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COFSAC 15-01

# Advancing Food Systems Issues in Colorado



COLORADO FOOD SYSTEMS  
ADVISORY COUNCIL

## Preparing for Food Security in an Age of Limited Natural Resources Part I: Water

*In order to grow the state's economy and support access to healthy foods for all Coloradans, the Colorado Food Systems Advisory Council (COFSAC) recommends that the State of Colorado assess and pursue opportunities to more efficiently use our natural resources to increase opportunities for food production. The COFSAC sees opportunities to foster stronger environmental stewardship while creating new opportunities for our food producers to grow more healthy Colorado products to reach more Colorado consumers at prices sustainable for both consumer and producer.*

*This issue brief is one of three that explores aspects of our natural resources – water, land, and energy – and the steps necessary to balance Colorado's need for increased agricultural production to feed its growing population and the sustainable use of its natural resources to support production.*

### Issues Facing Agriculture Today

*Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation* reported that recent hydrologic projections suggest declining runoff for most of Colorado's river basins in the 21st century<sup>4</sup>. For the Upper Colorado River Basin, comparing the 20<sup>th</sup> century's runoff, projections suggest a decrease from somewhere between 6% to 20% by 2050. The report also highlights that water demands for agriculture will be affected due to increasing temperatures that raise evapotranspiration by plants, lower soil moisture, alter growing seasons, and thus increase water demand.

The *Colorado River Basin Water Supply and Demand Study* also confirmed what most experts know: there are likely to be significant shortfalls between projected water supplies and demands in the Colorado River Basin in the coming decades<sup>5</sup>. Addressing such imbalances will require diligent planning and collaboration, including a focus on water use efficiency and reuse. The study proposed a process of three multi-stakeholder workgroups – one specifically to investigate potential for water reuse for Colorado industries, including agriculture.

**Colorado, along with the rest of the world, must adapt to feed more people with limited natural resources:**

Colorado's population was 5,355,866 in July 2014, a 6.5% increase since 2010<sup>1</sup>.

The 2014 Census data ranks Colorado as the nation's 4th-fastest growing state. Our state's projected population according to the State Demography Office is 6 million in 2020 and 8 million in 2040<sup>2</sup>.

*The challenges associated with protecting U.S. water security are among the most pressing issues of our present and future generations.* - National Water Working Group Report & Recommendations, August 2014<sup>3</sup>.

<sup>1</sup>United States Census Bureau (2014). *QuickFacts Beta*. Retrieved from <http://www.census.gov/quickfacts/table/PST045214/00.08>

<sup>2</sup>Colorado State Demography Office, Department of Local Affairs. Preliminary Population Forecasts by Region, 2000-2040. Retrieved from: <http://dola.colorado.gov/demog-cms/content/census-data>

<sup>3</sup>Association of Public & Land Grant Universities (2014). National Initiative on the Improvement of U.S. Water Security: Recommendations of the Water Working Group representing the nation's Land Grant Institutions. Retrieved from [http://www.aplu.org/members/commissions/food-environment-and-renewable-resources/CFERR\\_Library/national-initiative-on-the-improvement-of-us-water-security/File](http://www.aplu.org/members/commissions/food-environment-and-renewable-resources/CFERR_Library/national-initiative-on-the-improvement-of-us-water-security/File)

<sup>4</sup>Ray, A., Barsugli, J., Averyt, K., Wolter, K., Oerling, M., Doesken, N., Udall, B., Webb, R. (2008). *Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation*. Retrieved from <http://cwcb.state.co.us/public-information/publications/Documents/>



Examples of the many challenges that will require innovation include agricultural systems that are and will be threatened by drought, fire, and flood, and concerns over water reallocation (to growing metropolitan areas) and its impact on agricultural production and natural resources<sup>6</sup>. These challenges are found all over the country, but are exacerbated in the drought-prone, agriculturally robust, and rapidly growing Western United States. As recently as 2013, for example, Denver Water imposed mandatory outdoor watering restrictions due to drought conditions.

According to the Colorado Water Conservation Board, currently, agriculture accounts for 89% of water that is consumed in Colorado through any means – agricultural, municipal, or industrial<sup>7</sup>. Yet, both large-scale commercial and smaller, urban, or specialty crop farmers cite long-term access to water as a significant limiting factor to their operations<sup>8</sup>. With heightened demands placed on water with an increasing population, agriculture must become more efficient and innovative in its water use.

Among the primary water supply and demand challenges Colorado faces, the Colorado Water Conservation Board also identified agricultural dry-up: “Irrigated agriculture is being lost by the purchase and permanent transfer of agricultural water rights. At the current rate of transfer, there will be a major reduction in Colorado’s agricultural lands in the future. This could impact Colorado’s economy and food security. In addition, rural communities could dry-up along with agriculture if enough agricultural business goes away”<sup>9</sup>.

## Use of Reclaimed Water for Food Crops

*Much of this content for this section was adapted from the “White Paper on Reclaimed Water for Denver Water”, authored by Denver Water’s reclaimed water consultant Bahman Sheikh in January 2015. A final draft of that paper is expected to be published by the end of 2015.*

### Reclaimed Water: An Overview

Reclaimed water refers to domestic wastewater that has received secondary treatment by a domestic wastewater treatment works and such additional treatment as to enable the wastewater to meet the standards for approved uses. In Colorado, reclaimed water (also called recycled or reuse water by some) is currently used for landscape irrigation, non-food crop irrigation, silviculture, fire protection and commercial and industrial uses. In Colorado, use of reclaimed water is controlled by Regulation 84<sup>10</sup>, which was developed by the Colorado Department of Public Health and Environment Water Quality Control Commission, with input from stakeholders.



<sup>5</sup>United States Department of the Interior Bureau of Reclamation Lower Colorado Region (2013). *Colorado River Basin Water Supply and Demand Study*. Retrieved from <http://www.usbr.gov/lc/region/programs/crbstudy.html>

<sup>6</sup>Association of Public & Land Grant Universities (2014). National Initiative on the Improvement of U.S. Water Security: Recommendations of the Water Working Group representing the nation’s Land Grant Institutions. Retrieved from [http://www.aplu.org/members/commissions/food-environment-and-renewable-resources/CFERR\\_Library/national-initiative-on-the-improvement-of-us-water-security/File](http://www.aplu.org/members/commissions/food-environment-and-renewable-resources/CFERR_Library/national-initiative-on-the-improvement-of-us-water-security/File)

<sup>7</sup>Colorado Water Conservation Board (2014). *Colorado’s Draft Water Plan*. Retrieved from <http://coloradowaterplan.com/>

<sup>8</sup>Northern Colorado Regional Food System Assessment (2015). Retrieved from <http://www.larimer.org/foodassessment/>  
Graff, G., Mortenson, R., Goldback, R., Thilmany, D., Davies, S., Koontz, S., Ponce-Pore, G., Rennels, K. (2013). *The Values Chain of Colorado Agriculture*. Retrieved from [http://outreach.colostate.edu/docs/Value\\_Chain\\_of\\_Colorado\\_Agriculture\\_2013\\_EXECUTIVE\\_SUMMARY.pdf](http://outreach.colostate.edu/docs/Value_Chain_of_Colorado_Agriculture_2013_EXECUTIVE_SUMMARY.pdf)

<sup>9</sup>Colorado Water Conservation Board (2014). *Colorado’s Draft Water Plan*. Retrieved from <http://coloradowaterplan.com/>

<sup>10</sup>Colorado Department of Public Health and Environment Water Quality Control Commission (2013). *Regulation No. 84: Reclaimed Water Control Regulation*. Retrieved from <https://www.colorado.gov/pacific/sites/default/files/Regulation-84.pdf>



To protect public health and the environment, the current Regulation specifies various approved uses, treatment and water quality requirements for specific reuse categories, as well as conditions for use, monitoring, record-keeping, and reporting requirements<sup>11</sup>.

Currently, State Regulation 84 does not allow reclaimed water to be used for farms, urban gardens or greenhouses. Regulation 84 specifically prohibits irrigation of any type of food crops (including nuts and fruits intended for human consumption) with reclaimed water.

Produce that will be handled and consumed by the public needs to be irrigated with water that meets high standards that protect public health from pathogens and other harmful contaminants and provides the consumer with confidence in the safety of the products. Fortunately, current water and wastewater treatment technologies can meet virtually any water quality goals, regardless of the source of water. However, with higher treatment levels comes increased costs; therefore, the Draft Colorado Water Plan (p. 310) notes that it is important to set treatment requirements that are not overly burdensome and that allow, “the type of reclaimed water use [to] trigger the treatment and best management practices required before and during use.”

In order for farmers, greenhouse growers, and community gardens to be able to irrigate with reclaimed water, modification of Regulation 84 would be required to include treatment levels, water quality criteria and distribution system management standards sufficient to ensure that human exposure to reclaimed water and ingestion of food grown with reclaimed water is reliably safe. Several states currently allow food crop irrigation with recycled water, but differences exist in required treatment, water quality standards and distribution system management, complicating direct comparisons between approaches.



Allowing reclaimed water to be an approved agricultural irrigation source for food crops affords the opportunity to maximize the use of a limited resource without creating new water rights or taking from existing water rights. This is a significant potential benefit for Coloradans who may be affected by the economic and lifestyle implications of future water scarcity. This is particularly relevant in the case of reclaimed water because reuse is a right that is predetermined by the type of water right that the holder owns; adding an approved use to Regulation 84 works within an existing framework and does not expand or minimize current water rights.

## Considerations for Using Reclaimed Water

Many studies<sup>12</sup> have found that with proper treatment there are no significant negative health or environmental effects when using reclaimed water in comparison to its potable counterpart. With any changes, however, there are always trade-offs that must be carefully examined. According to the Colorado Water Conservation Board, the South Platte River Basin (in which Denver lies) is leading the state in municipal and industrial efficiency – which could also mean less water available for agriculture because municipal and industrial return flows will be diminished<sup>13</sup>. Additional considerations include how new treatment requirements for reclaimed water used to irrigate edible crops might affect cost for the water treatment facilities.

<sup>11</sup>Colorado Water Conservation Board (2014). *Colorado's Draft Water Plan*. Retrieved from <http://coloradowaterplan.com/>

<sup>12</sup>Asano, T., Audrey D. Levine, 1995 “Wastewater reclamation, recycling and reuse: past, present, and future”, *Water Science and Technology*, Volume 33, Issues 10–11, 1996, Pages 1–14; Sheikh, B., 1998. Chapter 17, Tertiary Reclaimed Water for Irrigation of Raw-Eaten Vegetables, in “Reuse of Wastewater” edited by Prof. Takashi Asano, pp. 779-825; Sheikh, B., R.C. Cooper, K. E. Israel, 1999, “Hygienic Evaluation of Reclaimed Water Used To Irrigate Food Crops—A Case Study”, *Conference Proceedings*” *Wat. Sci. Tech.* Vol.40, No. 4-5, pp 261-267.; Crites, R., 2006, “Water Reuse and Groundwater Protection in Central Oahu” in *Water Environment & Technology* 46.; Parsons, L. R., Bahman Sheikh, Robert Holden, David York, 2010 “Reclaimed Water as an Alternative Water Source for Crop Irrigation”, *HortScience* vol. 45 no. 11 1626-1629

<sup>13</sup>Colorado Water Conservation Board (2014). *Colorado's Draft Water Plan*. Retrieved from <http://coloradowaterplan.com/>





Additionally, most current studies assessing the long-term application of reclaimed water have come from California, and our climate, soils, and rainfall are considerably different here in Colorado. Of particular concern is the accumulation of chloride (Cl) when using reclaimed water on Cl-sensitive crops over many years. Some studies have concluded that mitigation in the form of increasing the leaching fraction and improving drainage may be needed to grow Cl-sensitive crops with reclaimed water<sup>14</sup>. Other studies have found that leaching by rainfall over 20 annual inches (far above Denver’s annual rate and much of agricultural Colorado) can be enough to control the accumulation of Cl in some crops<sup>15</sup>.

Mitigating accumulated Cl may need to be proactively managed with long-term use of reclaimed water, at least in some parts of the state. Denver Water has, however, developed “Recycled Water Characteristics” in the context of established irrigation guidelines and has shown that salinity and Cl levels in Denver Water’s reclaimed water is consistently in the safe zone and lower than the corresponding levels in raw waters used for irrigation<sup>16</sup>. Therefore, existing growers’ management practices perhaps do not need to be modified as a result of shifting to use of reclaimed water in the greater Denver area.

## Opportunities for Colorado

Denver Urban Gardens and Denver Water, with multiple other state and regional partners, are working to amend Regulation 84. Additionally, this amendment could be specifically advocated for in the Colorado Water Plan, a multi-stakeholder plan that is being updated, with broad public engagement and comment, in 2015 by the Colorado Water Conservation Board. The Plan will set forth a vision and strategy for ensuring productive economies and sustainable natural resources in Colorado.

The infrastructure in place exists predominantly in the City and County of Denver. Thus, some of the initial sites may be most appropriately targeted at Denver-sited gardens, farms and greenhouses. However, as water treatment providers update their infrastructure, there is potential for food producers all across the state to have access to Category 3 reclaimed water. For example, Meridian Service Metropolitan District is approved for Category 3 water for construction and soil compaction, but currently only Category 2 for irrigation.

In most cases across the country, there is a cost savings for food producers who are able to use reclaimed water since the water treatment provider typically subsidizes such water given its potentially more ample supplies. For example, prices for reclaimed water charged by Denver Water are about 20% less than prices for potable water. The purveyor of reclaimed water (Denver Water or other agency) wants to encourage use of reclaimed water to relieve demand on potable water, thus subsidizing its real costs with a sizable discount. According to Bahman Sheikh, Denver Water’s reclaimed water consultant, “Subsidizing the cost of reclaimed water is relatively universal and well-established. Subsidizing reclaimed water is justified by the benefits from use of reclaimed water to society as a whole: environmental benefits, receiving water discharge elimination or reduction, source water relief, energy savings, or drought-protection.”

Currently, although there are approximately 25 water providers authorized to treat reclaimed water in Colorado, Denver Water is the only active provider of Category 3 reclaimed water and the only entity currently equipped to treat water to that level of disinfection.

At least four other water providers (also located in the Metro Denver and Colorado Springs area) have been identified across the state that could use their infrastructure for treating reclaimed water to the level of Category 3.



<sup>14</sup>Platts, B.E., Mark E. Grismer, 2014a, “Chloride levels increase after 13 years of recycled water use in the Salinas Valley.” *California Agriculture* 68(3):68-74. DOI: 10.3733/ca.v068n03p68.

<sup>15</sup>Platts, B.E., Mark E. Grimer, 2014b, “Rainfall leaching is critical for long-term use of recycled water in the Salinas Valley.” *California Agriculture* 68(3):75-81. DOI: 10.3733/ca.v068n03p75.

<sup>16</sup>Personal communication with Mr. Damian Higham, Denver Water.



In addition to cost savings, consistent access to water supply may be enhanced through the use of reclaimed water, as Denver Water currently does not impose drought restrictions on reclaimed water even when restrictions would be in place on other supplies.

## Advancing COFSAC's Charge

Decreasing amounts of water available for agriculture limits our state's ability to grow a bounty of healthy foods easily accessible for our residents. Central to the charge of the COFSAC is to improve healthy food access for all Coloradans - especially for those who currently lack sufficient access. The fact is, not only do many Coloradans lack such access—but many currently struggle with accessing and affording enough food to simply feed themselves consistent, healthy meals.

Using reclaimed water for food crops has the potential to strengthen healthy food access for all Coloradans and support Colorado's growers by ensuring stable water availability for both rural and urban growers, removing barriers such as access to or prohibitively high costs for water, and potentially allowing for more affordable healthy foods for Coloradans.

If farmers and urban gardeners are allowed to use reclaimed water (that is included in a revised Category 3 standard or perhaps a new to-be-defined category) to irrigate food crops, this will help manage the upward pressure on the price of water and increase healthy food production, especially in urban areas where reclaimed water is already available and being used on public properties - including schools and parks. For a current map of Denver Urban Gardens, potential gardens, and current and potential pipes for reclaimed water, see Figure 1. This map demonstrates the reach of reclaimed water for gardens in Denver alone.

Such public sites offer ample opportunity for food production in the form of farms and gardens that could take advantage of already-available reclaimed water. However, the use of reclaimed water in community gardens and school farms will necessitate public education on the need to monitor the soils and mitigate accumulated salts. In drought prone years, the mitigation could be more challenging. Reclaimed water can help provide stable water access as well as increased water availability to Colorado's gardeners and farmers. The result is that by increasing grower access to water via reclaimed water, both rural and urban farmers can benefit from a reduction in production costs. Ultimately, this could help increase the availability of healthy foods for Coloradans at affordable prices.



## How It Can Work: Examples From the Field

The economic viability of irrigation of food crops with reclaimed water has been demonstrated over several decades in states including Florida, Arizona, Texas, and California. Major citrus growing areas in Orange County, Florida, have been in successful production since 1987 in a program called Water Conserv II. In Monterey County, California, over the past 16 years, many of the growers have had such positive experiences from using reclaimed water they have switched significant shares of their acreage from low-revenue crops to higher-margin enterprises such as strawberries and raspberries. In their forthcoming White Paper, Denver Water also found that additional benefits of using reclaimed water for crop production can include reducing agricultural susceptibility to droughts and potentially reducing the need for fertilizer application if some of the nitrogen needed for crops is maintained in the reclaimed water. Farmers using recycled water in Monterey County, California have learned that they can reduce applications of chemical fertilizers by one-third to one-half because of ready availability of nitrogen in recycled water<sup>18</sup>.

<sup>17</sup>Coleman-Jensen, A., Gregory, C., Singh, A. (2014). *Household Food Security in the United States in 2013*. Retrieved from <http://www.ers.usda.gov/publications/err-economic-research-report/err173.aspx>



## Recommendations

Colorado has many opportunities to conserve natural resources while supporting its agricultural economy and the production and sale of more, healthy Colorado products into underserved markets. Across all recommendations, efforts should be encouraged to identify and manage food safety implications, reclaim resources for production that are underemployed (rather than competing for resources that are already fully utilized in other sectors), research yield and cost implications for farmers and ranchers, and, facilitate the policy changes that may be necessary to lower the barriers to adoption of new models. Opportunities for the state to explore further include:

### Research & Assessment:

- Conduct an evaluation of appropriate requirements, prohibitions, standards and concentration limits related to the treatment and/or use of reclaimed water for edible crop irrigation to ensure protection of public health. The evaluation should also include an assessment of public health risk using epidemiological studies, or alternatively, the regulatory framework of a state with a successful track record of irrigation of edible food crops with reclaimed water could be adopted.

### State Partnerships:

- Support efforts to integrate strategies related to water reuse in the Colorado Water Plan. “Food Crops” could be called out in Section 6.3 as a specific “low and no regret action” for the application of reclaimed water.

### Regulatory Amendments:

- Consider amending State Regulation 84, based on the following recommendations from Denver Water:
  - ◊ Remove the prohibition against food crop irrigation with reclaimed water from Regulation 84;
  - ◊ Insert language in Regulation 84 specifically permitting irrigation of food crops with reclaimed water meeting certain criteria;
  - ◊ Develop a regulatory framework to enable farmers, greenhouses and community gardens to use reclaimed water.
- Encourage input from multiple stakeholders regarding the inclusion of detailed water treatment specifications and/or finished (treated) water quality specifications, which must be approved by the Water Quality Control Commission.

### Education & Awareness Building:

- Support and raise awareness around Denver Urban Gardens’ and Denver Water’s efforts to develop educational materials about growing and cultivating community gardens with reclaimed water.
- Work with state and academic partners to assess opinions and perceptions about growing with reclaimed water, and test perceptions for change as growing with reclaimed water increases.

### Leveraging Resources:

- Work with state and local partners to take advantage of unprecedented investment in sustaining our natural resources while feeding a growing population:
  - ◊ The 2014 Farm Bill created the Regional Conservation Partnership Program (RCPP) of the Natural Resources Conservation Service (NRCS), a program that will fund up to \$235 million for water quality, drought-related, and agricultural viability projects.
  - ◊ As of 2015, USDA was funding 37 water and wastewater projects and 25 renewable energy projects totaling more than \$112 million in loans and grants for rural communities through the [Water and Environmental Program](#) (WEP) and the [Rural Energy for America Program](#).

<sup>18</sup>Monterey Regional Water Pollution Control Agency. Draft Environmental Impact Report (2015): Shifts in Crop Acreage and Corresponding Value from Artichokes to Strawberries in CSIP Service Area [area continually under recycled water irrigation during the interval 1998 -2015.



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*The COFSAC charge is to advance recommendations that strengthen healthy food access for all Coloradans through Colorado agriculture and local food systems and economies.*

*For more information see [www.cofoodsystemcouncil.org](http://www.cofoodsystemcouncil.org).*

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