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Reviewing the Advantages and Disadvantages of reusing the Greywater

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Abstract: *2009 marks the third straight year California has been in a severe drought. The state's reservoirs are at half the levels they should be and California has been forced to reduce water consumption. There has been water rationing, water price increases, and reduction in water allocations. The need to conserve water is clearly present. The reuse of greywater is a viable way to reduce overconsumption of potable water. Subsequently, people must remain cognizant of the fact that greywater is wastewater and regulatory powers need to manage its use properly. Unfortunately, California policies cause confusion and uncertainty in the use of greywater due to the lack of uniform and consistent regulation. Jurisdictions cannot even settle on one uniform definition of greywater. Some regulatory agencies consider it the same as black water, while others consider it a separate category. The issue of greywater use is not so black and white, but rather "grey." Greywater has the potential of reducing the demand for potable water if clear and feasible regulations surrounding its use are enacted.*

Keywords – *potable water, wastewater, irrigation, pollution*

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I. Introduction

The common definition of greywater is untreated household wastewater that has not come into contact with toilet waste. Toilet wastewater is referred to as black water. The standard definition of grey water includes water from showering, bathing, and washing dishes and clothes. However, the definition of greywater can vary within jurisdictions. For example, California takes the grey water definition one-step further by stating it shall not include wastewater from kitchen sinks, dishwashers, or laundry water from soiled diapers. New Mexico takes the definition of greywater to a greater extreme by classifying it to be the same as black water (Ludwig, 2009). For the purposes of this study, the standard definition of greywater will be used.

Greywater comprises fifty to eighty percent of residential wastewater (Ahmad, Juriah, & Vijayaraghavan, 2008). The estimated home breakdown use of water in the United States goes as follows: toilet equals 16.8 percent, laundry equals 21.7 percent, shower equals 26.7 percent, faucet equals 15.7 percent, and leaks equal 13.7 percent (AWWA, 2008, p. 1). As seen by the numbers, the reuse of greywater can significantly reduce household consumption of potable water. An experiment conducted in the early 1990s by Los Angeles Department of Water and Power of Public Works found that home installations of greywater systems diverting water from washing machines, showers, bathtubs and bathroom sinks to irrigate outside gardens reduced potable household water consumption by 50 percent (Haefele, 2009, p. 1). Not only can the use of greywater reduce household water bills and consumption, but also results in less stress on septic and sewer systems.

Greywater can be reused for either landscape irrigation or redirected for toilet flushing. In Tokyo, greywater recycling is mandatory for all buildings with an area of over 30,000 square meters. Buildings achieve this mandate through the use of toilets and urinals that are flushed by water that was previously used for hand washing. This allows Tokyo to potentially reuse 100,000 cubic meters of water per day (Attili, 2008, p. 1).

Advantages of reusing greywater

There are many systems currently out on the market that use water from bathroom sinks to flush toilets. One system is the AQUS Greywater Recycling System, which even treats the water from the sink prior to being used for flushing as shown in Fig.1. It is estimated that the AQUS system can reduce potable water usage by 10 to 20 gallons a day in a two-person household. The AQUS system cost 300 dollars (PFPW, 2009, p. 1). There are no U.S. or state regulations that prohibit the act of diverting water from bathroom sinks to flush toilets. In fact, the state of Vermont recently proposed a bill to require the use of greywater for toilet water in state buildings. However, the bill did not pass (Ludwig, 2009).

Besides using greywater to flush toilets, it can be used for landscape irrigation. In many arid places such as Los Angeles and Arizona, nearly half of residential water use is for outdoor irrigation (Carpenter, 2008,

p.1). With greywater comprising fifty to eighty percent of household water use, using it to irrigate landscapes holds great potential in reducing water consumption. The use of greywater for landscape irrigation has many benefits other than reducing consumption of potable water and strain on septic and sewer systems. Greywater often contains detergents that have nutrients such as nitrogen and phosphorus, which are beneficial to plant growth (Ahmad et al., 2008).

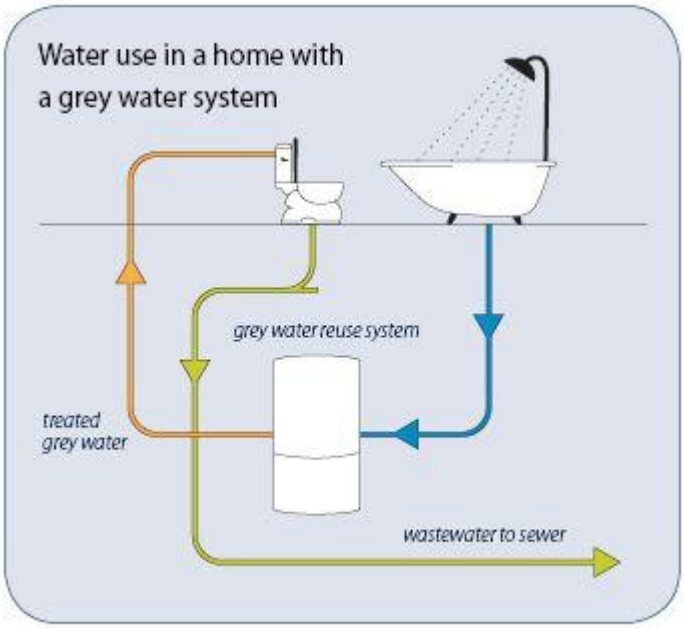

Fig 1. AQUS Greywater Recycling System.

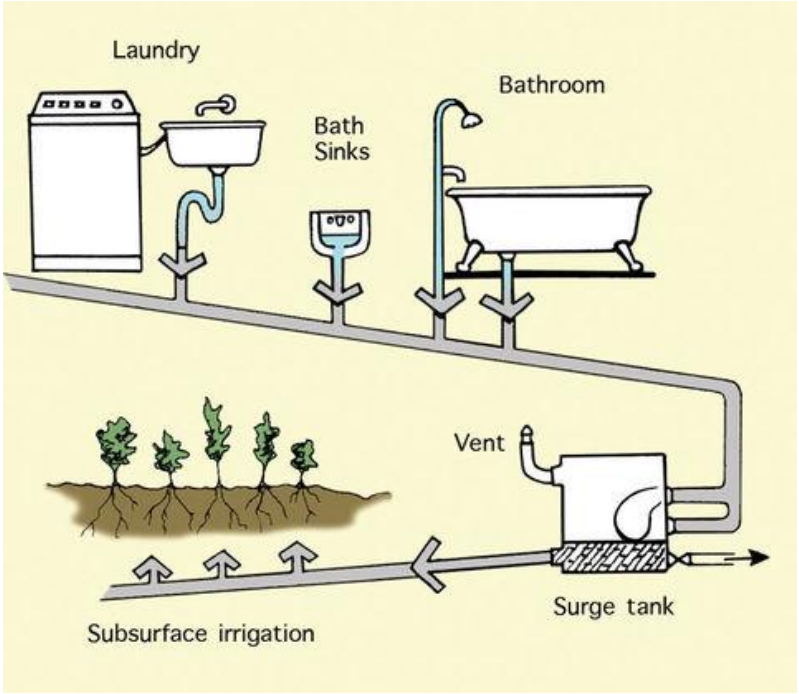

Fig 2. Diagram showing the using of greywater for landscape irrigation.

Disadvantages of reusing greywater

However, greywater has been found to have high alkalinity (low acidity) due to the residues from soap and detergents, which can have adverse effects on plant growth. Powdered detergents and soaps have "filler" ingredients, which are often sodium compounds. When grey water is used for irrigation, the use of laundry detergents, softeners, and soaps that contain high levels of compounds of sodium, potassium, and calcium should be avoided. These chemicals are all alkaline chemicals and when they are applied to the ground, they raise the alkalinity level of the soil. Shade loving and acid loving plants do not like grey water. Hardy, drought tolerant plants such as native desert plants handle high alkalinity soils very well (Noah, 2002).

Other disadvantages of using greywater are that it can have high levels of turbidity and microbial contamination such as bacteria, protozoa, and viruses (Noah, 2002). Studies have found that greywater contains levels of suspended solids as high as 149 and 162 milligrams per liter, exceeding the minimum levels that many states allow for surface disposal (Noah, 2002). Greywater that is allowed to pond can accumulate dangerous amounts of contaminants like viruses and bacteria, which attach to suspended particles in high turbidity water. The turbidity/suspended particles in ponds of greywater shade and protect bacteria and viruses that would otherwise be killed by ultraviolet sterilization. When untreated grey water is stored for longer than a day, it can dramatically change with increased contaminants (Noah, 2002).

Greywater can also be subject to microbial contamination from human contact. People that are ill can shed pathogens into greywater from showering, washing their hands, or doing laundry (Noah, 2002). Feces, which contain E-coli, can also enter greywater from the bathtub and through underwear put in the washing machine. The University of Arizona did a yearlong, ten-house study on the quality of greywater and the soil it irrigated. The study found that fecal coliforms in the greywater were above normal levels (the U.S. Environmental Protection Agency prohibits any level of fecal coliforms in drinking water). Greywater also introduced E-coli into soil that would normally have zero amounts of the contaminant (Noah, 2002). E-coli is an indicator of the presence of pathogens.

The use of greywater for landscape irrigation needs to be properly managed to prevent the spread of pathogens and avoid the possible depletion of soil fertility. The United States has no federal greywater regulations; its management is left to the states. Usage rules may differ within a state. One locality may permit grey water use while another prohibits it. Likewise, neighboring states have different standards.

California was the first state to adopt greywater regulations. Greywater regulation started in California in August of 1989 (a period of drought) when the city of Santa Barbara officially legalized the use of greywater through building codes, separating it from black water into its own category (Ludwig, 2009). This prompted California to mandate statewide codes regulating the use of greywater. Unfortunately, the California greywater codes of 1992 through mid 2009 made legal use of greywater in the state prohibitively expensive, either causing residents to not bother reusing greywater or go around the laws and install illegal, non-compliance systems.

In California, greywater standards are part of the State Plumbing Code. They are regulated under Title 24, Part 5 of the California Administrative Code (CPC, 2007). From 1992 thru mid-2009, the code prohibited human contact with greywater and required that it be kept underground during irrigation, through either subsurface drip irrigation or mini-leach field systems. Also, anyone legally installing a greywater system had to obtain a permit as the code stated, "it is unlawful for any person to construct, install, or alter…any greywater system in a building or on a premises without first obtaining a permit to do such work from the Administrative Authority" (CPC, 2007). This strict enforcement made installing a legal greywater system in California prohibitively expensive.

California required any diversion of greywater to be kept underground by at least eight inches through either a leach field or a subsurface drip irrigation system to prevent any human contact. Before any of these systems could be installed, a plan of the system had to be approved for a permit by the administrative authority. Soil tests, percolation tests and slope levels of the landscape had to be included. Moreover, the systems had to have storage tanks with overflow valves and three-way valve systems. The requirements for legal greywater systems in California made design of the system too complicated and expensive for the average homeowner. Legal systems cost thousands of dollars to install (Ludwig 2009).

The high cost and intensive designs of legal greywater systems in California discouraged homeowners from complying with state standards. When grey water use was legalized in the years 1992 to 2008, only 200 permits were issued for its use (Haefele, 2009, p. 1). Nevertheless, it is estimated that 1.7 million greywater outlets were running illegally (Haefele, 2009, p. 1).

If a homeowner wanted a licensed professional to install a legal greywater system, it would have cost thousands of dollars (in the range of 10,000 to 15,000). State codes from the 1990's to mid 2009 prohibited simple systems. Thus if a homeowner wanted a simple system, they had to install it illegally and had no other choice than to do it themselves. A system could be as simple as running a pipe directly from a washing machine to a rose bed covered with mulch.

Therefore, homeowners who wanted simple, cost-effective greywater diversion systems did not know how to proceed legally since they could not seek help from a licensed professional. They could not afford the cost of a legal system, and licensed professionals risked losing their license by installing illegal systems. An organization called the Greywater Guerrillas sprang into existence to protest the confusion and the costly regulations.

The Greywater Guerrillas are a self-described group of educators, designers, builders and artists who teach and empower people to "build sustainable water culture and infrastructure" (Greywater Action, 2009). The group started in 1999 out of Oakland, CA and holds workshops on how to install illegal and "practical" greywater systems. Interested parties may even request that members of the guerilla group come to their homes to install such systems.

Why do California codes regulating legal greywater systems make it so prohibitively expensive and complex? The California Department of Public Health is afraid that greywater could spread pathogens, causing illness and death. Greywater use should be managed to prevent the spread of pathogens, but this can be done without the extreme measures of the state codes. There has not been one case of anyone becoming ill from contact with greywater and millions of people in California alone use greywater for landscape irrigation.

California could learn from the actions taken by Arizona, a state with more practical and feasible greywater use standards. The state of Arizona has a three tiered system where buildings that generate no more than 400 gallons of greywater per day do not require a permit for using grey water for landscape irrigation (this would include most residential homes); while systems that generate more than 400 gallons per day must obtain a permit through the state. Even though most residential households are not required to obtain a permit, they still have a list of standards to abide by. Such standards include that greywater must ***not***: 1) come into human contact, 2) irrigate food plants, except for citrus and nut trees, 3) contain hazardous chemicals derived from such activities as cleaning car parts, 4) pond or runoff property, 5) come into contact with soiled diapers (Ludwig 2009).

Legal greywater fixtures in Arizona can be as simple as attaching a hose from the water outlet on a washing machine and running the hose outside as long as Arizona standards for greywater use are followed. Under California code from 1992 to mid 2009 this kind of simple system would not be allowed. When Arizona adopted the three-tiered greywater use standards, compliant rates for greywater code (which ensure safe use of greywater) rose from near zero percent to 50 percent (Ludwig 2009).

Recently, California reacted to the infeasibility of its greywater codes. In August of 2009 the state added "Chapter 16A No potable Water Reuse Systems" into the state plumbing code that regulates greywater use. The new chapter does not require permits to divert greywater from clothes washers and single fixture systems for irrigation. "The new law opens the door to upgrading greywater systems by the professional installation of simple graywater systems using licensed landscapers, contractors, and plumbers, improving the safety, helping the environment, and providing green jobs" (Ludwig 2009).

Although the state of California now allows for household greywater irrigation, it is still illegal in many state counties. Cities, counties and their administrative authorities are responsible for regulating water use. Local jurisdictions can adopt the greywater standards the state has set, make more stringent standards of their own, or can prohibit grey water reuse all together. To this day, the state County of San Bernardino prohibits the use of greywater for irrigation in all cases.

With so many discrepancies surrounding the use of greywater among states and counties, one would think that there would be many court cases dealing with the use of greywater, But this has not happened. Cities, counties and their administrative authorities are responsible for regulating water use. Their job is to decide if the procedures followed by the agencies in enforcing the regulations are in accordance with the law and follow due process procedures. Due process procedures include proper notice and a fair hearing following the particular laws. If there is disagreement with regulations or enforcement with regulations, then cities, counties, and their administrative authorities are responsible for regulating water use. Courts do not want to get involved in the details of such regulations. A plaintiff can take a state or county agency to court only on the grounds that the agency violated the laws or violated the person's due process rights. Courts have not yet handled cases that involve changing greywater codes or regulations. That is left to state, county and city agencies.

However, the growing need to use greywater may require uniform, federal standards for the protection of the nation's water supply. Widespread use of greywater for irrigation has the potential of polluting water supplies. The federal government has an interest in protecting our nation's waterways and water supply.

The Clean Water Act (CWA), for example, though not aimed specifically at greywater, regulates the discharge of pollutants into the "navigable waters of the United States," (CW 2008). "Navigable waters" is broadly defined and includes some water, such as tributaries, which are not large enough to allow the passage of ships.

In the late 1990s Chicago municipalities wanted to trench out land that included seasonal ponds in order to construct a landfill. The Army Corps of Engineers (The Corps) refused to permit the trenching because

they were protecting "navigable waters" under the Clean Water Act. The Corps claimed they had the right to protect the land because its ponds provided habitat for migratory birds.

The corps decision was taken to federal court in the case: Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers of 2001. The case ended with the U.S. Court of Appeal for the Seventh Circuit Court ruling that "navigable waters" include some waters, such as tributaries, which are not large enough to allow the passage of ships. Wetlands (migratory habitat for birds) are protected if they can be classified as small streams leading to navigable waters or if adjacent to navigable waters. Thus, not only the Sacramento River or Colorado River, but also the streams and other bodies that flow into these rivers, could be regulated under the Clean Water Act.

The potential effects of greywater on water quality and supply could therefore become a significant federal issue if increased use of greywater ever leads to pollution of bodies of water that flow into "navigable waters." Recently, the United States Supreme Court heard two cases, which dealt with the issue of how far away from navigable waters a wetland may be and still be covered by the Clean Water Act (Rapanos v. United States and Carabell v. United States Army Corps of Engineers). Though these cases were remanded to the trial courts and did not specifically deal with greywater, the growing need to use greywater may require uniform standards for the protection of our water supply.

II. Conclusion

The idea of using greywater is simple; divert water used for washing and bathing from going into the sewer/septic to instead be used for flushing toilets or watering the garden, but the regulations are not so simple. They are inconsistent and cause confusion. With the urgent need in California to conserve water, greywater use could significantly reduce potable water use, but the regulations need to be clear and consistent. Currently, the state says greywater use is legal, but in many state counties, it is strictly prohibited. If the legality over greywater is taken out of the grey blur it has been in for the last two decades in California, then the state might have more power to encourage greywater use and reduce potable water use. Plumbers and homebuilders could install legal and safe systems statewide and greywater plumbing would no longer be left to greywater guerillas. This would be one big step of many steps needed to conserve water at a time when California faces a water crisis that continues to escalate with current climatic conditions.

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