Reclaimed Water Use for Edible Crop Production in Florida[1]

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Introduction

Increasing demand for water from Florida's population and multiple land uses is stressing supply. The aim of this document is to educate the general public about water use and options for using reclaimed water. Groundwater comprises 95% of the world's available freshwater resources. Surface water, which includes lakes, rivers, streams, springs, and wetlands, is also a significant source of freshwater. From 1950 to 2005, total fresh and saline water withdrawals for all uses in Florida increased 600%, primarily as a result of increasing population. In 2005, approximately 18,359 million gallons per day (mgd) of saline and freshwater were withdrawn for use in Florida. Of those withdrawals, 4,247 mgd were from groundwater, primarily from the Floridan Aquifer, and 2,626 mgd were from fresh surface water, primarily from the southern Florida hydrologic unit subregion. As shown in Figure 1, the largest water use was for agriculture and the public water supply. Florida saw a small decline in withdrawals between 2000 and 2005 as a result of increased rainfall, water conservation restrictions, reduced agricultural acreage, increased reclaimed water reuse, and implementation of best management practices (Marella 2009).

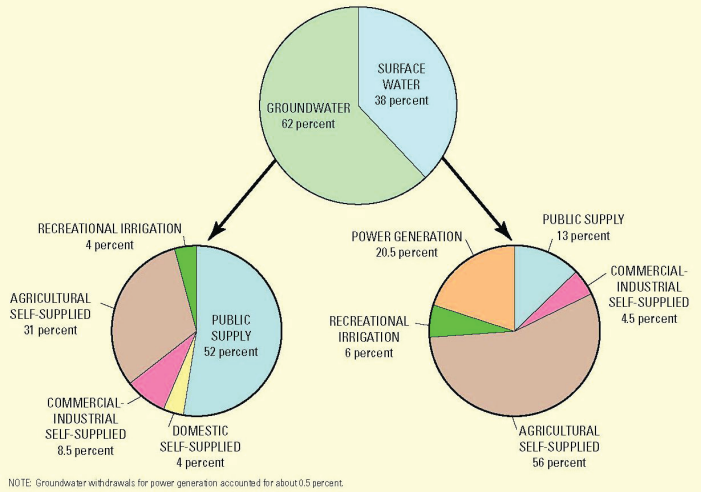

Figure 1. Fresh groundwater and surface water withdrawals in Florida categorized by use in 2005 (Marella 2009).

The use of reclaimed water for agricultural irrigation in Florida dates back as early as the 1960s at Southeast Farms in Tallahassee (SWFWMD 1999). Between 1986 and 2005, reclaimed water use increased from 206 mgd to 660 mgd (Marella 2009). As defined in Rule 62-600.200(67), Florida Administrative Code (F.A.C.), reclaimed water is water that has received at least secondary treatment and is reused after flowing out of a wastewater treatment facility. Rule 62-600.200(68), F.A.C., further defines reuse as the deliberate application of reclaimed water, in compliance with department and district rules, for a beneficial purpose. The beneficial purposes include:

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- Landscape irrigation (such as irrigation of golf courses, cemeteries, highway medians, parks, playgrounds, school yards, retail nurseries, and residential properties);
- Agricultural irrigation (such as irrigation of food, fiber, fodder and seed crops, wholesale nurseries, sod farms, and pastures);
- Aesthetic uses (such as decorative ponds and fountains);
- Groundwater recharge (such as slow-rate, rapid-rate, and absorption field land application systems);
- Industrial uses (such as cooling water, process water, and wash waters);
- Environmental enhancement of surface waters resulting from discharge of reclaimed water having received at least advanced wastewater treatment, or from discharge of reclaimed water for wetlands restoration;
- Fire protection; or
- Other useful purpose

This rule excludes the following from the definition of reuse:

- Overland flow application systems,
- Rapid-rate land application systems providing continuous loading to a single percolation cell,
- Other land application systems involving less than secondary treatment prior to application,
- Septic tanks, and
- Groundwater disposal systems using Class I wells injecting effluent or wastes into Class G-IV waters

Future planning to further increase reuse of reclaimed water, especially for agricultural irrigation, has great potential to alleviate the strain on Florida's water supply.

Rules and Regulations of Reclaimed Water Use for Edible Crop Production

The regulations dictating how reclaimed water can be produced and used are outlined in the Florida Administrative Code Chapters 62-600, 62-601, 62-610, and 62-620, F.A.C. The Florida Department of Environmental Protection (FDEP) is the regulatory agency tasked with monitoring and enforcing these rules.

Rule 62-610.475, F.A.C., requires that crops intended for human consumption be peeled, skinned, cooked, or thermally processed if directly spray irrigated with reclaimed water. Crops that are not processed in this manner are prohibited from coming in direct contact with reclaimed water but can be indirectly irrigated. Examples of approved indirect irrigation methods include ridge and furrow, subsurface, and drip irrigation systems. The permittee of the wastewater treatment facility providing reclaimed water for crop irrigation must maintain an inventory of the agricultural operations supplied and report annually to the FDEP.

Current Reclaimed Water Use in Florida

According to the FDEP's 2010 annual reuse inventory, the total amount of reclaimed water reused for beneficial purposes was 659 mgd, which represents 42% of the domestic wastewater produced in Florida. Only 11% of this reclaimed water was used for agricultural irrigation, while over half of the reclaimed water produced was used for irrigation of other public lands. Nearly 40% of the reclaimed water used for agricultural irrigation was produced in the Northwest Florida Water Management District. Of the 73.2 mgd of reclaimed water used for agricultural irrigation during 2010, only 15.9 mgd of reclaimed water were used to irrigate edible crops. Reports indicate that 77 farms used reclaimed water for the irrigation of 13,110 acres of edible crops in 2010. It is estimated that the reclaimed water used for public access irrigation, fire protections, edible crop irrigation, toilet flushing, and industrial uses replaced approximately 419 mgd of potable-quality water that would have otherwise been used (FDEP 2011).

In 2010, 78% of all crop acreage irrigated with reclaimed water was occupied by citrus groves. Other edible crops irrigated with reclaimed water included strawberries, tomatoes, figs, pecans, peaches, grapes, blueberries, peas, beans, corn, herbs, and other unnamed fruits and vegetables. Microirrigation was the primary irrigation method used (FDEP 2011).

Pros and Cons of Reclaimed Water Use for Crop Production

Substituting ground or surface water with reclaimed water not only benefits the environment but also the users. Reclaimed water provides farmers with a dependable water supply for irrigation during droughts and freezes. It also has the potential to eliminate the need for a consumptive use permit, which is required for irrigation wells, as well as the operation and maintenance costs associated with pumping ground or surface water. In addition, fertilizer costs can be

significantly reduced because nutrients in reclaimed water can be utilized by crops (Morgan et al. 2008). Surface water withdrawals for irrigation come from Class III (recreational and fish and wildlife) and Class IV (agricultural supply) waters of the state, both of which have lesser standards for fecal coliform limits than reclaimed water. As such, these waters may pose a greater public health risk than reclaimed water (York 2011).

One of the largest obstacles to reclaimed water use on edible crops is public perception, mostly resulting from a lack of adequate education (Krauss and Page 1997). Public health concerns include the presence of pathogens and heavy metals, which are typically of little concern following proper treatment of domestic wastewater (Toze 2006). In terms of crop productivity, there are concerns regarding the high salt content of reclaimed water. Overwatering with reclaimed water may result in salt accumulation in the soil, resulting in poor root growth and water uptake by crops (Harivandi 1982). It is important to note that tolerance of reclaimed water use varies by crop type. Although the organic and inorganic nutrient content of reclaimed water can benefit farmers by reducing the need for fertilizers, high nitrogen concentrations may result in excessive microbial growth and activity and be detrimental to crops (Magesan et al. 2000). If overwatering leads to heavy runoff, these nutrients may also pose a water quality risk to surface water bodies.

Reclaimed Water Use for Citrus Production

During 2007–2008, Florida was responsible for 70% of the United States's citrus production (Florida-Agriculture.com 2011). As a result, citrus groves have historically claimed between 600,000 and 950,000 acres in Florida, all of which require some irrigation (Fig. 2) (Marella 2009).

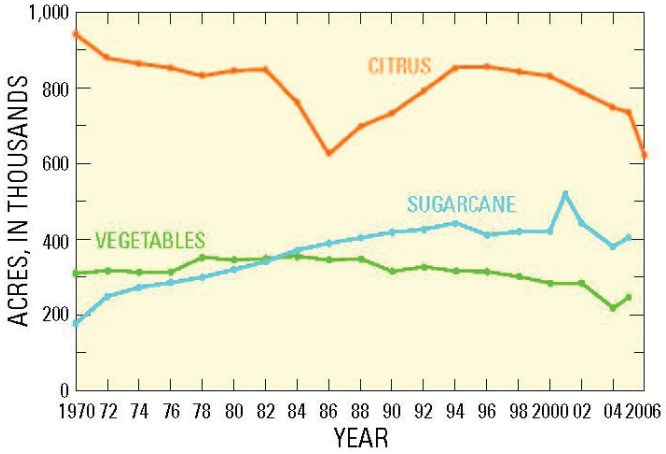

Figure 2. Historical agricultural acreage in Florida for selected crops, 1976–2006 (Marella 2009).

As one of Florida's most valuable industries, citrus has been proven to benefit from irrigation with reclaimed water. Water Conserv II, established in 1987, was the first reuse project permitted by FDEP that allowed reclaimed water irrigation of edible crops. The project irrigates 2,737 acres of citrus groves annually in Orange County, Florida, as well as other crops. Extensive research over the past 24 years has been conducted at the site to determine the effects of irrigating citrus with reclaimed water, but no negative impacts on citrus have been observed (Morgan et al. 2008). In fact, reclaimed water has benefited citrus growth by improving rates of young tree growth. Reclaimed water use also improved fruit quality and abundance. The presence of calcium, boron, and phosphorus in reclaimed water allows farmers to reduce their rate of fertilizer application. The soil pH range resulting from reclaimed water has also been determined to be ideal for citrus production (Morgan et al. 2008).

In the Water Conserv II studies, weed growth within the citrus groves irrigated with reclaimed water was higher than the groves irrigated with well water, requiring some farmers to increase herbicide applications (Morgan et al. 2008).

Summary

While there is much research still to be done on the long-term effects of irrigating edible crops with reclaimed water, it remains a promising, cost-effective solution to Florida's overuse of freshwater resources. When properly treated for the removal of pathogens and monitored for nutrients and heavy metals, reclaimed water can even result in increased crop productivity. Future planning and feasibility analyses to expand reuse projects to rural areas will prove invaluable to the agricultural industry. Farmer and public education is a critical component to the success of reuse projects and must be incorporated into the future planning process.

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