

Backyard Urine Recycling in the United States of America: An Assessment of Methods and Motivations

This paper discusses the newly emerging urine harvesting movement in the United States of America.

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Abstract

In the United States of America awareness and practice of ecological sanitation is in its infancy. In this article we briefly assess the urine harvesting practices of a small group of individuals in the San Francisco Bay Area, California, Portland, Oregon, and coastal Massachusetts. Though there are no coordinated or sponsored urine harvesting projects, a few Americans, learning primarily from the international urine harvesting community, as well as from historic practices, are beginning to implement individual-scale, "backyard" urine harvesting projects. We found that urine reuse is gaining in popularity, is accepted in certain social groups, and that urine harvesters have seen exceptionally beneficial results from using the urine fertilizer. Urine harvesting seems a good first step towards ecological sanitation practices because it is legal in the United States, whereas other practices are not. Some U.S. regulations are now changing around ecological sanitation practices, which bodes well for a trend toward greater acceptance of urine recycling and other ecological sanitation practices.

Introduction

In the United States of America, despite advanced technology, high levels of education, and growing concern about environmental sustainability, awareness and practice of ecological sanitation is in its infancy. In this article we briefly assess residential-scale ecological sanitation practices in the USA by focusing on the urine harvesting practices of a small but active, and representative, group of individuals in the San Francisco Bay Area, California, Oregon, and Massachusetts.

Urine harvesting practices in the USA are growing from the grassroots level. Though there are no coordinated or sponsored urine harvesting projects, a few Americans, learning primarily from the international urine harvesting community, as well as from historic practices, are beginning to implement individual-scale, "backyard" urine

harvesting projects. We believe there is similar interest and practice of urine harvesting in other parts of the USA as well.

The USA have a long history of composting toilet use, mainly in rural areas that do not have sewer or septic systems. Traditionally, American composting toilets have not separated urine. All manufactured American composting toilets today combine urine, except one, "Nature's Head", which is designed for use on boats and has only been available since 2007 (Nature's Head, 2010). The most popular book on the subject, *The Humanure Handbook*, by Joseph Jenkins (Jenkins, 2005; first edition 1994, now in its 3rd edition), advocates combined sources, though most rural compost toilet users encourage people to "pee outside" and not in the toilet. There is only one book about urine harvesting from the USA (Steinfeld, 2004) which includes information on the global urine harvesting

Key messages:

- Urine reuse is practiced in the United States of America even though there are no coordinated projects
- Urine is socially accepted in certain social groups
- Urine recycling is gaining popularity
- Regulations are changing around sustainable sanitation practices
- Urine recycling is legal, contrary to popular belief
- International information on urine recycling could spur growth **of USA's urine adoption**

movement, as well as a few examples from the USA. A few public examples of urine diverting toilets are found across the country, including one at the office of 2020 Engineering in Bellingham, Washington. Currently, there are plans to build the largest urine diverting project in the U.S. in a future six story building in Seattle, Washington, at the headquarters of the Bullitt Foundation (Pryne, 2010).

During January 2010, we conducted interviews with seven individuals in the San Francisco Bay Area, California, and two individuals in other states who practice some form of urine recycling (capturing and using urine to fertilize plants). Systems ranged in sophistication from a simple 5 gallon (18.9 liter) bucket (Figure 1) to collection from urine-diverting compost toilets. Interviews with urine recyclers covered basic quantitative aspects (quantities of urine collected and specific collection methods), as well as qualitative aspects (individuals' motivation, sources of information, observed benefits, and social acceptance of the practice).

The results of the interviews show that people have learned from a variety of sources, with the international ecological sanitation movement being a major one. Urine recyclers expressed the belief that American society in general holds an unfavorable view of the practice, but reported that among their friends and colleagues there is much interest and acceptance. Though the scope of this study is extremely limited by the small number of interviews conducted, the information about successes and challenges leads to a few preliminary suggestions for best management practices, and highlights an undocumented segment of the ecological sanitation movement: Americans.

Urine reuse is gaining attention at the global level as scientists, agronomists, backyard gardeners, and development professionals look to this universally available substance for solutions to a variety of water and sanitation problems. Urine collection reduces toilet water use by as much as 80% by decreasing flushes (Larsen, et. al., 2001), and reduces energy needed by sewer treatment plants to remove nitrogen (Wilsenach and van Loosdrecht, 2006). Plant nutrients, mainly nitrogen and phosphorus, can be captured from urine and used as agricultural fertilizer, reducing demand for chemical fertilizers. Composting toilets that separate urine from feces can be easier to manage and have fewer odor problems than non-separating composting toilets, as they contain less liquid.

As a matter of public policy, urine reuse can reduce infrastructure costs and conserve energy. Recent research also shows that urine may be an efficient source of hydrogen for energy (Boggs et al. 2009).



Figure 1: Fertilizing roses with urine.

Urine harvesting projects funded by international or national agencies are found all over the world, from urine diverting flush toilets in apartments in Sweden (Esrey, S. et al. 1998), and the GTZ headquarters in Germany (GTZ, 2005), to community-scale urine collection in Tepoztlan, Mexico (Esrey, S. et al. 2001) and city-scale urine diverting dry toilets in Dongshen, China (SEI, 2004).

For backyard gardeners, urine diverting toilets provide a free source of fertilizer while reducing household water consumption due to fewer toilet flushes. Each adult produces an estimated 1.5 liters per day, (WHO, 2006) which contains about 4 kg of nitrogen, 0.36 kg phosphorus, and 1 kg potassium per year. This amount is enough to fertilize about 300-400 square meters of crop for each person (Jonsson et. al. 2004). The range of low-cost options for collection makes backyard urine reuse accessible for all income levels and for both renters and homeowners.

Legal aspects

In Alameda County, California, where we conducted most of our interviews, there is no legal code that specifically prohibits use of urine or regulates backyard urine use, although public perception generally views it as unacceptable or perhaps illegal. The two legal regulatory bodies that could potentially regulate backyard urine use are the state plumbing code, which, in California, mandates one toilet per dwelling unit connected to either a private septic system or to municipal sewerage (IAPMO, 2007), or the Environmental Health Department, which regulates a large range of concerns related to health and the environment. Staff in California's Environmental Health Departments reported that they had no regulations on urine, and had never been asked about it's use before (Allen, 2010).

Regulations in the United States that historically prohibited legal ecological sanitation practices are changing. In 2009 the California state plumbing code, which regulates greywater reuse, was revised to allow for simple and legal grey water reuse, allowing irrigation of edible crops, reducing

discharge depth, and waiving permit requirements for very simple systems from washing machines. Since 2001, beginning with the state of Arizona, drought-affected states like Arizona, Texas, and New Mexico have revised grey water standards, and wetter states such as Oregon are revising standards to allow for legal rainwater reuse. In addition, composting toilet use has been on the rise for many years (While there is a lack of quantified growth trends, reports in the media affirm the growth in use and interest in compost toilets: see <http://www.treehugger.com/files/2009/07/composting-toilets-us-cities.php>, and <http://www.carolsteinfeld.com/compostingtoilets.html> though the regulations around it in most states remain prohibitive at worst, and unclear at best.

Given California's history as a region of "early adopters" and cultural visionaries, it is not surprising that a fledgling ecological sanitation movement should emerge here. It is also timely at the current moment, as California has been in drought for three consecutive years. According to the California Drought Center the last two water years have resulted in 63 and 72 percent of average annual precipitation (CA Department of Water Resources, 2009).

The change in state regulations on greywater reflects a growing awareness of the need for increasing water efficiency practices, while the practices of individual urine-recyclers reflect a growing desire for more progressive environmental policies. Urine harvesting is an easy first step for individuals concerned about reducing water use and restoring natural cycles.

The law presents a major barrier in the USA to adoption of many ecological practices. Many sustainable practices, like greywater, rainwater, and composting toilets, are illegal under local and state building regulations. Because of this, early adopters of ecological practices in the United States are often breaking local or state laws. Though most do so without consequence, there is a history of a few "pioneers" being fined, losing property, and being forced to remove the unpermitted projects (Kettmann, 2009). Organizations are hesitant to attempt projects that break local laws, thus further slowing the progress of ecological sanitation implementation in the U.S. Residential urine harvesting falls outside of existing laws; with increasing knowledge about its benefits, and legality, more users will be able to implement the practice without fear of legal consequence.

Motivation

Nine urine recyclers were interviewed during January and March, 2010. Since there are no sanctioned urine recycling projects in the USA, the authors found the participants through networks of environmental organizations. The participants had a diverse range of occupations: a director of a small ecological justice non-profit organization, an "eco-artist" and dog border, an architect specializing in green design, a gardener and public park employee, a supervisor in a construction company, an ecological designer, a medical program manager, a small businessman, and a statistician.

The nine individuals surveyed range between 27 and 60 years of age; live in cities of the metropolitan Bay Area: Oakland, Berkeley, and San Francisco, or in Portland, Oregon, and coastal Massachusetts. Five of the nine own their homes, while four are renters. The average period they have practiced urine recycling is around two years, though one individual has maintained the practice over a period of twelve years. All nine survey participants voluntarily practice other forms of residential-scale ecological resource stewardship, including recycling and composting, both locally common practices. Most are innovators in other ways: seven of the nine practice some form of unregulated grey water reuse, while two of the nine collect and channel some portion of the rainwater on their property (also an unsanctioned and unregulated practice).

Given the propensity of this group to engage in ecological practices, it is not surprising that their



Figure 2: This "Pee-pee-ponics" system uses urine to water Figure and fertilize plants. Credit: Nik Bertulis

motivations are fairly similar; all cited “saving water” or “problems with sewers” as a prime motivating factor; seven cited “fertilizer” as a primary factor, while four spoke of the importance of having a “free and available,” fertilizer, and that the practice itself is “simple and accessible,” “makes sense,” and is “a good way to turn a problem into a solution.” One cited feeling good that “my nutrients are being cycled without compromising further our stressed watershed” and “saving energy at pumps and processing at the waste treatment facility.”

Due to the lack of public U.S.-based urine reuse projects, the majority of individuals learned about and were inspired to practice urine harvesting from ecological sanitation projects in other countries. Five attended a workshop or lecture where they learned about urine recycling projects in Mexico, Zimbabwe, Sweden, and China. The rest came to the practice through the experience of “living rurally” (where regulations are more lax and outdoor latrines are common), growing up on “a family farm,” or simply “not wanting to flush the toilet” due to ecological concerns. These people learned about the fertilizing benefits later on, through informal conversations with friends. One person began collecting urine while living without a flush toilet during a home remodel, but didn't reuse it (he poured it down a shower drain) until he attended a lecture and learned about other people around the world fertilizing with urine.

Materials and methods

A variety of low-tech methods were used to separate the urine. Three of the respondents use pre-fabricated Separrette urine-diverting inserts in custom made compost toilets as shown in Figure 4 and 5 (most of the prefabricated composting toilets made in the U.S. do not separate urine), while the other five use homemade systems ranging from “a plastic bucket” (Figure 1) and “a yogurt container” to “an antique urinal that was used on trains.” One uses a self-made urine diverting toilet and one respondent uses a “pee-pee ponics” system (shown in Figure 2): an outdoor urinal that directly fertilizes a planted container (with a soil medium of 2/3 fine wood chips and 1/3 potting soil). Four respondents are the sole users of their systems; two (who both live alone) use their systems with one or two guests, while the remaining three maintain systems that are used by three or more people (a family of two and three and a collective house of five, respectively).

All of the respondents use the urine to fertilize garden plants and fruit trees. Respondents’



Figure 3: Urine cured this formerly sick lemon tree in San Francisco.

answers showed a general lack of concern with precise dilution ratios; dilution ratios range from undiluted use to a ratio of 8:1. No one stored the urine for longer than a week, and did not report any issues with odors.

Seven of the nine reported seeing significant results from using urine as fertilizer. They were delighted in “roses blooming all winter long,” “luxuriant plant growth,” “super happy bamboo,” and that their “bougainvillea really took off and started blooming much more [after receiving urine].” Their reports on edible plants reported a “citrus tree perked up,” “I grew very large broccoli, and had happy trees,” “my kale and tomatoes were really happy,” “I cured a sick lemon tree” (Figure 3), and “after fertilization my peppers took off.” Only one respondent observed no results, but reported that he started “only recently” and the trees he fertilizes are currently dormant, and another respondent said he “hadn't done any formal trials and the results were merely psychological benefits at this point.” One person noted a dramatic reduction in family water use. His family of three, who also maintain many other ecological practices including reuse of grey water from the laundry and a composting toilet in one of the two bathrooms, has measured its water savings “from 130-140 gallons (492- 530 liters) per day down to 60-70 gallons (227-265 liters) per day.”

Social acceptance

Cultural acceptability is an important indicator of the adoption potential of any sanitation practice or technological change; because urine collection is largely unfamiliar in the United States, peoples' reactions to it show a particular sensitivity. One person “only talks about it to people [she] thinks will be interested, like other gardeners,” and “sometimes worries what people will think”; Another, who works in the building trade, “doesn't



Figure 5: Composting toilet with Separrette diverting insert.



Figure 4: Urine and faeces collection from toilet in Figure 4.

All of the nine respondents demonstrated a sense that urine collection as they practice it is neither legal nor illegal, with comments ranging from “I’m sure it’s illegal” to “There’s no law against it to my knowledge,” to “I try not to know the law.” These responses demonstrate at once the lack of regulation of the practice, the lack of information about it, and the spontaneous, “grassroots” approach of these individuals in

talk about it with her co-workers,” and cites “respecting the other people who live on [her property]” as a concern. A third also cites “personal challenges: a roommate didn’t like it,” and another says that his friends “seem to feel like it’s something they’d feel uncomfortable doing.” The final person, who uses an antique urine pot, cited perhaps the most extreme concerns over acceptability, saying, “I have to decide what to do when company comes over, usually I hide [the system] when guests come over for a party,” and “at first I didn’t tell my girlfriend.”

At the same time, each of the respondents reported clearly positive reception from those to whom they’ve revealed their practice, ranging from “bemusement” and “generally positive” to “intrigue” and “inspiration.” One person says that after seeing his system, “Some [friends] have even built their own [urine diverting composting] toilets.”

Four of the nine cited small technical challenges, such as difficulty emptying the urine container and minor odor issues, but none found these challenges insurmountable.

Reporting other insights into their practices, one said the ability to make the change to urine collection “speaks to how adaptable we are as humans. Our cultural norms are socially constructed, we have such a phobia around pee and poo,” but it’s “easy to adapt.” The architect who specializes in green design and tries to incorporate other ecological practices into his buildings, expressed concern that public health norms in the United States have “made living sustainably illegal” and are so rigid as to have “made the perfect the enemy of the good.”

addressing the perceived problem. One respondent said she felt secretive about it and did not want her neighbours to know, though she wasn’t sure if it was actually illegal.

Conclusion

As a major world power and an exporter of both culture and technology, the United States of America has a unique ability to affect the perception and acceptance of sanitation technologies globally. Given the widespread acceptance of the flush toilet as the “gold standard” of sanitation technology and the increasing scarcity of both fresh water and fertile agricultural soils, we believe that wide acceptance of ecological sanitation in the United States can both conserve resources locally and play a crucial role in shifting perceptions of these practices worldwide.

From this small sample of ecological sanitation practitioners in one region of the United States we can draw several conclusions: acceptance of these practices is minimal, with practitioners made up largely of people who share both a high level of ecological awareness and a willingness to engage in practices that diverge from the perceived norm. At the same time, the material benefits (water savings and fertilization) are so considerable as to be observable almost immediately, and acceptance, while slow, is growing, as demonstrated by the fact that the average period of practice among the nine people surveyed is a mere two years.

The recent change in California’s state plumbing regulations to better accommodate residential grey water reuse bodes well for a trend toward

greater acceptance of urine recycling and other ecological sanitation practices. Given that concerns among our respondents to issues of social acceptance appear to weigh more heavily than technological or infrastructure challenges and those empirical benefits are readily apparent, it appears almost certain that more progressive regulatory frameworks will lead inevitably to wider cultural acceptance of ecological sanitation in the United States.

The increased exposure and awareness of global ecological sanitation practices, including urine harvesting, will help promote increasing ecological sanitation practices in the United States.

Recommendations

There is a lack of studies and projects on urine recycling in the United States. We believe there should be U.S.-focused studies and organized urine recycling projects.

- Americans can be socially accepting of urine use.
- Urine harvesting is a good first step toward ecological sanitation practices.
- Increased knowledge that urine harvesting is legal in the USA can increase numbers of adopters of the practice.
- Increased exposure of the international ecological sanitation practices can positively affect practices in the USA.

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