Greywater Reuse:

Understanding Greywater Reuse Systems in the Current and Future Urban Contexts and How Individuals can Promote Greywater Reuse.

http://www.iwaponline.com/wst/05912/2341/059122341.pdf

http://www.greywater.com/samples.htm

http://farm3.static.flickr.com/2424/3587089444_058afc9a41.jpg

CRP 3840: Green Cities

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Introduction:

It is a widely known fact that water is a finite resource. Unfortunately, in the developed world we have taken water for granted as it is provided to us instantly through water fountains, sinks, showers, baths, toilet bowls and even decorative sources like fountains and manmade ponds. The world is currently in the midst of a cross roads where the unsustainable and impractical uses of water are no longer acceptable. The Organization for Economic Cooperation and Development (OECD) predicts that the water sector in many of the OECD countries will face enormous changes in the long-term. For example, population growth and the increase in urban populations are likely to stretch water demands in both large and small urban areas. Environmental stresses like the severe droughts plaguing Australia are most likely to continue if not spread to other nations and urban areas. The constant degradation and elimination of watersheds and groundwater supplies requires the implementation of new water infrastructures. Among all of these current and upcoming changes, greywater reuse has emerged as a way to reduce freshwater use and instill in the public an awareness of water conservation.

In this study we seek to understand:

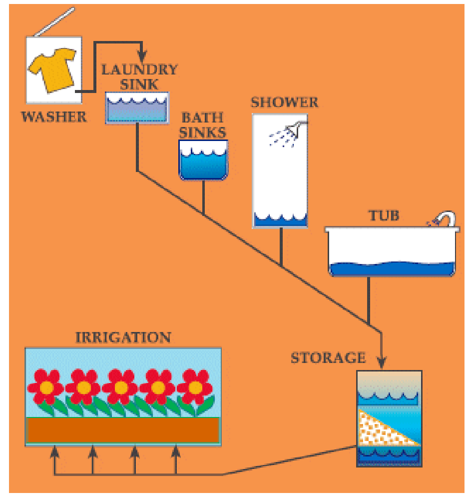
- Greywater reuse systems
- The benefits of greywater reuse systems
- What policies national, state or city governments are implementing to promote the installation and use of greywater reuse systems
- Where in the urban context greywater reuse systems are used
- What studies are being done to promote greywater reuse and which parties are conducting these studies
- What can be done by the individual and future governmentsto promote greywater reuse

What is Greywater?

Greywater is the wastewater generated from domestic activities. These activities include showering, taking a bath, washing hands, and doing laundry. The wastewater generated from toilets and the kitchen sink is considered blackwater. Blackwater, unlike greywater, may not be reused due to the high concentrations of harmful viruses and bacteria. Blackwater consists of many organic compounds that have already been treated by the digestive tracts of the human body. The organic material, therefore, contains more bacteria than greywater and takes a longer amount of time to decompose once in the water. Greywater nonetheless contains microorganisms as a result of its contact with the human body. The concentrations of the microorganisms are substantially lower than the concentrations found in blackwater and are therefore much safer. Greywater may be safely reused if the proper systems are implemented. These systems mostly maintain that greywater not be stored for long periods of time, but instead reused within short periods of time.

How is Greywater Reused?

Greywater may be reused if directed and collected using a plumbing system that is separate from the plumbing system used for blackwater. Separating the greywater from the blackwater will ensure that it does not obtain higher concentrations of harmful and disease-inducing microorganisms. The separate plumbing systems for greywater reuse are designed in such a way as to ensure that the greywater is not harmful or reused in such a way that is harmful to people. There are two main categories of systems: the diversion systems and the filtration and purification systems.



http://www.tucsonaz.gov/water/img/gwsys.gif

Greywater Diversion Systems:

The diversion systems generally divert the greywater from the laundry, bath, shower, and sink sources to a site or sites of immediate reuse. These sites of immediate reuse are more often than not the garden or landscaping incorporated in the built environment. The diversion systems are permanent plumbing and irrigating systems that are integrated into the established plumbing system of the building. For a private home, the diversion system would, after use, divert the greywater to the garden. The greywater here does not have to undergo a purification process because it is never stored for more than a couple of hours. However, if it were stored for more than a few hours without being purified the bacteria in the greywater would grow at high rates, causing the water to smell bad and possibly be harmful to people (Friedler et. al., 2005).

http://www.sustainablealternatives.com.au/6.html

The greywater is dispersed often through a flood or drip-irrigation system (an essential regulation of the California Greywater Law). The components of this system, like the drip line, are often simply laid on top of the soil adjacent to the foliage that it provides greywater to. Mulch is often lightly dispersed above and http://www.enter-shop.com.au/catalogue/c24/c25

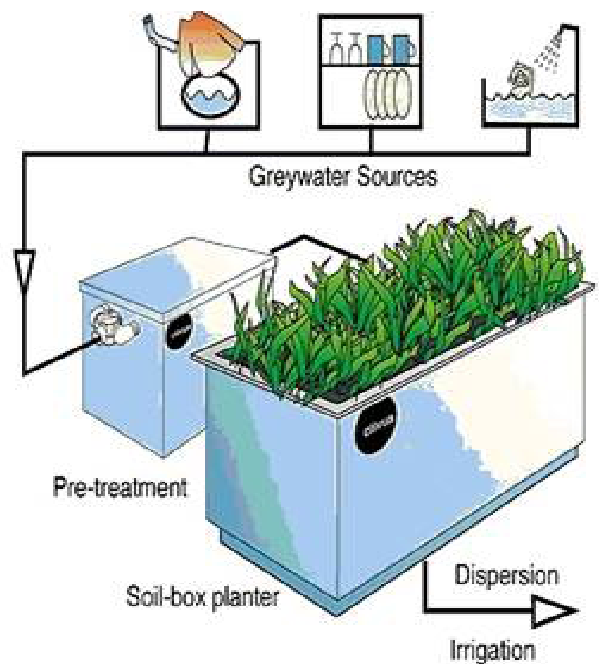
around the drip line to ensure that the greywater does not pool and spoil as a result. This orientation of the drip line within the garden is easily adaptable to well established gardens. For newer homes that might have a greywater reuse system built into the original plumbing, subsurface irrigation trenches may be used throughout the garden. This type of irrigation line involves "slotted pipes laid in shallow trenches filled with coarse sand, aggregate or blue metal under a layer of topsoil" (Planet Ark, 2007). The greywater in this pipe system is distributed underground and directly to the roots of the plants. The roots then take up the greywater and the nutrients found in the greywater. They act as a type of filter.

Under this System, Greywater is Reused in:

- The Garden
- Other types of Landscaping

Greywater Purification and Filtration Systems:

The treatment systems involve the removal of bacteria and organic particles through filters and disinfection technologies. The greywater in these systems is transferred from the typical bath, shower, sink, and laundry sources to a purification treatment and then ultimately a greywater service tank. From the service tank, greywater is redistributed to various uses throughout the building or household. After undergoing the purification process, the greywater is potable or nearly potable.



http://www.ci.huntington-beach.ca.us/images/users/public_works/Greywatersystem.jpg

The purification treatments are often broken down into many stages and levels. The greywater usually first enters a pre-treatment. This stage may include the filtering of the greywater through a type of sieve, to remove particles, and then a distillation process (though distillation is rather intense and not necessary). Sand bed filters are often used to remove the particles from the greywater.

The greywater then enters a type of biofiltration for the further removal of particles within the water. The most popular types of biofiltration technologies include soil box planters, living green walls, greenroofs, and reed beds. The roots of the plants in each of these biofiltration technologies further purify the greywater by absorbing the nutrients in the water. Almost all of these plant systems are either integrated into the outdoor areas of the building or in the garden and landscaping. Some living walls and soil box planters, however, may be incorporated in indoor spaces. While the plant roots purify the greywater, the greywater also provides nutrients for the plants that allow them to grow and produce oxygen.

For incredibly high quality greywater, many filtration systems include a UV disinfection stage. One German study found that UV disinfection in an apartment greywater purification system reduced the miniscule amounts of E. coli concentrations found in greywater by over 99% (Nolde, 2005).

After undergoing this purification step, the greywater is either stored in a holding tank or dispersed to areas throughout the building or household for further reuse. The most common practice is to have the greywater stored in a tank because it is rarely ever used as fast as it is produced. The greywater is then dispersed via plumbing pipes from the storage tank to toilet bowls, garden irrigation systems, or, in the case of the UV disinfected greywater, to washing machines.

http://www.cat.org.uk/consultancy/water.html

http://www.sustainabilityinstitutesc.org/enews_sept08.html

http://www.treehugger.com/files/2009/11/roca-toilet.php

In the case of the purification system, the greywater may be stored and reused. Furthermore, it "delivers water services and qualities matched to users' needs, rather than just delivering quantities of water" (OECD, 2008).

Under this System, Greywater is Reused in:

- The Garden
- Other types of Landscaping
- Toilet Bowl Water
- Laundry Water

Why is Greywater Reuse Relevant in Cities Today?

Freshwater is an essential living resource because it is the only source of water capable for humans to drink. Unfortunately, it is also becoming a scarce resource throughout the world. There is, and will continuously be, a growing global shortage of freshwater. According to Scientific American magazine, the addition of population growth to current climate change will create water scarcities far and wide. Even in the developing world, where many citizens enjoy abundant water supplies, many regions are suffering from physical scarcity, where local demand exceeds local availability. The rapid growth of water-intensive agriculture in developing countries and inefficient water management practices in the developed world are contributing to a global reduction in future freshwater supplies.

The United Nations Environment Program report, which was created by more than 200 water resource experts worldwide, confirms that the above-mentioned practices are the two main culprits behind the world's growing freshwater problems. The report states that the environment is foreclosing on unsustainable water debts on an extensive scale. Recent agricultural practices, and not weather-related factors, for example, are contributing to the rapid depletion of groundwater levels in India. According to Dr. Raj Gupta, a scientist at the International Maize and Wheat Improvement Center, Indian farmers rely heavily on irrigation to water their crops. In developed nations, such as those in Japan, the United States, and Europe, most water shortfalls arise from politically popular but inefficient subsidies and protections of agriculture, which accounts for 85 percent of freshwater consumption worldwide. Therefore, the problem of water scarcity not only hits the poorest people of the world but the most affluent as well.

What will be the consequences of a global water shortage? Without an increase in water conservation efforts, a rise in human population would increase the total global demand for water. This would result in a sharp rise in water prices throughout the world. Unfortunately, according to the Earth Policy Institute, this problem is already happening today. In Tunisia, the price of water irrigation increased fourfold over a decade, and in the United States, water rates have increased by an average of 27 percent.

In addition to demand, the costs of transporting water will also increase because freshwater sources are becoming harder to find and maintain. In many places around the world, most wastewater gets dumped in the sources where freshwater is obtained in the first place. For example, in the United States, the Great Lakes hold about one-fifth of the world's freshwater; cities in the region, however, are dumping the equivalent the equivalent of more than 100 Olympic swimming pools full of raw sewage directly back into the Lakes every single day. While many U.S. households are still paying very little for water compared to many other parts in the world, the government will have to pay even more to maintain the health of its current sources. According to the Great Lakes Sustainability Fund, governments within the Great Lakes basin have already spent billions of dollars on municipal sewage treatment systems since the mid-1950s.

The Benefits of Using Greywater Reuse Systems:

- Decrease in demand for fresh water
- Decrease in discharge of wastewater into the environment
- Reduction in the amount of energy needed to transport water as a result of water used being produced on site
- Reduced amount of greenhouse gas emissions (as a result of the reduced amount of transportation energy needed)
- Plants grow at higher rates as a result of nutrient uptake
- Groundwater is recharged
- Soil health is increased
- Purification of air as a result of increased plant growth
- Fully reclaimed use of nutrients that might otherwise be wasted

The Forerunners in Urban Greywater Reuse Policy:

Greywater reuse systems have been established in some urban areas since the 1960s. However, they have not been widely accepted in many areas until this past decade. For the majority of the world, including OECD countries, strict regulations have deterred the use of greywater reuse systems. The systems have been misunderstood as producing poor quality water that poses many health risks. Many countries and cities have recently adopted policies promoting the implementation of greywater reuse systems as a result of environmental crises like droughts or water scarcity. They have essentially been forced into doing so. This trend has resulted in the emergance of three major players as the promoters of greywater reuse policies: California as of this year, Australia as of the past five years, and Japan since the 1960s. In this section we will explore what policies California, Australia, and Japan have established concerning greywater reuse systems, how these policies are implemented in urban areas, and where in urban areas greywater reuse systems are being implemented.

California and the City of Palo Alto:

The State of California, one of the most productive agricultural regions in the world, is suffering from a prolonged period of water shortage. According to the state government, California is entering its third year of drought as a result of below average precipitation and runoff. While natural supplies of water are not being replenished, the state's population is nevertheless continuing to rise. The California Legislative Analyst's Office issued a report in November 2009 stating that the state's population will grow by at least 1 percent a year. Dwindling freshwater supply levels, coupled with rise in population, are creating a conflict of interest among those involved in state water politics. Gary Coehlo, a farmer in the Central Valley, commented to National Public Radio that the state has not made any major additions to water storage, even though its population has nearly doubled over the past 50 years.

Farmers believe that more of the state's water should be distributed to them, but many scientists believe that the Central Valley's current agricultural practices cannot continue because too much water is being moved away from residential purposes. Peter Gleick, an environmental scientist at the Pacific Institute, says that agriculture takes about 80 percent of the water for human consumption in California. Nevertheless, even though more water could be redistributed for residential purposes, this would not change the overall quantity of water unless improvements in water efficiency can be made. Greywater can be one of the ways that the State of California can meet its distributional challenges.

Before the droughts of the late 2000s, implementing greywater technology in California cost a large amount of time and money. In 1992, when the first statewide greywater policies were implemented under Appendix G of the California Plumbing Code, homeowners found it difficult to install systems for their own personal use. According to the appendix, those who wanted to install their own greywater systems needed to obtain a permit by an appropriate administrative authority. In Santa Barbara, only 10 systems were granted permits over the past 20 years. Moreover, even if homeowners managed to obtain a permit, they had to construct their system underground with an extensive filtering apparatus. In neighboring Arizona, however, it is much more easier to install a greywater system. Arizona legislation states that homeowners are allowed to install systems without a permit as long as they follow certain guidelines and are recycling no more than 400 gallons of grey water a day.

As a result of political pressure from greywater advocates, politicians in California have been making efforts to make greywater systems more feasible for the state. California Senate Bill 1258, passed on July 2, 2008, directed the Department of Housing and Community Development to develop a more wide-ranging set of greywater systems for both indoor and outdoor uses. This past August, an emergency ruling unanimously approved by the Assembly and the Senate modified the existing greywater system standards so that homeowners could finally build simple greywater systems for household use without obtaining a permit. Under the new regulations, California finally opened the doors for widespread implementation of personal greywater systems.

With the help of the new legislation, local governments in California are reaching out to domestic homeowners who can easily afford to pay the costs associated with installing a new greywater system. In the City of Palo Alto, for example, many of the residents are willing to pay a little more to help conserve the environment. Last year, it announced that more than 20 percent of residents had enrolled in a voluntary renewable energy program known as PaloAltoGreen. While the energy program did not add significant costs to residential energy bills, water-saving systems such as greywater recycling can be more costly to implement for personal use. A high-end home greywater system can cost up to $5,000 to build, so city officials are promoting incentives that will help offset the high costs associated with the installation of such systems. Palo Alto officials are offering homeowners $1.50 per square foot, up to $3,000, of lawn removal if greywater irrigation and less water demanding landscaping are established. City officials are promoting a variety of greywater recycling systems that can serve to be eligible for the rebate. These systems include both the diversion system and the filtration systems. Palo Alto residents are eligible for a rebate as long as they call an inspector to verify an irrigated lawn before construction begins.

Australia:

Australia is the driest inhabited continent on Earth, and droughts are not a surprise to many who live there. In recent years, however, long-term droughts have become so severe in certain regions that they are now the worst on record. The droughts have heavily impacted Australia's agricultural sector. In 2007, agricultural production fell by almost one-quarter for the year (Department of the Environment, Water, Heritage and the Arts). Moreover, in 2008, an expert panel warned that the Murray-Darling basin, one of Australia's most productive agricultural regions, would experience severe long-term ecological damage if rains did not improve over time. Realizing the severity of its water shortage, the Australian national government introduced a massive water investment program called Water for the Future during the very same year. Under the program, the government is investing $12.9 billion over ten years to address the health and security of Australia's water supplies. $250 million of this plan is to be delivered to the National Rainwater and Greywater Initiative, which will provide rebates for citizens who install greywater systems.

Unlike the limited availability of greywater installation rebates in California, Australians do not need to live in certain cities in order to take advantage of low-cost opportunities to implement household greywater recycling. The rebates, however, are likely to be given to Australia's urban households within the country's most populated eastern provinces. In all of these provinces, the installation of a greywater system does not require a permit. Other more sparsely populated provinces, such as Western Australia, require a permit for construction. Moreover, the rebate amount offered by the Australian government is much lower than the amount offered by officials in the California City of Palo Alto. The federal government is willing to subsidize up to $500 for Australians to purchase and install their own permanent greywater system. Therefore, greywater system implementation in Australia is likely to be limited to those who can afford to pay for the costs of installation.

As a result of the nation-wide greywater reuse policies, greywater reuse systems are used in the majority of the cities throughout the country. The most widely used technologies are diversion systems for garden irrigation. In fact, the majority of the diversion systems that are advertised online are produced and sold in Australia. There are even several websites that provide advice for how to maintain a pristine garden by using greywater diversion systems. As a result, it is most likely that single family homes are the main beneficiaries of these systems. They most likely have the most access to them and enough income to maintain them and along with nice gardens. Greywater filtration systems are also widely used in homes and other properties.

The overall trend is as follows: greywater treatments are mostly installed by private homeowners and property owners, and not by the government. The government uses its funding to subsidize the private installation of greywater reuse systems and to educate the people on the benefits of greywater reuse, along with the proper technologies to use, and methods of using the technologies. By doing this, the government makes greywater reuse technologies the status quo. This method allows the public to fully understand what greywater is, how they can benefit from its reuse, and through which technologies they can reuse it. We believe that this public acceptance and understanding, along with the government subsides and the immense accessibility to greywater technologies, are the key factors that have made Australia's greywater reuse policies so successful.

Japan:

In comparison to California and Australia, Japan is situated in an area of the world that receives an abundant amount of rainfall. On the other hand, Japan's per capita rainfall is actually one-fifth of the world average due to the country's dense population (Japan for Sustainability, 2009). As a result, Japan is strained by rising freshwater demand. Compared to agriculture and industry, where the total volumes of water use have either stayed the same or are decreasing, the residential sector uses a greater share of water. From 1975 to 2002, total household water use increased by 5.0 billion cubic meters. In addition, approximately 40 percent of Japanese have experienced cuts in the supply of water. Fortunately, however, 70 percent of Japanese also support the utilization of rainwater or recycled water. The government of Japan is highly aware of the need to conserve water, so greywater technology is already a popular choice for household water needs.

http://www.re-nest.com/uimages/re-nest/9-26-2008caroma.jpg

The Japanese government does not provide incentives for household residents to implement greywater systems in their own living spaces. Nevertheless, many people choose to implement them in urban areas because water costs are very high. Greywater systems in Japan are less extensive than those in California or Australia because there are very few backyards that would require the use of an extensive outdoor irrigation system. Residents typically limit the use of greywater systems to simple system revolving around the bathroom toilet. Hand washing basins are placed above toilets and are connected to the same water pipes that deliver water to the urinal. When new water is delivered to the urinal, water comes out of the hand-washing basin. The water from hand washing is then used to fill the urinal as greywater. While this system is very simple, it nevertheless promotes the conservation of water for residential use.

On the other hand, the Japanese government is making an effort to implement greywater technology in more extensive urban commercial uses. In the capital city of Tokyo, greywater recycling is mandatory for buildings with an area greater than 30,000 square meters or with a potential non-potable demand of more than 100 cubic meters per day. In order to offset the costs associated with construction, the Japanese Ministry of Construction provides subsidies of up to 50 percent of the capital costs. The government also assists in connecting commercial greywater systems to the public sewerage system. Therefore, while residential greywater use is minor in Japan, commercial greywater use is very extensive.

Conclusions Based on these Forerunner Case Studies:

- Greywater reuse systems are somewhat costly to implement, so governments often need to subsidize the costs of installation
- In all of these case studies, greywater reuse systems are mostly localized within urban areas
- With the exception of Japan, greywater reuse systems are mainly installed in private homes and are not a part of the municipal water infrastructure
- Public acceptance and understanding of greywater reuse systems is necessary in order for the systems to be widely and properly used in homes

Private Pilot Studies:

As stated earlier, many city and state governments have not adopted policies to promote the implementation of greywater reuse systems. Policies and regulations remain rather strict. They deter most homeowners and property owners from attempting to install the systems. With the success of the greywater reuse policies in California, Australia, and Japan, many other governments are beginning to consider initiating greywater reuse policies. These policies are not instantly implemented. Many governments want quantitative proof that greywater reuse systems meet health standards and actually save a significant amount of water. Many private corporations and research groups, sometimes partially funded by the government, have conducted pilot studies. These pilot studies are meant to examine whether greywater reuse systems are effective and which greywater reuse systems are effective in the urban environment. Based on the results found in many of these studies, coupled with the declining water conditions, the OECD states that many nations will have to shift their policies and infrastructures towards alternative ways of providing water (OECD, 2009).

Private Greywater Reuse Systems in Residential Developments in Germany (2005):

Germany currently does not have any state supported policies that promote greywater reuse. However, it faces regional differences in water supply and rising water costs (E. Nolde, 2005). These two factors have caused an increasing demand for greywater treatment plants for apartment buildings and in private homes. Many of these plants and greywater technologies are being implemented by companies and researchers seeking to test how their products work in live situations. These technologies are also being implemented by these parties because every greywater system has to be registered with the Health Office and this is a very big hassle for individual residents.

In this 2005 investigation, conducted by E. Nolde, many types of greywater technologies were examined. All of them were small-scale. The largest systems were for hotels and apartment buildings. The smallest were scaled for single family homes and developments. The most successful system, which is the one most present throughout Germany, was the AquaCycle modular system. In this system, like most systems, "the greywater originates from bath tubs, showers, hand-washing basins, and occasionally from washing machines" (E. Nolde, 2005). It was found that "95% of the supplied systems are installed in single and double-family households with a treatment capacity of about 600 L/d" (E. Nolde, 2005). Furthermore, "200 m3 of water could be saved yearly if the system were used to its full capcity" (E. Nolde, 2005). E. Coli concentrations were undetectable in the greywater after filtering through the system. The water was suitable enough to be reused in the toilet bowls and laundry machines within the households.

On-site Greywater Treatment and Reuse in Seven Apartments in Haifa, Israel:

This study examined a greywater treatment pilot plant for seven apartments in Haifa, Israel. The plant combined a biofiltration stage with sand filtration and disinfection stages as well. E. Friedler et. al. state that "domestic in-house water demand in industralised countries consists of 30-60% of the urban water demand… of which 60-70% is transformed into greywater" (E. Friedler et. al., 2005). It was found that the combination of biofiltration, sand filtration, and disinfection stages in the greywater reuse system had a contaminant removal efficiency of 64-98% (E. Friedler et. al., 2005). The greywater in this system was reused for the toilet water for the seven apartments. The study conductors concluded that if this system were more widely spread, the "greywater reuse for toilet flushing can reduce… urban water demand by up to 10-25% (E. Friedleret. al., 2005).

Informal Greywater Treatment in two Squatter Settlements in South Africa:

The squatter settlements located outside of Cape Town, South Africa maintain little to no water infrastructure. Sewage runs adjacent to the streets and many people have to defecate on public grounds. The University of Cape Town conducted an investigation of the role of greywater and greywater disposal in two of the many squatter settlements. The study attempted to establish an informal pilot greywater reuse method and successfully inform the residents how to use this method.

This disposal system consisted of a crate drain (located in the ground), lined with a filter membrane. As the greywater was poured through the particles in the water would filter out. The greywater would then drain underground, where it would be further filtered by reed and other plant roots. The most significant problem with the system was the lack of understanding by many of the residents in the settlements (N.P. Armitage et. al., 2009). Many of them were not informed of the system, which lead to the contamination of the disposed greywater. People used it to dispose of blackwater because they were unaware.

Conclusions Based on these Pilot Studies:

- **In the urban context, modular, residential-based greywater reuse systems seem to be the most successful and adaptable**
- **Systems that combine biofiltration, purification, and disinfection produce higher quality greywater that may be reused in more ways, like for the laundry and toilet water**
- **Public acceptance and understanding of greywater reuse systems is necessary in order for the systems to succeed in urban environments like homes and apartment buildings**

Concluding Remarks:

The Future of Greywater Reuse Policies and Systems in Urban Areas:

Some conclusions and lessons may be drawn from the examined forerunner and pilot case studies. Environmental threats such as drought and water scarcity have forced California, Japan, and Australia to implement greywater reuse policies. The OECD predicts that turning the urban greywater reuse systems will be a major option for more cities as they face "the increasing mismatch between available water resources and rising demand, in both OECD and developing countries" (OECD, 2009). With population increases, and the subsequent increase in demands for water supplies, many countries and urban areas will be forced to implement policies that promote alternative water systems (OECD, 2009). Furthermore, unregulated environmental threats like droughts limit, and will continue to limit, water supplies to many of the world's countries and urban areas. Alternative water systems, specifically greywater reuse systems, should be implemented sooner rather than later in order to avoid major crises. Based on the case studies examined, greywater reuse systems are successfully implemented in urban areas given several factors.

In both the pilot studies and the cases of California, Australia, and Japan, the modular and small scale greywater reuse systems easily adapt to existing municipal water infrastructures. These small scale systems are often used in individual homes and residential developments. Currently in Japan, however, government subsidies are directed towards large-scale commercial greywater systems. Small-scale greywater residential use has already been a popular choice for several decades. This renders government subsidizing unnecessary for greywater in the home.

The small scale system greywater is, on the whole, reused either for irrigating home gardens or for toilet and laundry water. For the indoor uses, the highest quality water is generally produced by systems that combine multiple stages of filtration. These stages include biofiltration, sand filtration, and then a final disinfection stage. If the technology is better and produces higher quality water, the public will be more willing to install greywater systems technologies in their residences.

Many urban areas and countries, like the majority of the OECD, do not promote the implementation of greywater reuse systems. However, with the coming water provision issues, it will be easiest for these cities and countries to adopt small scale greywater reuse systems for alternative water sources. In order for governments to succesfully integrate greywater reuse systems into the urban fabric they should subsidize installation and widely educate the public on the benefits of greywater reuse. As seen in the informal greywater reuse systems implemented in the South African squatter settlements study, without an informed public

the greywater reuse systems were misunderstood and, therefore, unsuccessfully implemented. Many of the residents in the squatter settlements were unaware of how to use the greywater reuse systems. This resulted in many accidental contaminations.

Conversely, in both Australia and California the governments invest much of their funds in informing about greywater reuse systems and educating the public. Once the public understands how greywater reuse benefits them, coupled with government subsidies, greywater reuse systems should be widely implemented as we have seen in Australia and California. So, governments seeking to switch to alternative water systems like greywater reuse systems should provide incentive and awareness to the public in order to see a smooth integration of the systems into the existing infrastructures.

Governments Seeking to Implement Greywater Reuse Systems and Policies in the Future Should:

- Start implementing systems sooner, rather than later, to avoid major threats like significant water scarcity
- Implement policies that promote the adoption of small scale greywater reuse systems in homes and other private residences
- These policies should allow people to easily access, instead of restrict and deter, people from installing greywater reuse systems in their homes
- Diversion systems may be implemented for greywater that is used to irrigate gardens and several-stage filtration systems should be implemented for indoor greywater reuse in toilet bowls and laundry (for higher quality water)
- Provide subsidies to people for systems installation
- Widely educate the public on the benefits of and proper technologies for greywater reuse

What Individuals, like Cornell Students, Should do to Promote Greywater Reuse:

While all of the case studies demonstrate how governments and private parties have initiated greywater reuse policies, we believe that the individual still has a role. The most important role we think that individuals have is spreading an awareness of what exactly greywater reuse is, what its benefits are, and how aplicable it is to everyday urban life. By educating people about greywater reuse systems, more people will be able to understand what they are and exactly how beneficial they are to implement into the household. The greater amount of awareness, greywater reuse systems will gain more supporters, and the more governments will feel pressured to implement greywater reuse policies.

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