Agric Hum Values (2008) 25:177–181
DOI 10.1007/s10460-008-9130-4

The illusion of control: industrialized agriculture, nature, and food safety

Diana Stuart

Accepted: 10 December 2007 / Published online: 22 January 2008

Abstract I explore the role of nature in the agrifood system and how attempts to fit food production into a large-scale manufacturing model has lead to widespread outbreaks of food borne illness. I illustrate how industrial processing of leafy greens is related to the outbreak of *E. coli* 0157:H7 associated with spinach in the fall of 2006. I also use this example to show how industry attempts to create the illusion of control while failing to address weaknesses in current processing systems. The leafy greens industry has focused efforts on sterilizing the growing environment and adopting new technologies, while neglecting to change the concentrated structure of processing systems. Repeated breakdowns in these systems illustrate a widening fault line between attempted and failed control of nature in industrial food production.

Keywords *E. coli* 0157:H7 · Food safety · Industrial agriculture · Nature · Technology

Introduction

Industrialized agriculture increasingly emulates the production, processing, and distribution characteristics of large-scale manufacturing. Agriculture has become more uniform and mechanized, while post-harvest processing offers more "value added" and packaged goods. Paralleling other industries, the agribusiness sector has also experienced significant consolidation of power: fewer decision-makers are responsible for larger quantities of food. To keep the high-volume food factories running, control is paramount. This entails controlling human and non-human actors, keeping them inline with the manufacturing model. However, this kind of control may not be possible with agriculture, an industry which is very closely tied to biological entities and processes.

Nature plays a primary role in agriculture, presenting a different context relative to manufacturing. Nature is not inert or external, but is a dynamic actor (Latour 2004). As indicated by Boyd et al. (2001), nature can present risks, uncertainties, and surprises to industry. Despite efforts to maintain control over nature, reoccurring breakdowns in the industrial agrifood system are increasing concerns about food safety. There are growing fault lines emerging from attempted and failed control. Food scares both highlight the impossibility of control and lead to additional attempts to manage, dominate, or eliminate nature. New technologies (the application of complex, man-made, and/or mechanized tools) are increasingly prescribed to address failures in the food system. It is unclear whether these technologies represent a source of resilience within industrialized agriculture, or if they will ultimately lead to more widespread failures.

Whether or not efforts by industry result in increased control over the agrifood system, they may succeed in propagating the image of control. Because food safety is a top issue for consumers, firms need consumers to believe that their products are safe. When outbreaks occur, firms often deny responsibility, place blame on others, and resist changes in their production or processing procedures. When firms are found at fault, they often advertise new technological fixes, increasing the complexity of the production system as well as its reliance on synthetic substances and controversial measures (e.g. irradiation). While the extent to which these actions actually increase

D. Stuart (✉)
Environmental Studies Department, University of California Santa Cruz, 1156 High Street, Santa Cruz, CA 95064, USA
e-mail: dstuart@ucsc.edu

the safety of food is not clear, industry may succeed in temporarily perpetuating the image that food is now safer.

This paper focuses on the fall 2006 outbreak of *E. coli* O157:H7 from raw 'ready to eat' bagged spinach distributed under the Dole label. This incident resulted in over 200 illnesses and at least three deaths in 26 US states and Canada. In this case, the leafy greens industry was unable to control a strain of bacteria that spread though the pre-packaged salad production system. In an attempt to regain control, or the appearance of control, the industry is actively fighting back against nature in an attempt to sterilize production sites. In addition, the leafy greens industry is adopting new technologies that may serve to increase the illusion of safety to a greater extent than they function to protect consumers. What the industry is failing to acknowledge or address is how concentrated processing systems inherently increase risks to consumers. Biological entities cannot be controlled in the high-volume, manufacturing-like production of bagged leafy greens. Despite investments in new technologies and public relations campaigns, reoccurring outbreaks continue to highlight the widening fault line between attempted and failed control in the industrial agrifood system.

Outbreak: *E. coli* O157:H7 in pre-packaged bagged spinach

The contaminated spinach associated with the September 2006 outbreak of *E. coli* O157:H7 was traced to the Central Coast of California, a highly industrialized agricultural region. Industrialization has included crop specialization, advanced irrigation networks, increased farm inputs, increased labor, extensive output processing, and the increasing dominance of large-scale corporations (FitzSimmons 1986). The region is responsible for up to 70% of US leafy greens. Many growers in the region have contracts with large-scale processors such as Dole and Fresh Express. According to the Community Alliance with Family Farmers, of the 12 outbreaks of *E. coli* 0157:H7 from leafy greens traced back to California since 1995, 10 (80%) were from processed and bagged products which were responsible for over 98% of all associated illnesses (CAFF 2007).

Outbreaks of food-borne illness from fresh produce are significantly more prevalent in recent decades. Whereas produce-associated outbreaks accounted for 0.7% of all food-borne outbreaks in the 1970s, they accounted for 6% in the 1990s (Sivapalasingam et al. 2004). This could be related to increased detection and reporting, the overall increase in consumption of raw fruits and vegetables (Beuchat 1996), changes in human demography, microbial adaptation (Altekruse et al. 1997) and/or changes in farming or processing practices (Beuchat 2002). Changes in industry and technology, including industry consolidation and mass distribution, have been specifically cited by scientists at the Center for Disease Control as a factor contributing to the emergence of food-borne disease. Centralized processing plants with larger geographic ranges increase risks of dispersed outbreaks (Altekruse et al. 1997). Representing a rather telling omission, recognition of this risk factor is not reflected in the official response to the 2006 spinach outbreak.

Although there was a formal investigation, the US Food and Drug Administration (FDA) and the California Department of Health Services (CDHS) have not been able to conclusively determine the specific causes of the spinach outbreak (CDHS/FDA 2007). Much attention in their final report was given to cattle and wild pigs, whose feces were found to contain the same strain of *E. coli* O157:H7 as found on the contaminated spinach. Recommendations were made by the CDHS and the FDA which address possible sources of contamination during growing, harvesting, cooling, and processing. However, recommendations related to processing do not address questions of scale. There are no calls for major changes to the current processing system, and the focus rests on expanding documentation and record keeping (CDHS/FDA 2007).

Despite a lack of conclusive evidence, it is generally agreed that cattle in close proximity to cropped fields were the most likely source of contamination in the spinach outbreak. Cattle are the primary known reservoir of *E. coli* O157:H7, and some argue this has increased due to the presence of concentrated grain-fed livestock operations. Most scientists agree that *E. coli* O157:H7 is a relatively new hybrid strain of bacteria which appeared on the food safety radar in the early 1980's. Although it is unknown whether this *E. coli* strain evolved as a result of industrialized cattle operations, this particularly virulent human pathogen is common in cattle operations. In the case of the spinach outbreak, the fields in question were in close proximity to a cattle operation. There is uncertainty about the role of wild pigs, but some believe they could have transported cattle manure from grazing lands into cropped fields.

Although attention after the spinach outbreak primarily focused on the role of cattle and wild pigs, some news stories and opinion pieces did implicate the industrialized processing system as a major factor in the outbreak. According to one story, 90% of all salad greens are sold by Dole and Fresh Express, who truck leafy greens to "centralized processing plants where tainted and untainted leaves can be mixed during chopping, washing, and bagging," increasing the likelihood for larger and more widespread outbreaks (Engel and Lin 2007). Others also highlighted that even if contamination occurred at the field level, centralized processing was inherently responsible for the extent of the outbreak. Despite these critiques, the leafy

greens industry has not restructured processing arrangements and has instead directed efforts toward controlling nature through the destruction of natural ecosystems near production fields.

The war against nature

New food safety measures created by the produce industry attempt to sterilize production sites; however, these actions may prove to increase risks to the environment and human health. Reactions by specific produce firms to the spinach outbreak have already greatly impacted ecosystems in the Central Coast of California. Despite the lack of conclusive evidence regarding sources and vectors of contamination, many buyers (processing and retail firms) have developed food safety standards with detailed requirements for leafy greens growers. Depending on who growers sell to they may be required to follow multiple sets of standards. If growers do not follow these standards they may be unable to sell their crops. Most standards indicate that cattle are a significant source of pathogenic bacteria. However, some also state that wildlife (e.g. birds and small mammals) are also dangerous. Despite scientific studies indicating that most wildlife are unlikely to pose substantial threats to food safety (Stuart et al. 2006), industry leaders are focused on removing and discouraging wildlife.

Leafy greens growers are being specifically told by buyers that if they do not deter wildlife their crops will not be purchased. Personal interviews I have conducted with growers have provided many examples. One grower admitted he now carries a rifle and shoots to kill anything that moves. Many also use poisoned bait. Conservationists are concerned about the impacts on birds of prey, such as red-tailed hawks. Smaller animals which consume poison are eaten by larger animals, transferring the poison through the food chain. Standards also call for tall fences around fields, trapping wildlife in certain areas, cutting off migration and increasing risks of drowning in floodplains. Interviews indicate that many growers do not view wildlife as a significant threat and are upset about the control measures they are being required to implement.

Industry standards are also impacting regional water quality. Standards call for bare ground buffers around fields to separate crops from other land uses and to allow for the inspection of animal tracks. The creation of these buffers entails the removal of vegetation. Growers are also being told to remove any vegetation that could serve as wildlife habitat. Unfortunately, this non-crop vegetation is specifically encouraged by environmental agencies and farm organizations to filter out pollutants in agricultural run-off. Shrubs and grasses have been installed around fields to prevent pesticides and fertilizers from entering waterways which empty into the Monterey Bay Marine Sanctuary. Decades of environmental efforts to protect water quality in the Central Coast could be substantially undermined. Regional and state environmental groups are currently organizing to address this serious issue.

Despite its intent, this war on nature may not have the desired effects and could actually serve to increase risks to human health. Studies have shown that natural vegetation can reduce the spread of *E. coli* in surface water. Removing vegetation and leaving bare ground may increase the transport of pathogens from surrounding lands. In addition, the loss of biological diversity could increase the prevalence of pathogens. Diversity relates to balance: the loss of certain species could allow other species (including pathogenic bacteria) to thrive in the absence of competitors. Lastly, the impacts to natural ecosystems will surely affect human health through increased run-off and polluted waterways. Attempts to exclude nature from agricultural production are likely to lead to more problems, further widening existing fault lines.

New technologies and the illusion of control

Applied to processing, the dominant response to address reoccurring outbreaks of food-borne illness has been the adoption of new technologies. For the leafy greens industry, these technologies include optical digital testing devices to sort and remove non-chlorophyll based substances as well as new "fire wall" systems requiring high-tech bacterial testing before produce is released from processing plants. In addition, firms are developing washing systems using new mixtures of chlorine or ozone. Irradiation has also been proposed as a final "kill step," and researchers are exploring the viability of irradiation for leafy greens. Lastly, scientists are exploring possible vaccines for humans and for cattle to treat *E. coli* O157:H7.

Whether new technologies are successful or not, agribusiness firms are working hard to support an image of producing safer food. Following the spinach outbreak, firms hired public relations consultants specifically to address food safety. Some publicly shared their approaches to protect consumers, as seen through a front page article in *USA Today* titled: "Fresh Express leads the pack in produce safety" (Schmit 2006). Natural Selection Foods, the company linked to the spinach outbreak, is promoting a new "Four-level Food Safety Program." Even grocery store chains advertise having safe food. A common mantra now heard throughout the industry is: "our food is the safest in the world." Industry wants consumers to believe that they are in control. However, new technologies will not lead to total control over all aspects of food production. My research indicates that many leafy greens growers

expect that more outbreaks will occur. These continued outbreaks are likely to reveal that the industry is merely fueling an illusion of control.

As argued by Juska et al. (2003) regarding industrial meat processing, new systems and technologies to reduce the presence of pathogens will not be effective, given that increasing structural intensification is amplifying even lower levels of contamination. The work of Charles Perrow on normal accidents clearly indicates that systemic flaws can lead to large-scale and catastrophic consequences. Beck (1992, 40) echoes these concerns: "modernization risks occur around *systematic causes* that coincide with the motor of progress and profit. They relate to the scale and expansion of hazards." In addition, nature may not respond to new technologies as expected. As described by Beck, technological manipulations can result in a "boomerang effect." Nature can evade and complicate attempted manipulation. Despite a widespread trust in technology, in some cases technological innovations can lead to greater problems than they set out to fix.

Opportunities

It remains to be seen how resilient agribusiness will be in the face of additional food scares. Shortly following the 2006 spinach outbreak, over a hundred more people were sickened by an outbreak of *E. coli* O157:H7 traced to lettuce served at Taco Bell and Taco John's restaurants. In addition, as I was editing this paper for publication (September 2007) a major leafy greens distributor recalled over 68,000 pounds of bagged spinach after samples tested positive for *Salmonella*. Despite recent efforts to control pathogens in the food system, failures have already occurred and there are bound to be more. Although the leafy greens sector has attempted to bounce back with new images of safer food, this resilience may be superficial and short lived. Continued food scares will provide an opportunity for agrifood scholars and the industry itself to reevaluate the relationships between agriculture, technology, and human health.

Recent attention to food safety also provides an opportunity to examine the role of capital accumulation in foodborne illness. For example, most outbreaks of lettuce and leafy greens are from pre-packaged bagged products. These "value added" products are very important to produce firms because they are much more profitable than heads of lettuce or bunches of spinach. However, cost-effective high-volume processing methods can result in several spinach or lettuce leaves contaminating thousands of packaged bags. Refusal to modify concentrated processing systems reflects political economic relations of contemporary agrifood systems. Similar examples can also be found in the meat industry (see Worosz et al., this issue). Future research in agrifood studies should explore how agribusiness uses new technologies and public relations schemes to manage public perceptions at the expense of consumer health. The food safety issue provides an interesting test of the limits of retailers and supermarkets' ability to police (i.e., re-regulate) supply chains. Additionally, studies should identify the winners and losers in cases as they arise.

Recent food scares provide an important opportunity to emphasize that nature cannot be ignored in agrifood systems. Nature is not a static resource, but an ever-changing actor in the food system. Ignoring nature and treating agriculture like large-scale manufacturing is likely to result in negative impacts to consumers, ecosystems, and farm communities. In addition, attempts by agribusiness to gain more control over nature may increasingly create more hazards to human health. Although agribusiness propagates the illusion of control over nature, nature often reacts to attempted manipulation in unexpected ways. Scholars should be continually conscious of the role of nature in agrifood systems.

Conclusion

Reoccurring outbreaks in the leafy greens industry clearly highlight the growing fault line between attempted and failed control in the industrial agrifood system. Because agriculture is so closely tied with nature and nature is unpredictable, total control will always be unattainable. Attempted control may be problematic when food production emulates high-volume, profit-maximizing manufacturing models at the expense of consumer health. Future research in agrifood studies may help to identify in what cases these models are especially problematic and how alternatives may provide a different outcome. While agribusiness continues to use public relations schemes and the adoption of new technologies to divert consumer attention, this fault line of failed control may continue to widen. Scholars should be increasingly aware as new breakdowns in the food system unfold, exploring possible linkages to large-scale processing and revealing any inherent systemic failures in industrial models.

Acknowledgements Special thanks to Margaret FitzSimmons for her ideas on an earlier draft of this paper. Also thanks to Steven Wolf, Phil Howard, Dustin Mulvaney, Jill Harrison, and an anonymous reviewer for their comments and/or advice.

References

Altekruse, S.F., M.L. Cohen, and D.L. Swerdlow. 1997. Emerging foodborne diseases. *Emerging Infectious Diseases* 3 (3): 285–293.

Beck, U. 1992. *Risk society: Towards a new modernity*. London: Sage.

Beuchat, L.R. 1996. Pathogenic microorganisms associated with fresh produce. *Journal of Food Protection* 59 (2): 204–216.

Beuchat, L.R. 2002. Ecological factors influencing survival and growth of human pathogens on raw fruits and vegetables. *Microbes and Infection* 4 (4): 413–423.

Boyd, W., W.S. Prudham, and R.A. Schurman. 2001. Industrial dynamics and the problem of nature. *Society & Natural Resources* 14 (7): 555–570.

CAFF. 2007. Community alliance with family farmers. Website: http://www.caff.org/foodsafety/. Accessed 21 Oct 2007.

CDHS/FDA. 2007. Investigation of an *Escherichia coli* O157:H7 outbreak associated with dole pre-packaged spinach. California Department of Health Services and US Food and Drug Administration.

Engel, M., and R. Lin II. 2007. Processing may spread *E. coli*. *Los Angeles Times*. 20 Jan 1997.

FitzSimmons, M. 1986. The new industrial agriculture: The regional integration of specialty crop production. *Economic Geography* 62 (4): 334–353.

Juska, A., L. Gouveia, J. Gabriel, and K.P. Stanley. 2003. Manufacturing bacteriological contamination outbreaks in industrialized meat production systems: The case of *E. coli* O157:H7. *Agriculture and Human Values* 20 (1): 3–19.

Latour, B. 2004. *Politics of nature: How to bring the sciences into democracy*. Cambridge, MA: Harvard University Press.

Schmit, J. 2006. Fresh express leads the pack in produce safety. *USA Today*. 23 Oct 2006.

Sivapalasingam, S., C.R. Friedman, L. Cohen, and R.V. Tauxe. 2004. Fresh produce: A growing cause of outbreaks of foodborne illness in the United States, 1973 through 1997. *Journal of Food Protection* 67 (10): 2342–2353.

Stuart, D., C. Shennan, and M. Brown. 2006. Food safety versus environmental protection on the Central Coast of California: Exploring the science behind an apparent conflict. University of California Santa Cruz, Center for Agroecology and Sustainable Food Systems Research Brief 10(Fall).

Author Biography

Diana Stuart is a Ph.D. candidate in Environmental Studies at the University of California, Santa Cruz. Her research focuses on agricultural geography and political ecology, specifically looking at efforts to address food safety in California agriculture.