16 Int'l J. Global Envtl. Issues 119, 122 (2017), *available at* https://www.researchgate.net/profile/Guel_Ozerol/publication/315906202_Assessment_of_water_governance_in_the_West_Bank_Palestine/links/5a5fbcb4aca272735244df9a/Assessment-of-water-governance-in-the-West-Bank-Palestine.pdf.
28. *See* McNeill et al., *supra* note 25, at 320.
29. Amjad Aliewi & Issam A. Al-Khatib, *Hazard and Risk Assessment of Pollution on the Groundwater Resources and Residents' Health of Salfit District, Palestine*, 4 J. Hydrology: Regional Stud. 472, 480 (2015), https://www.sciencedirect.com/science/article/pii/S2214581815000919.
30. *See id*.
31. *Id*. at 484.
32. *See* A. Harry Walters, *Nitrate in Water, Soil, Plants, and Animals (A Viewpoint)*, 5 Int'l J. Envtl. Stud. 105, 112 (1972), *available at* https://www.tandfonline.com/doi/pdf/10.1080/00207237308709598?needAccess=true.
33. *Id*. at 114.
34. Maher O. Abu-Madi, *Farm-Level Perspectives Regarding Irrigation Water Prices in the Tulkarm District, Palestine*, 96 Agric. Water Mgmt. 1344, 1345 (2009), *available at* https://www.sciencedirect.com/science/article/abs/pii/S0378377409001176?via%3Dihub.
35. United Nations Conference on Trade and Development, The Besieged Palestinian Agricultural Sector 9 (2015), https://unctad.org/en/PublicationsLibrary/gdsapp2015d1_en.pdf.
36. *Id*.
37. *Id*.
38. *Id*. at 1.
39. *Id*.
40. *Id*.
41. *Id*.

### B. *Status of Water Obligations Between Israel and Palestine*

In 1995, Israel and Palestine entered into a binding "Water Agreement"[42] that establishes the Joint Water Committee.[43] The agreement recognizes Palestinian water rights in the West Bank, allocates them certain amounts of water annually from Israel, and agrees to consider additional water provisions for Palestinians.[44] Additionally, it commits each side to taking all necessary measures possible to prevent any harm, pollution, or deterioration of water quality of all water resources.[45] Both countries are required to establish Joint Supervision and Enforcement Teams, which shall operate to monitor, supervise, and enforce the agreement.[46]

The committee reestablished itself in 2017 after six years of dormancy for the purposes of providing better water access to Palestinian towns and villages though modernized infrastructure, funded by U.S. and European Union (EU) aid organizations.[47] The deal aims to provide Palestine with one-quarter of their annual water needs at a reduced rate by building a $900 million pipeline over five years.[48]

Dynamics over water are complex and inextricably linked to ongoing and shifting relations between the two entities. Israel and Palestine have differing perspectives of the results of the Water Agreement and Joint Committee. Under the agreement, Israel maintains control over all Palestinian water decisions, a control that it has exerted to maintain other forms of domination in Palestine.[49] However, Israel believes that they are fulfilling their obligations by supplying more water than required by the agreement.[50] They have also accused Palestinians of wasting and overconsuming water for agriculture and personal consumption and violating the agreement by drilling more than 300 unauthorized wells to siphon water from Israeli waterlines.[51] Further, Israel has accused Palestine of leaving 95% of its sewage untreated, which ultimately contaminates Israel's environment and aquifer.[52] These accusations likely overlook the fact that one-third of water is lost due to leakages in aging pipes in Palestine.[53] In addition, Israel has also been accused of "stealing" water allocated to Palestine.[54]

Water infrastructure is also highly unequal between the two entities. Palestine does not recycle its water, while Israel does recycle its wastewater for agricultural use.[55] Approximately one-half the homes in Gaza are connected to a wastewater collection network.[56] Forty percent of Israel's water is drawn from wastewater recycling and desalination.[57] Israel is a world leader in wastewater reuse and treats 86% of its domestic wastewater for agricultural use.[58] Its agricultural water is 55% reused domestic wastewater.[59]

Ongoing conflict and strife have worsened conditions. In 2014, Israel and the Islamic Resistance Movement attacked and destroyed two major treatment plants and 20%-30% of the sewage and water networks, leaving nearly 500,000 people without running water.[60] In 2019, troops cut off water and destroyed facilities in 12 Israeli-controlled villages in Palestine after only six months of operation under the justification that the law blocks Palestine from hooking into existing water infrastructure without a permit.[61] The Palestinian villages now have returned to expensive and dangerous trips to gather water and transport it back.[62]

## III. Defining Roles in Decentralized Water Systems

### A. *Role of Formal Regulators*

While many off-grid communities are by definition detached from centralized systems, they are likely to be affected by ongoing regulatory changes and may benefit from government programs.[63] In light of the varying impacts of formal regulations on communities and varying relationships between communities and government, it is nonetheless important to maintain initial decisionmaking power at the local level.[64] Community buy-in is vital for the longevity of any community-based system or technology, especially in communities where individuals are reluctant to interact with governmental bodies and their agents.[65] In many cases, the support and oversight from the central government may be attractive for a community. To encourage government support of extension programs, it is helpful to emphasize public health and potential economic gain that greywater systems have on communities.[66]

42. Jewish Virtual Library: A Project of AICE, *Water in Israel: Overview of Israel-Palestinian Water Issue* [hereinafter *Water in Israel*], https://www.jewishvirtuallibrary.org/overview-of-israel-palestinian-water-issue (last visited Mar. 22, 2020); *see also* Israeli-Palestinian Interim Agreement on the West Bank and Gaza Strip, Sept. 28, 1995, Isr.-Palestine, Annex 3, app. 1, art. 40, https://www.jewishvirtuallibrary.org/oslo-ii-annex-i-3#app-40.
43. *Water in Israel*, *supra* note 42.
44. *Id*.
45. *Id*.
46. *Id*.
47. *Id*.
48. *Israel, Palestine Authority Reach Water-Sharing Deal*, Al Jazeera, July 13, 2017, https://www.aljazeera.com/news/2017/07/israel-palestinian-authority-reach-water-sharing-deal-170713165223323.html (equating to 32 million cubic meters, or 32.9 billion liters).
49. *See generally* Elena Lazarou, European Parliamentary Research Service, European Parliament Briefing: Water in the Israeli-Palestinian Conflict (2016), http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/573916/EPRS_BRI%282016%29573916_EN.pdf.
50. *Water in Israel*, *supra* note 42.
51. *Id*.
52. *Id*.
53. Lazarou, *supra* note 49, at 49.
54. *Water in Israel*, *supra* note 42.
55. *Id*.
56. Lazarou, *supra* note 49, at 6.
57. *Id*. at 5.
58. *Id*.
59. *Id*.
60. *Id*. at 6.
61. Hass, *supra* note 15.
62. *Id*.
63. *See* Parkinson & Tayler, *supra* note 17, at 87.
64. *See id*. at 80.
65. *See id*.
66. *See* Christopher J. Martinez, University of Florida Institute of Food and Agricultural Sciences Extension, Gray Water Reuse in Florida 4 (2010), https://edis.ifas.ufl.edu/pdffiles/AE/AE45300.pdf.

While local governance should be an objective in any scenario, the dynamics of development and implementation differ widely based on the relationships of the local entity in question with the governing entity at the national level. The variability of these scenarios is why, no matter the eventual regulatory framework, the systems themselves must be as simple and easy to use as possible.

In the United States, greywater regulations vary widely from state to state.[67] In the absence of specific federal regulation on the matter, California has adopted a more localized approach to greywater regulation. Water conservation through greywater reuse regulation is in the state plumbing code, which was updated in 2019.[68] These updates went into effect in January 2020. Greywater does not include wastewater from kitchen sinks or dishwashers, but it does include wastewater from clothes washing machines, bathwater, and bathroom washbasins.[69]

The code lays out specific regulations for "construction, alteration, discharge, use and repair of alternate water source systems for non-potable applications."[70] There are three greywater systems outlined in the code: clothes washer systems, simple systems (discharging fewer than 250 gallons per day), and complex systems (everything else).[71] Section 1503.1.1 exempts clothes washer systems from the construction permit system.[72] There are local organizations in California that hold educational workshops to teach individuals how to design and install greywater irrigation systems.[73]

The regulations also acknowledge greywater systems in both residential and nonresidential areas, and state that the piping for greywater irrigation systems should be in compliance with the plumbing code.[74] For nonresidential buildings, treated greywater may be used for non-potable indoor water systems or outdoor irrigation.[75]

Local California government also has an important regulatory role in managing greywater systems. The plumbing code allows city, county, and local governments to adopt greywater construction building standards that are more restrictive than state standards, providing local government with a greater degree of control over greywater systems.[76] For example, the California Regional Water Quality Control Board has delegated its regulatory authority over unincorporated areas of Sonoma County to Permit Sonoma, a department of the local county government.[77]

One striking difference between Californian clothes washer greywater systems for residential use and Palestinian systems is the strict prohibition in California against contaminants in the water. For example, no hazardous materials may be in the water, such as water from cleaning car parts, oily rags, waste from home photo labs, or soiled diapers.[78] Unlike typical Palestinian systems where wastewater is untreated and collected in unlined pits, California's plumbing code has specific guidelines on greywater discharge, requiring, for example, that all systems be equipped with a diverter valve that can send water to a sewer system, irrigation plot, or disposal field.[79] In California, "ponding or runoff" of greywater is prohibited, and excess greywater not used for irrigation must either be diverted to a sewage system or stored in a "surge tank."[80] In addition, greywater in California may not be used to irrigate crops for human consumption,[81] indicating much stronger limitations on the use of these systems than in Palestine.

### *B. Roles for Nongovernmental Partners*

National governments, like Palestine's, have vocalized support for greywater systems.[82] However, the support fails to manifest itself into tangible realities. Even in the United States, not all states have adopted greywater systems, and, even with a proposed uniform code for these systems, there has not been widespread support for them.[83] Since local governments often do not have the resources to establish and fund these projects, they are often supplemented and assisted by external organizations. These organizations, like universities and nongovernmental organizations (NGOs), can provide catalytic financial assistance to overcome capital costs and technological expertise to communities that wish to implement such systems.[84] To ensure long-term usage, external partners should seek to give communities as much autonomy and opportunity for participation as possible.

External NGOs should work directly with the local communities to build the system.[85] System management can effectively come from a third-party organization that the community pays with cost savings from the system, as with a utility.[86] Complete third-party management, however, reduces community buy-in, and thus a microfinancing approach might be more effective over time.[87] In this model, the communities would be taught how to manage and monitor the system without third-party assistance and

67. *See generally* Greywater Action, *Greywater Codes and Policy*, https://greywateraction.org/greywater-codes-and-policy/ (last visited Mar. 22, 2020).
68. *See generally* Cal. Plumbing Code §§1-17 (2019).
69. *Id*. §209.
70. *Id*. §1501.1.
71. *Id*. §§1503.1.1-.1.3.
72. *Id*. §1503.1.1.
73. *See* Central Coast Greywater Alliance, *Getting Started*, https://centralcoastgreywater.org/getting-started/ (last visited Mar. 22, 2020).
74. Cal. Code Regs. tit. 24 app. §4.305.1 (2016).
75. *Id*. §5.304.8.
76. Cal. Plumbing Code §1503.1 (2016).
77. *See* County of Sonoma, California, *Frequently Asked Questions About Graywater*, http://sonomacounty.ca.gov/PRMD/Eng-and-Constr/FAQ-Graywater/ (last visited Mar. 22, 2020).
78. Cal. Plumbing Code §1503.1 (2016).
79. *Id*.
80. *Id*. §1503.2.1.
81. *Id*. §1503.2.
82. Carlos Cedeno et al., University of Maryland, Baltimore and College Park, Greywater Feasibility in the West Bank: A Proposal to Commercialize Greywater Treatment Systems With Legal and Health Considerations 6, https://www.umaryland.edu/media/umb/global-local/documents/Greywater-Report.pdf.
83. *See generally* Greywater Action, *supra* note 67.
84. *See* Parkinson & Tayler, *supra* note 17, at 80.
85. *See id*.
86. Cedeno et al., *supra* note 82, at 9.
87. *Id*. at 9-12.

pay back the third-party funder a flat fee like a loan for implementation costs.[88]

When the community's system runs on a loan repayment structure, the ability to pay the loan through increased agricultural revenue is contingent on a working system, thus increasing buy-in, and ensures the system's long-term success.[89] Organizational management support could be as simple as training the community members how to operate and monitor, or could consist of an external entity taking charge of system operation and monitoring.[90] Of these two options, the former is preferred because it promotes community buy-in through education of and connection to the system in addition to self-enforcement.

There is also an opportunity for university extension programs to play a large role in helping off-grid communities develop, operate, and regulate greywater systems. Extension programs can educate communities about the importance of preventing contamination of waste streams,[91] or create or assist with creation of cooperatives.[92] Academic institutions can create easy-to-disseminate tools including work sheets and checklists, which would encourage compliant user behavior and monitoring without consistent oversight and provide one place for information to be analyzed and recorded.[93]

It would be important for these programs to host workshops and demonstrations to train one or a few community members in the information and skills needed to implement the system and have them disseminate it to the community.[94] Information would include benefits about the systems and specifics on operation and monitoring.[95] Lastly, it is important that the government allocate sufficient funds for extension programs, which is something else that can be coordinated through external entities. This is a less direct way of funding greywater systems, which is more palatable to governments, as it reduces their liability in the event that something goes wrong.

Programs similar to the University of California Agricultural Extension Program in the United States could be used as part of broader educational programs if bought into by the government. Extension programs provide "non-formal education and learning activities to people throughout the country," and "[emphasize] taking knowledge gained through research and education and bringing it directly to the people to create positive changes."[96] One of the hallmarks of the program is its ability to provide "modern technologies to farmers, consumers, and families" that address public needs.[97] Many U.S. universities have published information on their extension web pages about greywater, but none of the programs provide much beyond basic information and resources.

Extension services can also identify low-cost technologies that encourage communities to take ownership of their management systems. Technology is expensive, especially in remote areas. However, affordable technology is becoming more accessible. Smartphones, for instance, offer a cheap way to be able to disseminate online training, self-monitoring mechanisms, and data to a larger audience. One low-cost technological option is installing on-site water quality monitoring technology and broadcasting the data to a centralized server for which governments, laboratories, or NGOs can be responsible for monitoring and comparing to others.[98] The limit to this option is that most existing sensors are limited to measuring the chemical, not biological, components of water quality.

## IV. Implementing Greywater Systems in Off-Grid Communities

### A. *Regulatory Governance Considerations*

Defining the relationship between the local, regional, and national governments is vital to establish the roles of implementing and operating a greywater reclamation system. The roles must be well-defined, transparent, enforceable, nonoverlapping, and remain consistent across systems and time. On-the-ground groups find that this might require shifting of traditional responsibilities, which can be met with resistance because of "political turf wars" between the different levels of government.[99] This will allow for efficient and effective systems in the long term, because it will minimize unnecessary oversight of the system and promote self-sufficiency.

Many governments frequently shift responsibilities among different ministries, whether as a result of recent development or in response to complex and evolving political contexts. Where such government structures exist, it is important that the primary regulators are localized. Local and regional governments will likely be more reliable and understanding of local conditions in the West Bank because of the governmental shifting at the national level. Therefore, the West Bank could consider adopting a regulatory approach similar to California, where the state government delegates some regulatory authority to local and regional governments.

88. *Id.* at 9.
89. *Id.* at 9-10, 15.
90. *Id.* at 31.
91. *See generally* Marsha Wright, New Mexico State University College of Agriculture and Home Economics, Guide M-106: Safe Use of Household Greywater (1996), https://aces.nmsu.edu/pubs/_m/M106.pdf.
92. *See generally* University of Arizona Cooperative Extension, *Home Page*, https://waterwise.arizona.edu/ (last visited Mar. 22, 2020).
93. *See* PennState Extension, Pennsylvania Farm-A-Syst: Worksheet 3: Household Wastewater Treatment System (2017), https://extension.psu.edu/pennsylvania-farm-a-syst-worksheet-3-household-wastewater-treatment-system.
94. *See* Cedeno et al., *supra* note 82, at 31.
95. *See id.*
96. U.S. Department of Agriculture National Institute of Food and Agriculture, *Extension*, https://nifa.usda.gov/extension (last visited Mar. 22, 2020).
97. *Id.*
98. *See, e.g.*, U.S. Environmental Protection Agency, Online Water Quality Monitoring in Distribution Systems for Water Quality Surveillance and Response Systems (2018) (EPA 817-B-18-001), https://www.epa.gov/sites/production/files/2018-05/documents/owqmds_guidance_042018.pdf.
99. INECE, INECE Compliance Conversation: Developing Compliance Models for Off-Grid Wastewater Treatment and Reuse Systems—Session 2 Notes 2 (2019), https://inece.org/assets/Publications/5c9a80340fc4e_INECEComplianceConversationSessionNotesDevelopingComplianceModels__synthesis.pdf.

### B. When Is Formal Engagement Needed?

One reason formal regulation is useful is because it can provide funding to implement and operate greywater systems in off-grid communities. If formal regulation responsibilities remain consistent, formal government may be a more reliable source of funding than outside organizations. Formal regulation may hold the governments accountable to follow through on projects that they start to fund. Locking in funding could provide communities with a safety net if something in the system goes wrong. When formal regulators encourage, fund, and continue to regulate greywater systems, communities are less likely to be left behind by other stakeholders.

Informal regulation in Palestine and other off-grid communities may present obstacles of its own. Informal regulation places much of the responsibility for the system on the community, which requires significant community buy-in and long-term engagement to be successful. Putting the bulk of the responsibility for operation and maintenance in the hands of the community may be perceived as a risk to outside funders. On the other hand, placing initial responsibility for the system on an outside third party requires commitment to funding, educating, and transferring system management to the community. Creating a greywater system in Palestine under an informal regulatory structure may be reliant on what the outside organization chooses to fund, not on the greatest community need or desire for the system. If accessible, formal regulation may be more consistent across the nation as a whole.

### C. What Can Be Achieved Without Formal Regulations?

Off-grid communities often do not participate in, access the benefits from, or influence the course of formal regulations that govern centralized systems. Therefore, it is important to explore what is possible to accomplish without formal regulation. The answer is highly dependent upon local contexts, counting on the relationships between communities, local authorities, and state governing bodies, as well as the resources available to each of these actors.

For Palestinian off-grid communities, government intervention is limited given the often hostile relationship between Palestinian and Israeli authorities. Thus, off-grid communities in the West Bank must take on the challenge of instituting more sustainable water governance practices without relying on formal frameworks to do so. In the absence of public support, instituting a decentralized greywater system in these isolated communities will require support from external private parties. These actors will need to be able to provide initial capital investments, as well as the physical equipment and installation of a system. These parties could utilize a variety of different models to facilitate their intervention, as discussed above.

Once equipment and financing is secured, the question of how to manage the new system remains. It is at this stage that community buy-in takes immediate precedence. The safety and successful use of a new system will be dependent on the community's willingness to utilize, maintain, and monitor it. Experts will be needed at this stage to instruct the community in technical understanding, but should play a smaller role in crafting the actual rules of use and governance.

The lack of formal regulation does not imply the absence of any regulation. With any resource, if it is essential to the survival of a community, some party will take on the responsibility of imposing some form of regulation. Studies have noted that in many low-income nations, wastewater reuse "just happens" as water supplies dwindle, and communities recognize the necessity of the practice.[100] Humans are natural regulators, and they will establish forms of order for important resources. These communities already have their own understanding of the importance and usefulness of water to their livelihoods. Now, in order to help create community buy-in, individuals will need to recognize the importance of wastewater to their livelihoods too. Theoretically, as water supplies dwindle in Palestine and impede agricultural life, communities there should become more open to creating or partnering to create wastewater recycling systems.

Despite this tendency to self-regulate, it is important to recognize and consider the various barriers preventing complete community buy-in. In many cases, locally held perceptions of treated wastewater can discourage use of the system. There is a lot of stigma associated with the use of wastewater concerning public health risks, mistrust of monitoring systems, and ideological aversion.

Palestinian farmers are averse to using reclaimed greywater on their crops.[101] A study found that more than 50% of surveyed farmers there would be unwilling to use treated wastewater under any circumstances.[102] Many of them felt that the water would be unsafe and pose health risks if used for crop irrigation, especially because they sensed that current monitoring practices were insufficient to ensure safe reclamation.[103] In addition to fears around health and safety, community members also felt averse to greywater reclamation on religious grounds.[104] In Islamic faith, water and water quality are of serious importance, and there are significant concerns about ingesting impure water.[105]

Information is necessary to alleviate these concerns. Neighboring countries with similar attitudes to water already use reclaimed greywater for their agriculture, and materials detailing how to prevent health issues and which crops can be grown with greywater already exist.[106] Likewise, religious authorities have already looked into concerns about treated wastewater usage.[107] Islamic leaders issued *fatwas*, or rulings of religious consensus, decades ago supporting the use

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100. McNeill et al., *supra* note 25, at 316.
101. *See* Anne Dare & Rabi H. Mohtar, *Farmer Perceptions Regarding Irrigation With Treated Wastewater in the West Bank, Tunisia, and Qatar*, 43 Water Int'l 460, 464 (2018), *available at* https://www.tandfonline.com/doi/abs/10.1080/02508060.2018.1453012.
102. *Id.*
103. *See id.*
104. *Id.*
105. *See generally* Shaukat Farooq & Zaraf I. Ansari, *Wastewater Reuse in Muslim Countries: An Islamic Perspective*, 7 Envtl. Mgmt. 119 (1983), https://link.springer.com/article/10.1007/BF01867272.
106. *See* Dare & Mohtar, *supra* note 101, at 484.
107. *See* Farooq & Ansari, *supra* note 105, at 122 (stating that the Organization of the Eminent Scholars of Saudi Arabia had considered the question of reuse of sewage after purification).

of treated wastewater in agriculture on the grounds that the Qur'an agrees that substances, once impurities are diluted or removed, can be transformed and made pure.[108]

Empowering communities with the information they need about the systems is key to assuaging these concerns. Once communities feel comfortable with a technology, understand the processes by which it works, and feel they have a need for it, they will be more likely to institute such technologies and consider how to integrate them into a regulatory framework.

### D. Financial Needs

Funding is needed for initial capital investment of the system and for future costs related to maintenance and personnel. Initial capital funding can be found from regional or international donor organizations related specifically to water infrastructure or conservation, because local farmers do not have the surplus income. The funding scheme must be well-defined before implementation so a community will know the extent of their future financial responsibilities. Agricultural greywater systems rely on cost savings of the system and agricultural revenue to fund the systems after initial funding is gone. If there is no funding stream for the future costs, there would need to be strong internal regulations to ensure compliance or the system will fail.

A recent study of the West Bank conducted by the University of Maryland found that communities that invested money in the system remained engaged and interested in the system's successful performance.[109] The University of Maryland study also considered third-party funding. This involves a third party retaining control on a funded system through installation, management, and operations.[110] Individual households would pay into the system as they would a monthly utility, but without having a government-sponsored water authority involved.[111]

Another model that has demonstrated success is the microfinancing option of having a nonprofit or water authority provide upfront capital costs and help install the system, and leaving the responsibility of management to the communities who will pay back the capital costs as a loan from the cost-savings of water and increased agricultural revenues.[112]

From the two options involving third-party funding, microfinancing is the preferred method because it provides the community with the expertise to run the system, therefore creating lasting buy-in.[113] However, third-party funding would allow flexibility in repayment because it would be based on use.[114]

### E. Maintenance Needs

Community members need to be trained in standard upkeep of the systems, including how to monitor outputs, identify issues, and fix problems that arise.[115] University extension programs or dedicated organizations should provide communities with simple checklists, fact sheets, and workshops to demonstrate how to troubleshoot and routinely maintain systems.[116] Bringing training and technology to remote areas can be expensive, but cheaper technology and digitization allow fast information dissemination, lowering the cost of improved maintenance and operation.

### F. Technological and Infrastructural Needs

Technology can be used as a workable resource to monitor systems at all levels. Instituting a greywater reclamation system and ensuring that water quality is regularly monitored will require communities to gain access to new technologies and infrastructure.[117] The first consideration is the design of the reclamation and filtration system itself. Greywater treatment systems can range from high-technology options that utilize chemical or biological treatment techniques to low-technology options that rely on simple physical operations (such as granular filtration).[118] Costs of these systems are wide-ranging, and deciding which system works best is a community-level consideration. Which system best meets their end-use goals? What levels of funding are available? How comfortable do people feel about a given filtration technique?

Communities and their partners will also need to consider investment into equipment to monitor water quality. While relatively cheap, easy-to-use water monitoring systems exist (e.g., a "water quality tester" can be purchased on Amazon.com for $11),[119] such devices generally only check the chemical condition of water (salinity, pH, presence of solid particulates, etc.). The more serious and hazardous concern, however, is bacterial contamination.[120] Testing for the presence of microbes is a much costlier undertaking, requiring lab facilities and formal expertise.[121] This presents a significant barrier to off-grid communities, and may also impede building community trust in reclaimed greywater's safety.

As such, there is good reason to consider investing in a system that will require less monitoring in the long term. For example, purple pipe systems separate out different types of wastewater streams for different purposes.[122] This system has been successfully used in Arizona, where greywater is piped through purple pipes separately from other wastewater and

108. *See id.*
109. Cedeno et al., *supra* note 82, at 10.
110. *Id.* at 9-10.
111. *Id.*
112. *Id.* at 9.
113. *Id.* at 12.
114. *Id.* at 10-12.
115. *See id.* at 15.
116. *See generally* U.S. Environmental Protection Agency, *Training Centers for Onsite Wastewater Treatment*, https://www.epa.gov/septic/training-centers-onsite-wastewater-treatment (last updated June 18, 2019).
117. Cedeno et al., *supra* note 82, at 30.
118. *Id.* at 13.
119. Amazon, *KINCREA TDS Water Quality Tester*, https://www.amazon.com/gp/slredirect/picassoRedirect.html/ref=pa_sp_atf_aps_sr_pg1_1?ie=UTF8&adId=A0783308ZDN4KGJ79KXT&url=%2FKINCREA-Accurate-Reliable-0-9990ppm-Temperature%2Fdp%2FB07NNYPQ3L%2Fref%3Dsr_1_1_sspa%3Fcrid%3D2ZKV7TAT0CGGW%26keywords%3Dwater%2Bquality%2Btester%26qid%3D1561058593%26s%3Dgateway%26sprefix%3Dwater%2Bquality%2B%252Caps%252C120%26sr%3D8-1-spons%26psc%3D1&qualifier=1561058593&id=3545741672904021&widgetName=sp_atf (last visited Mar. 22, 2020).
120. *See* Aliewi & Al-Khatib, *supra* note 29, at 483.
121. Cedeno et al., *supra* note 82, at 30-31.
122. Deborah S. Brennan, *Expanding San Diego's Water Supply*, San Diego Trib., Jan. 11, 2015, https://www.sandiegouniontribune.com/news/environment/sdut-environment-water-purple-pipe-2015jan11-story.html.

cleaned only to the level necessary for its end-use (generally industrial or irrigational usage).[123] By ensuring that piping keeps differently contaminated water sources separated, the chances of cross-contamination are decreased and the need for frequent monitoring is reduced.[124]

Additionally, considerations should be given to more novel monitoring techniques that make use of technologies that are already available to off-grid communities. For example, cellular devices are becoming more and more commonplace. In the West Bank, 79.4% of young people own mobile phones.[125] Leveraging this may be a cost-effective way to minimize the impact of disease outbreak if it cannot be prevented altogether.

In Bangladesh, researchers created a call-in water monitoring system to help track microbial contamination in drinking water.[126] The system asked people to call in if they experienced waterborne disease symptoms (diarrhea, vomiting, etc.).[127] If the number of calls increased in a particular area, people were dispatched to troubleshoot potential problems with the area's water source.[128] A similar system could be used to alert community managers of greywater systems to potential issues. In the Palestinian context, this could be applied to agricultural reuse of greywater. Farmers experiencing noticeable issues with their crops following application of reclaimed greywater could call in to community managers of these systems to raise the alarm on problems before they spread.

In the United States, citizen-generated data have had a role in upholding, enforcing, and shaping environmental regulations. George Wyeth notes, "Citizen-generated data can inform government action in ways that include: increasing agency knowledge of environmental conditions, supporting rulemaking, providing additional data for environmental impact analysis, better informing permitting decisions, identifying potential violations, prodding agencies to act on violations, and helping to monitor how well states are performing delegated responsibilities."[129]

Greywater systems will require new infrastructure and technology, and what is possible will be limited by the amount of funding available. However, working with community members to see what they can do with what they already have and what level of filtration they are comfortable with for particular end-uses will help set priorities for future technological development needed to address water challenges in the region.

## V. Conclusion

The historical relationship between Israel and Palestine sheds light on the political and regional conditions that create off-grid communities that do not have access to clean and safe water, but have the opportunity to utilize greywater reuse for agricultural irrigation under suitable and clear regulatory regimes. Greywater reuse systems are decentralized from the grid, which suggests regulation of the systems could also be decentralized from the national government. To facilitate a functional greywater regulatory scheme in Palestine, initial decisionmaking power must be at the local level to garner community buy-in and limit national reliance. Initially, organizations may assist off-grid communities to fund and implement the systems but eventually should move operation and monitoring to the hands of the local community. Fluctuating governing powers in Palestine mean that long-term regulation and enforcement is best maintained at the local or regional level where the systems operate.

Surmounting the challenges of cultural opinions, regional political tensions, financial and technological needs, sparse organizational partners, and community education on greywater will be a challenging feat in Palestine. Nonetheless, it is a critical cause, given the need for clean and safe water in these communities. The regulatory structure developed throughout the INECE Compliance Conversation and proposed here aims to take these challenges into account while pointing to opportunities to strengthen local governance and water management. Ultimately, small-scale greywater systems, especially in the water-scarce Middle East, are an effective option for off-grid communities. In order for them to be successful, however, management schemes must take into account the long-term political landscape, funding, and technological needs of the communities to create effective systems that have community support.

## Appendix

### Legal Status in Palestine and Israel

The water conflict in Israel and Palestine has existed for generations due to enduring water shortages that interact with existing disputes. The history of tensions has led to the creation of joint obligations between the two nations. Due to the contentious nature of tenure and governance in the region, reporting on consumption rates and water allocation varies drastically depending on the source cited.[130] However, one agreed-upon benchmark since Oslo II in 1995 is that Israel controls more than 80% of the region's water resources and Palestine controls 20%.[131]

123. *Id.*
124. *See id.*
125. Internews, Media and Telecommunications Landscape in the West Bank and Gaza (2014), https://internews.org/sites/default/files/resources/Media-Landscape_WestBank-Gaza_29July14.pdf.
126. *See* Leela S. Carstensen et al., *The Cholera Phone: Diarrheal Disease Surveillance by Mobile Phone in Bangladesh*, 100 Am. J. Tropical Med. & Hygiene 510 (2019), *available at* http://www.ajtmh.org/docserver/fulltext/14761645/100/3/tpmd180546.pdf?expires=1585087632&id=id&accname=guest&checksum=BBCFD12ECAE4C3826E30EF20CFF46B64.
127. *Id.*
128. *See id.* at 511.
129. George Wyeth et al., *The Impact of Citizen Environmental Science in the United States*, 49 ELR 10237, 10238 (Mar. 2019).
130. *Compare The Gap in Water Consumption Between Palestinians and Israelis*, Israeli Info. Center for Hum. Rts. Occupied Territories, Jan. 1, 2011, https://www.btselem.org/gap-water-consumption-between-palestinians-and-israelis (stating that the West Bank uses 73 liters of water per day per capita, and Israel uses 242 liters per day per capita), *and* Camilla Corradin, *Israel: Water as a Tool to Dominate Palestinians*, Al Jazeera, June 23, 2016, https://www.aljazeera.com/news/2016/06/israel-water-tool-dominate-palestinians-160619062531348.html (stating that Palestinians get 73 liters per day and Israelis get between 240 and 300 liters per day), *with* Akiva Bigman, *The Myth of the Thirsty Palestinian*, Tower, Apr. 2014, http://www.thetower.org/article/the-myth-of-the-thirsty-palestinian/ (stating that in 2006, the per capita consumption of water in Israel was 170 meters cubed per year, and in Palestine, it was 129 meters cubed per year).
131. Lazarou, *supra* note 49, at 1.

### Palestine's Water Law Structure

In 1995, under the Palestine Water Law No. 3, the Palestinian Water Authority was created, which is housed under the Cabinet of Ministers and the National Water Council, to be the decisionmaking body of the water sector.[132] The Water Authority acts as a regulator, manager, implementer, and designer of water policy for Palestine, which spreads it very thin.[133] Palestine presently has no regulations concerning greywater.[134] Under the Water Agreement, Palestinian decisions regarding water are subject to Israel's final authority, which has made sovereign and sustainable water management tremendously difficult for Palestinian authorities.[135] The Water Agreement created the Joint Water Committee aimed at facilitating water investment in Palestine but gave Israel veto power over water development in Palestine.[136]

Water Law No. 3, Environmental Law No. 7, and the Water Agreement with Israel are the three regulatory documents governing wastewater in Palestine.[137] Environmental Law No. 7 requires the ministry, in coordination with agencies, to "set standards and norms for collecting, treating, reusing, or disposing waste and storm water in a sound manner."[138] The Water Agreement requires "treatment technology and reuse strategies" pertaining to "collection systems, wastewater treatment, sludge treatment, effluent reuse, and disposal."[139] The agreement states that agriculture is the primary use for reused water and any other use must gain the other party's agreement.[140]

Despite Palestine having these laws for wastewater, the capacity for wastewater treatment and reuse is virtually nonexistent in Palestine due to Israel's resistance to support Palestine and Palestine's own fluctuating governmental structure, and, as such, rules are not well enforced.[141] There is currently no centralized wastewater reuse in Palestine, but individuals have developed efficient use tactics in the absence of a more sophisticated water system.[142] As a result, Palestine has relied on water aid from the EU for many years.[143]

132. Water Resources in the Middle East 305 (Hillel Shuval & Hassan Dwiek eds., 2007).
133. *Id*. at 306.
134. Cedeno et al., *supra* note 82, at 22.
135. *See* Dalia Hatuqa, *Water Deal Tightens Israel's Control Over Palestinians*, Al Jazeera, Aug. 1, 2007, https://www.aljazeera.com/indepth/features/2017/07/water-deal-tightens-israel-control-palestinians-170730144424989.html.
136. *Water in Israel*, *supra* note 42.
137. Peter Hansen, Palestinian Economic Policy Research Institute, Encouraging the Use of Treated Grey-Water in Palestine 19 (2012), https://www.mas.ps/files/server/20141911100557-1.pdf.
138. *Id*. at 19-20.
139. *Id*. at 20.
140. *Id*.
141. *See generally id*.
142. R.F. Michael Snodgrass, *Greywater—The Reuse of Household Water: A Small Step Toward Sustainable Living and Adaptation to Climate Change*, 22 Geo. Int'l Envtl. L. Rev. 591, 614 (2009).
143. Lazarou, *supra* note 49, at 7.

### Israel's Water Law Structure

Israel operates under the Water Law of 1959.[144] The regulations authorized under the Water Law require different levels of wastewater treatment to be designated for unrestricted agricultural irrigation in specific geographical areas of the country, restricted agricultural irrigation from small treatment plants, or discharge into waters.[145] Permits to use the treated water for agriculture use are issued by the District Health Bureau.[146] Additionally, certain barriers must be used to protect fruits and vegetables from harmful contaminants.[147] In Israel, the collection, transmission, and treatment of wastewater is the responsibility of water corporations and local authorities.[148] Plants are established by the private sector.[149] Multiple ministries have legal authority over the systems.[150] There are also multiple statutory requirements.[151]

In June 2008, the Ministry of Health published guidelines that promote private greywater treatment plants through licensing. These guidelines regulate technologies needed, locations, treatment level, and responsibility of operation.[152] The ministry reviews and approves plans and has authority over the plants. Thus, the use of greywater in individual homes is banned in Israel.[153] However, the country has been examining the reuse of shower water for toilets and gardening in a pilot program.[154] The Ministry of Health assumes that individuals are not able to properly monitor greywater systems in which the risk of harmful bacteria counts is elevated.[155] Israel also reasons that the greywater is needed for treated sewage to be used in agriculture, which Israel does with 75% of its sewage water (the highest in the world).[156]

144. *See* Steven Plaut, Water Policy in Israel 3 (Institute for Advanced Strategic and Political Studies, Policy Studies No. 47, 2000), https://www.researchgate.net/publication/239548903_WATER_POLICY_IN_ISRAEL.
145. *See* State of Israel Ministry of Health, *Using Treated Wastewater in Agriculture*, https://www.health.gov.il/English/Topics/EnviroHealth/Reclaimed_Water/kolchim/Pages/agriculture.aspx (last visited Mar. 22, 2020).
146. State of Israel Ministry of Health, *Irrigation With Treated Wastewater* [hereinafter *Irrigation*], https://www.health.gov.il/English/Topics/EnviroHealth/Reclaimed_Water/kolchim/Pages/watering.aspx (last visited Mar. 22, 2020).
147. *Id*.
148. Israel Water Authority, The Wastewater and Treated Effluents Infrastructure Development in Israel (2015), http://www.water.gov.il/Hebrew/ProfessionalInfoAndData/2012/03-The%20Wastewater%20and%20Treated%20Effluents%20Infrastructure%20Development%20in%20Israel.pdf.
149. *Id*.
150. *Id*.
151. *Id*.
152. State of Israel Ministry of Health, *Grey Water*, https://www.health.gov.il/English/Topics/EnviroHealth/Reclaimed_Water/Pages/gray_water.aspx (last visited Mar. 22, 2020).
153. *Irrigation*, *supra* note 146.
154. Snodgrass, *supra* note 142, at 614.
155. *Id*.
156. *Id*. at 614-15.