The Food-Water Nexus: Irrigation Water Quality, Risks to Food Safety, and the Need for a Systems-Based Preventive Approach

Two nationwide disease outbreaks linked to fresh produce in the U.S. illustrate the concept of a watershed scale systems-based environmental assessment for investigation of potential effects of irrigation water quality on food safety.

In the first, fresh bagged spinach from a single farm in California was implicated as the source of a 2006 E. coli O157:H7 outbreak that caused over 200 illnesses and five deaths. The environmental investigation to determine how the spinach became contaminated included a watershed scale assessment of the farm’s surroundings to identify factors related to irrigation water that may have contributed to that contamination. Based on the available information, groundwater used as irrigation water and its potential contamination by surface water recharge were identified as the most likely water-related contributing factors involved in this outbreak.

Because of the seasonal climate in this region of California, winter rains are stored in reservoirs and then released during the dry summer season to recharge aquifers used for irrigation. Analysis of water samples from a river flowing through the farm found a bacterial strain matching the outbreak strain found in patients as well as the bagged spinach. Analysis of the hydrogeologic conditions at the farm indicated that pathogens in surface water could potentially have reached wells on the farm and contaminated irrigation water. Those conditions included a groundwater table that dropped below the level of the river during the growing season, allowing surface water to recharge groundwater on the farm. High rates of irrigation well pumping and layers of coarse-grained soils would also have contributed to creating the conditions under which contamination from the river could have
It ne ion. Backflow prevention bing control of the wastewater blending process, ing for a different E. coli O157:H7 outbreak in 2006. Samples from an initial environmental investigation revealed a genetic match between the outbreak strain and environmental samples from a single farm in a different region of California, leading to an in-depth systems-based analysis of the irrigation water systems on that farm. Three sources of irrigation water were used on the farm: groundwater pumped from on-site wells, surface water delivered through canals by a local water management agency, and effluent from wastewater lagoons on nearby dairy farms. The wastewater effluent was blended with water from the other sources and used only to irrigate animal feed crops. Water management on the farm, including control of the wastewater blending process, however, appeared to create the potential for cross contamination. Backflow prevention between piping networks used to convey blended wastewater and water from the other two sources was insufficient. In addition, the hydraulics in the combined piping networks were such that either high or low pressure situations could create the potential for cross contamination (California Food Emergency Response Team, 2008). The irrigation network on the farm had evolved over time to attempt to meet various needs, without an overall analysis of how that evolution created possibilities for contamination of irrigation water.

One implication of the results of these assessments is that the scope of produce-related outbreak investigations and potential prevention measures need to be conceptually broadened to include factors beyond those actually found on the farms identified as sources of produce involved in outbreaks. A systems-based, watershed scale analysis is necessary for comprehensive identification of factors potentially contributing to irrigation water contamination. A dimension of time also needs to be added; such environmental variables as water quality are dynamic, with seasonal or other variations influencing the quality of irrigation water. Irrigation systems themselves also evolve over time to meet varying needs, and those incremental changes may lead to unintended vulnerabilities. A preventive approach such as that contained within the Water Safety Plan process for drinking water may also be useful in managing irrigation water quality (Davidson et al., 2005). Such an approach would include a systematic identification of risks to irrigation water quality, both within an irrigation system as well as in the broader watershed environment, and could help to identify and prevent contamination of produce from irrigation water.

Corresponding Author: Mansoor A. Baloch, ORISE Fellow, Environmental Health Services Branch, Division of Emergency and Environmental Health Services, National Center for Environmental Health, CDC, 4770 Buford Highway, N.E., M.S. F-60, Atlanta, GA 30341. E-mail: mbaloch@cdc.gov.

References

Why? Because the National Environmental Health Association (NEHA) is the only association of the environmental and health professions will you find representatives from all areas of environmental health and protection, including all-hazards preparedness, food protection, waste, onsite wastewater, air and drinking water, and drinking water quality in both public and private sectors.

EHA MEMBER YOU RECEIVE

Why? Because the National Environmental Health Association (NEHA) is the only association of the environmental and health professions will you find representatives from all areas of environmental health and protection, including all-hazards preparedness, food protection, waste, onsite wastewater, air and drinking water, and drinking water quality in both public and private sectors.

EHA MEMBER YOU RECEIVE

of Environmental Health. A subscription is included with your membership.

Substantial Savings with Member Pricing on

- NEHA’s Annual Educational Conference (AEC) registration and exam fees from NEHA’s Online Bookstore
- Tutorials for Important Profession Programs
- Workshops at little or no cost
- Sabbatical Exchange Program
- Discounts on insurance
- Liability insurance
- Workshops at little or no cost
- Sabbatical Exchange Program
- Liability insurance

Become a Member!

October 2012 • Journal of Environmental Health 41

Reprinted with permission from NEHA