Opportunities and Threats to Widespread Adoption of Bacterial Standards for Agricultural Water**

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Summary

Within the proposed Food Safety Modernization Act Produce Safety Rule are new standards for the maximum allowable concentration of the indicator bacteria, *Escherichia coli*, in agricultural water used on covered crops. This will be first time that microbiological standards will be imposed on millions of acre feet of water for many growers across the United States. Numerous opportunities and challenges will occur as the Food and Drug Administration (FDA) and grower community endeavor to implement these regulations, requiring new science and new policy to facilitate the process. A key concern will be the lack of alternative water supplies for many regions of the U.S. and a lack of proven, affordable treatment technology for the large volumes of raw agricultural water. Without access to loans or cost-share mechanisms, low resource and smaller farming operations may find it difficult to comply. Moreover, growers may find it difficult to implement conservation programs under these new standards, such as reuse of irrigation water, which can concentrate microbiological contaminants. Nine policy action items are proposed to facilitate implementation of these new FDA standards, including federal and industry funding to jump start development of new treatment technologies, requiring irrigation districts to also comply with these new standards, conducting scientific research into more efficient sampling methods, and reaching regulatory consensus between FDA's efforts to improve water quality and the Environmental Protection Agency (EPA) and U.S. Fish and Wildlife Service (USFWS) conservation plans.

Current realities

During the past decade there has been a growing list of produce commodities associated with multi-state outbreaks of foodborne illness, ranging from leafy greens and cantaloupe to berries and almonds. As a consequence, the microbiological safety of produce has become a key focus of FDA's Food Safety Modernization Act (FSMA), expressed in part as the proposed Produce Safety Rule. Within this rule are proposed new standards for agricultural water that are based on U.S. EPA microbiological standards for recreation water, most notably the reliance on standards for the concentration of the indicator bacteria, *Escherichia coli*, that signal when agricultural water is of sufficient quality for its intended use.

The proposed rule defines agricultural water as "water used in covered activities on covered produce where it is intended to, or is likely to, contact covered produce or food-contact surfaces, including: water used in growing (including irrigation water directly applied, water used for preparing crop sprays, and water used for growing sprouts) and in harvesting, packing, and holding (including water used for washing or cooling harvested produce and water used to prevent dehydration)." This comprehensive definition indicates that across the United States the microbiological quality of millions of acre feet of agricultural water will be closely regulated. For example, according to the Farm/Ranch Irrigation Survey (U.S. Agricultural Census), in 2008 there were 54.9 million acres of irrigated land in the U.S., with 91.2 million acre feet of water applied to crops per year. In 2005, about 58% of the total volume of irrigation water used in the U.S. was from surface water sources according to the U.S. Geological Survey. Surface water derived from agricultural watersheds is notoriously vulnerable to microbiological contamination due to a variety of biotic, abiotic, and anthropogenic processes. Hence, adoption of these standards for agricultural water will undoubtedly result in considerable financial and operational difficulties for thousands of growers across the U.S., particularly for low-resource farmers and in regions of poor water quality.

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Scientific opportunities and challenges

There are numerous scientific and policy opportunities and operational challenges to the implementation of the proposed microbiological standards for agricultural water. A key challenge is the reliance on using the standard of 126 *E. coli* bacteria per 100 ml of water. This threshold for the maximum allowable concentration of bacteria for compliance will be exceeded for many sources of surface irrigation water across the U.S., particularly when water is impounded or reused under water conservation plans. Sources of water at risk for noncompliance would be irrigation ponds in the Southeast, sediment and tail-water basins in the arid West, and low gradient streams in mixed use (animal and plant) agricultural valleys of the Midwest. Climate such as summer thunderstorms that generate surface runoff typically result in spikes in bacterial indicators in local rivers and lakes, resulting in acute failures of compliance. If a farmer fails to comply with the bacterial standards, then he or she will be required to cease using the source of irrigation water and either treat and test for compliance, or switch water sources. One can imagine scenarios such as the source of irrigation water being a large river, such as the Yakima River in eastern Washington used to irrigate apples, or the All American Canal in the Southwest U.S. Federal and state natural resource agencies such as EPA and the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) may be reticent to permit chemical disinfection of surface water from such sources as rivers, streams, lakes, and ponds. For example, for growers that depend on the Colorado River for irrigation, treating such a large body of water is unfeasible. In these cases, the farmer will need to install treatment technology at the off-take or point-of-use, or reduce the upstream source(s) of bacterial contamination. Reducing these upstream sources can be technically challenging, requiring months to achieve compliance, not to mention issues of private property rights and the need for excellent watershed-scale landowner cooperation. If treatment or prevention options are limited either due to cost of technology, excessively large volumes (e.g., Mississippi River), lack of landowner cooperation, or local restrictions on chemical intervention (e.g., fisheries), then switching sources of irrigation water may be feasible in some circumstances. If the farmer has only a single well, canal, or other source of agricultural water, then acute failures of compliance with bacterial standards can lead to acute loss of access to water, a potential problem in the arid areas, low-resource, or small-farm regions of the U.S.

The other key scientific opportunity is the dearth of data demonstrating how the proposed bacterial standards for agricultural water promote the microbiological safety of produce for all agricultural systems and growing conditions across the U.S. These standards will likely indicate when substantial deterioration of agricultural water quality has occurred, but widespread scientific evidence exists that these bacterial standards can result in a false sense of security. There are many examples of drinking or recreational water meeting bacterial standards, yet outbreaks of waterborne enteric disease occurring or enteric pathogens being present. The scientific and regulatory communities are encouraged to fast track research and innovation in the area of effective waterborne indicators for produce microbial safety and to generate credible datasets that prove which water monitoring strategies and pathogen detection technologies are cost-effective and closely aligned with promoting produce safety.

Policy issues

- Farmers will need technical assistance to comply with the bacterial standards for agricultural water. To facilitate adoption of the FSMA Produce Safety Rule, it is recommended that FDA, USDA, and the World Health Organization (WHO) conduct a thorough and unbiased international review regarding proven technologies that can affordably reduce foodborne pathogens and bacterial indicators in high volumes of raw agricultural water, to be completed by June 30, 2014. The technical report will be distributed to commodity organizations, agricultural agencies, state and country farm bureaus, and cooperative extension services, and provided to countries that export produce commodities covered by the Produce Safety Rule to the U.S.

- Based on critical technology gaps identified from the technical review, the scientific community (academic, government, private) must immediately expand work on developing chemical, thermal, physical, and other processes that can affordably reduce foodborne pathogens and bacterial indicators in high volumes of raw agricultural water. Funding would be provided by state and federal agencies for basic science, and produce commodity market orders for proof-of-concept projects as needed.

- Depending on location, irrigation districts control much of the irrigation water available to growers. FDA is to implement policy by June 30, 2014 that requires irrigation districts to comply with the microbiological standards for the product they sell to growers (i.e., irrigation water) when alternative water supplies are not available.

- Effective immediately, USDA should shift resources to the NRCS and Cooperative Extension Service to implement on-farm practices and conduct grower workshops for implementing water quality compliance programs and how to remediate water quality problems, with similar programs to be implemented by allied grower associations.

- Uncertainty exists regarding the efficacy of indicator *E. coli* to accurately signal the microbiological safety of agricultural water. To improve the accuracy of water monitoring, testing should be performed for pathogens when a regional water source has a history of detections for a specific pathogen. For example, *Salmonella enterica* is a consistent adulterant of tomatoes from southeastern U.S., hence farmers should monitor for *Salmonella* in conjunction with indicator *E. coli* in these agricultural systems. In the event a pathogen is detected in agricultural water for covered produce, FDA and state agencies need to develop policy regarding the disposition of the exposed crop (e.g., test and hold, or destroy the product).

- The costs of implementing microbiological standards for agricultural water are due in part to the frequency of sampling. Alternative strategies are needed to improve monitoring efficiency, such as the scientific community and FDA assessing alternative sampling strategies that focus more on critical periods (e.g., last two irrigations prior to harvest) and increase the volume of water per assay (1000 ml) to better represent the microbiological quality of water. Highly secure water supplies (e.g., deep wells) and installment of FDA-approved treatment technologies would qualify the grower for reduced sampling frequency. This should be completed by June 30, 2015.

- In regions of shared water resources (e.g., western U.S. federally funded irrigation projects), the agricultural community can implement cooperative sampling for networks of growers served in common by these systems. Cooperative data will therefore represent the source of water for all participating growers.

- There will be inevitable conflicts between grower efforts to comply with the microbiological standards and water or wildlife conservation plans advocated by agencies such as the NRCS. NRCS, FDA, EPA, USFWS, and vested state agencies must identify key areas of potential conflict and work to develop regulatory agreement on how growers can achieve water quality compliance when competing conservation regulations are in place, ideally by June 30, 2015.

- Environmental pressure to reduce agricultural use of surface water in regions with critical fisheries habitat (e.g., Klamath River in western U.S.) will pressure growers to move to more efficient irrigation systems (drip) and water reuse infrastructure (tail-water ponds). Tail-water ponds are unlikely to comply with the proposed FDA microbiological standards, but USDA, EPA, and USFWS could subsidize the cost or provide low-interest loans to growers in critical aquatic habitat to shift from water-intensive to water-conserving irrigation systems.

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