Biosolids or Biohazards?

City of Lawrence, Kansas Wastewater Treatment Plant has a biosolids recycling program. According to the city, 90-95% of the biosolids are currently applied to local agricultural fields as a fertilizer and organic matter source. The remainder is made available for public distribution for residential uses on landscaping, gardening, etc. Photo by Joseph Mark Jarvis, http://bit.ly/RBJ7uj.

(Ed. note: This piece has been edited to clarify issues related to the plant uptake of contaminants in biosolids, 5/1/13)

by Xoco Shinbrot

Biosolids, or treated domestic sewage sludge, processed at wastewater treatment plants and used as fertilizer, is something that few people think about when they flush the toilet. However, treated and packaged sewage sludge has gained increasing attention and generated heated discussion as researchers increasingly find that it contains high concentrations of known toxicants and heavy metals.

Communities around the nation are required to treat their waste water under the *Clean Water Act*. The wastewater treatment process produces the semi-solid by-product called sewage sludge, or biosolids, which may be applied to the land, incinerated or landfilled, depending on the level of treatment. According to the U.S. Environmental Protection Agency (EPA), of approximately seven million dry tons of biosolids produced each year,[1] 50 percent is applied to land.[2] While less than one percent of the nation's agricultural land is biosolid-treated, biosolid application is increasingly considered by farmers, homeowners, and landscapers as an inexpensive and rich source of nutrients for their plants and agricultural commodities. Biosolids can be applied on farms by conventional farmers, as long as they receive a permit from their EPA Region. Users must prove that their application meets the human health standards of the *Standards for the Use or Disposal of Sewage Sludge*,[3] which limits the concentration of nine heavy metals and four pathogens. Proponents frame the discussion around its use as a solution to future fertilizer shortages, touting it as a sustainable option that should be considered compatible with organic agriculture. However, there are a variety of chemicals in biosolids that people flush into the system, such as pharmaceuticals, household care products, and a cocktail of other constituents that are not removed during waste water treatment. Currently, USDA organic certification is the only regulatory safeguard from biosolids threats to human health, given their prohibition in the *Organic Foods Production Act*.

Toxic Findings, Limited Regulation

Growing concern has prompted EPA to increase its efforts to answer questions about the presence of a broader range of chemicals in biosolids. In 2009, EPA released the results from its *Tar-*

geting National Sewage Sludge Survey (TNSSS), which measures chemical concentrations in land-based biosolid application areas.[4] The results are striking. Out of 84 samples:

- 27 metals are found in virtually every sample with antimony found in no less than 72 samples;
- Of six semi-volatile organics and polycyclic aromatic hydrocarbons (PAHs), four are found in 72 samples, one is found in 63 samples and one found in 39 samples;
- Of 72 pharmaceuticals, three (i.e. ciprofloxacin, diphenhydramine, and triclocarban) are found in all 84 samples, nine are found in at least 80 samples;
- Of 25 steroids and hormones, three steroids are found in 84 samples and six are found in 80 samples; and,
- All flame retardants, except one, are found in nearly every sample.

Over the past 30 years, a significant body of research has been compiled on the organic chemical contaminants in land applied biosolids that support these findings. While the focus has ranged from persistent organic pollutants, such as chlorinated dioxins/furans, to polycyclic aromatic hydrocarbons, organochlorine pesticides, heavy metals, PCBs, and pharmaceutical contaminants, only dioxins have been assessed by EPA. While they took no action based on the assessment, they determined that risks were below the levels of action.

The results of TNSSS prompted EPA to develop a list of nine pollutants (nitrite, nitrate, barium, manganese, silver, fluoranthene, pyrene, and 4-chloroaniline) that are being evaluated based on biosolids exposure and hazards assessments. EPA officials have indicated that rulemaking on these nine chemicals may take place within 2013 or 2014. As for more than 130 other pollutants identified in TNSSS, no timeline for rulemaking has been set.

EPA's failure to fully regulate biosolids and threats to human health has come under scrutiny as news articles, exposés, and non-fiction novels have critiqued land applied sewage sludge. John Stauber and Sheldon Rampton were two of the first authors, in their exposé *Toxic Sludge is Good for You*, to publicly chastise public relations manipulators for misleading the public on biosolids. The authors examine the ongoing marketing campaign to redefine sewage sludge as a beneficial, cheap, and risk-free fertilizer. As part of this effort to sell sludge, the most active pro-sludge advocacy group, Water Environment Federation (WEF), coined its new name. "It's not toxic, and we're launching a campaign to get people to stop calling it sludge. We call it 'biosolids,'" said then WEF director of information Nancy Blatt.

During this campaign, companies like Heinz, Nestlé, and Del Monte, which expressed staunch support of biosolid-free agriculture, began to seriously consider growing their raw agricultural products in soils treated with biosolids.[5] Representatives for Del Monte indicated that their "long-standing position . . . to avoid using raw agricultural products grown on soils treated with municipal sludge" was likely to change in the future. It's unclear whether Heinz and Nestle have changed their stance, but according to their website on corporate responsibility, Del Monte has avoided products grown with sewage sludge.[6] Many conventional farmers and food processors, however, still use biosolids as a crop fertilizer and have strongly opposed labeling legislation (see H.R. 207, *Sewage Sludge In Food Production Consumer Notification Act* of 2005) to inform consumers on whether food is grown on biosolid-treated land.

Human Health and Unregulated Toxicants

Plant uptake and ingestion

Since the early 1980s, scientists have been cognizant of heavy metal uptake by food plants fertilized with biosolids. Keefer et al. (1986)[7] analyzed the impact of biosolids rich in cadmium, zinc, nickel, copper, chromium, and lead on the edible and inedible portions of radishes, carrots, cabbage, green beans, sweet corn and tomatoes grown in biosolids. As expected, many of the crops in biosolid amended soils have higher concentrations of heavy metals than the control crops. Nickel concentration is higher in both edible and inedible parts of most of the vegetables, and copper and zinc concentrations are also higher in those vegetables. Though levels are highly dependent on the species type, the heavy metal, the plant part, and the level of absorption, concentrations of heavy metals in crops grown in sludge-amended soil can have serious consequences.

Pumpkin seedlings planted out on windrows of composted biosolids at community compost education garden.

For example, cadmium accumulation varies distinctly in different plant types, but is regarded as the most hazardous metal element based on its concentration in sewage sludge. In the short-term, ingesting high levels of cadmium residues can cause vomiting and stomach irritation, but prolonged exposure to low levels can cause kidney damage and bone fragility.[8] The Agency for Toxic Substances and Disease Registry cites research showing that cadmium tends to accumulate in plant leaves, and therefore is more risky, especially for leafy vegetables grown on contaminated soils.[9] Tobacco, lettuce, and spinach, are known to be particularly prone to cadmium absorption. Currently, the *Standards for the Use or Disposal of Sewage Sludge*[10] regulate the application of biosolids with concentration limitations for heavy metals—specifically for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. EPA's established standards on pollutant concentrations, pathogen density, and the attraction of potential pathogen vectors (e.g., insects, scavenging mammals, and birds) can be found in the Biosolids Rule (40 CFR Part 503). This regulation requires farmers to monitor these parameters at least once a year and up to 12 times a year, depending on the total amount of biosolids used.[11] While heavy metals, pathogens, and disease vectors are regulated, there are a myriad of chemicals, pesticides, and emerging contaminants in biosolids that do not have any regulatory limits.

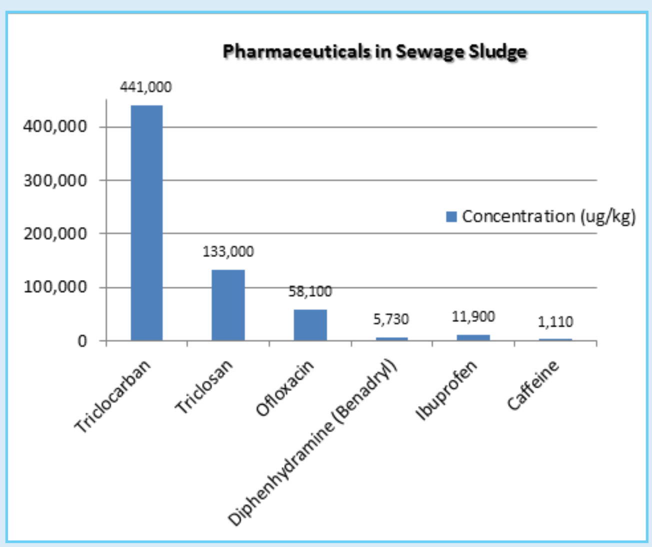
A recent study conducted by Wu et al. (2012) documents the transfer of pharmaceutical and personal care products (PPCPs) into the tissues of five widely consumed crops, namely peppers, collard, lettuce, radish, and tomato. Drugs and other contaminants enter the sewage system through various pathways, but trace amounts may come from urine or fecal matter or pharmaceuticals dumped down the drain. Therefore, researchers chose three of the most frequently detected pharmaceuticals in biosolids, according to EPA's 2009 Targeted National Sewage Sludge Survey, to study under laboratory conditions: a prescription drug for epilepsy, nerve pain, and bipolar disorder (carbamazepine); an over-the-counter drug for allergic reactions and motion sickness, better known by its brand name Benadryl (diphenhydramine); and an antibacterial agent used in disinfectants and soaps (triclocarban). The treatment group of plants were grown in biosolids-based potting soil and fortified with additional pharmaceutical and personal care products to ensure detection. Added PPCP concentrations were comparable to those detected in agricultural soils treated with biosolids. All three compounds were found in every one of the studied crops grown in biosolid-treated soils. Triclocarban had the highest root concentration in all the plants, while carbamazepine had the highest above ground concentrations particularly for collards, peppers, and lettuce. Additionally, diphenhydramine was concentrated in the fruits of both the tomato and pepper plants. In other words, pharmaceuticals were found in the edible portions of the plant.[12]

Previous studies had shown that emerging contaminants can be transported into plants in hydroponic systems[13] and from soils low in organic matter.[14] The above described study demonstrates that the organic matter in biosolids does not prevent the uptake of some emerging contaminants. Finally, the work of Wu et al. (2012) builds on his own research demonstrating that not only are pharmaceuticals taken up by crops, but some are persistent in soils.[15]

These studies are largely conducted in the greenhouse and laboratory setting rather than in the field, although one study conducted under normal farming conditions does suggest that PPCPs may be taken up by vegetables grown on biosolid amended soils.[16] More research is certainly needed on plant uptake of emerging contaminants, however, the current results are alarming particularly as the Biosolid Rule only requires pathogen reduction and monitoring for heavy metals.

Antibacterial Pesticides Persist in Biosolids

Because 95% of the uses of the antibacterial pesticide triclosan, and its cousin triclocarban, are in consumer products that are disposed of down residential drains, sewage and wastewater provide a prime medium for their entry into the larger environment. Triclosan and triclocarban are found in high concentrations in biosolids. Triclosan, while not completely removed from water during the treatment process, accumulates in sewage sludge in municipal wastewater systems. After treatment, biosolids are recycled on land, and triclosan can then leach down through the soil and run off into surface water from the fields. Triclosan has been shown to persist in the runoff from treated fields for as long as 266 days after biosolid application and to persist in the sediment for long periods of time. EPA, in its T*argeted National Sewage Sludge Survey Report*, found that triclosan was detected in 79 of a total of 84 sludge samples used in the survey.(See chart).



Triclosan-contaminated biosolids can pose longer term risks to environmental and human health. One study reported that, "The beneficial reuse of digested municipal sludge as agricultural fertilizer represents a mechanism for the reintroduction of substantial amounts of [triclosan] into the environment."[20] Subsequently, agricultural lands exposed to contaminated biosolids can leave residues in earthworms, crops, and wildlife. Once in soil, it has been shown that triclosan is in fact taken up and translocated in plants. In soybean plants, triclosan was observed to be taken up from the roots and eventually translocated to the beans.[21] This suggests that people may also be exposed to triclosan by unknowingly consuming contaminated food.

Among those contaminants of concern include so-called nanomaterials, materials that are engineered at the ultra fine molecular scale that display novel characteristics like increased strength or conductivity. In the study, "Soybean susceptibility to manufactured nanomaterials with evidence for food quality and soil fertility interruption," researchers found that biosolid application to soybeans caused zinc oxide nanoparticles to bioconcentrate in soybean tissues, especially the leaves, and that nano-cerium oxide completely shut down nitrogen fixation. "Juxtaposed against widespread land application of wastewater treatment biosolids to food crops, these findings forewarn of agriculturally associated human and environmental risks from the accelerating use of MNMs [manufactured nanomaterials]," the study finds. [17]

Field after application of biosolids at Colorado State University's Biosolids Research site in Byers, Colorado. Photo courtesy CSU College of Agricultural Sciences, Soil Crop and Sciences Dept. http://biosolids.agsci.colostate.edu

User and bystander exposure

Beyond those chemicals that are ingested, the total number of potential health impacts due to contact with contaminants are numerous, ranging from rashes, cough and headaches, to vomiting and nosebleeds. The Cornell Waste Management Institute published a report (2008) that compiled all the health complaints associated with land application of biosolids.[18] Some of the most important impacts include: asthma, allergies, birth complications, congenital defects, respiratory complications and failure, eye problems, gastrointestinal complications, inflammation of the lungs due to irritation caused by the inhalation of dust, alterations in pulmonary function, chronic bronchitis, chronic emphysema, inactive tuberculosis, cardiovascular effects, lesions, nausea, and tumors.

Symptoms, including rashes, have been linked to proximity to agricultural soils treated with biosolids. For example, one study published in 2009, "Interactions of pathogens and irritant chemicals in land-applied sewage sludges (biosolids)," found that 25 percent of residents studied living within approximately one kilometer (0.6 miles) of land application sites were affected by *Staphylococcus aureus* in their skin and respiratory tracts, including two who died. While *S. aureus* infections frequently accompany diaper rash, the effects can be lethal.[19]

Biosolid impacts on nature

In addition to extant chemical residues on food crops and direct exposure for applicators and bystanders, biosolids pose significant potential hazards to surrounding ecosystems. Leaching of personal care products, pharmaceuticals, and other classes of micropollutants into local waterways have gained regulatory and scientific scrutiny.[22]

Soil runoff, fish kills, fresh water eutrophication, and reproductive disruption for aquatic animals are just a few of the potential environmental hazards of biosolids application. One of the most potent impacts occurs as biosolids are washed downstream into waterways and groundwater. Biosolids are rich in phosphorus and nitrogen, which are required for crop growth. Unfortunately, as nutrient rich soils flow into local waters, it stimulates the prolific growth of microorganisms and algae. This algal growth harms the aquatic ecosystem in two major ways: first, algae blocks sunshine, depressing growth of underwater vegetation that fish and aquatic life rely on for food; second, when the blooms die, their decay depletes the dissolved oxygen in the water, slowly suffocating aquatic life. Thus, increasing use of biosolids is not just an aesthetic issue of algal blooms, it poses serious environmental problems.[23]

As with human health, environmental health is severely affected by additives that are not removed by wastewater treatment plants. For example, pharmaceuticals like birth control pills have dramatically changed fish reproductive patterns and health. In 2008, researchers reported that minute quantities of estrogens found in the birth control pill alter sperm development by changing the number of chromosomes, which can lead to lower survival and long-term health problems in offspring.[24] In 2010, more research reveals that small concentrations of synthetic progesterone-like hormones found in contraceptive drugs, not just synthetic estrogen, threaten fish reproduction.[25]

As synthetic chemicals are continually being introduced, EPA has not yet worked out a process to regulate these chemicals. Pesticides are only now being identified for testing to determine whether they are endocrine disruptors, chemicals that interfere with development, hormones, and reproduction through the Endocrine Disruptor Screening Program. In 2007, U.S. Representative Henry Waxman (D-CA) and others harshly criticized EPA for failing to provide a comprehensive endocrine disruptor screening program. In 1996, the *Food Quality Protection Act* (FQPA) required such a program for endocrine-disrupting pesticides to be implemented by 1999: "Today, over ten years after the law was passed and eight years after the FQPA deadline, EPA has not tested a single chemical for endocrine-disrupting effects…,"[26] said Rep. Waxman. In 2006, EPA had developed its first draft list of chemicals to be screened by pesticide manufactures, but included only a portion of 1,700 chemicals identified for screening under FQPA mandate, which is minute compared to more than 75,000 chemicals listed under the *Toxic Substances Control Act*. By 2010, EPA finally released its Endocrine Disruptor Screening Program, which developed Tier 2 tests for endocrine disruptors and implemented draft policies and procedures that the agency will use to require screening.[27] Tier 2 testing, however, is still in progress and EPA has not implemented regulations. Meanwhile, the European Union (EU) has already launched its *EU-Strategy for Endocrine Disruptors,* including a comprehensive priority list of chemicals requiring regulation.[28]

Regulatory pitfalls: A focus on pathogens

Current biosolid regulations

The Standards for the Use or Disposal of Sewage Sludge (Title 40, Code of Federal Regulations, Part 503) was published in the Federal Register on February 19, 1993. This document established a set of general requirements for pollutant limits, management practices, and operational standards for biosolids. It describes the procedure for land application of biosolids, surface disposal, landfilling, and incineration. The EPA Office of Water's risk assessment of biosolids established limits based on current toxic exposure data, oral reference dose, and human cancer potency values. The analysis compared 14 different chemical exposure pathways and EPA chose the final limits based on the most toxic pathway for exposure.[29]

The biosolids regulation is based on heavy metal loading and pathogen concentrations. None of the nine heavy metals may exceed the promulgated ceiling levels. Processes for reduction or elimination of pathogenic bacteria, entric viruses, and helminth ova must be used. Standards for Class B biosolids require that pathogens are reduced by at least 99 percent, while Class A biosolids require further treatment. Because Class B biosolids still contain traces of pathogens, farmers may only use them if they receive a permit, enforce a buffer, restrict public access, and restrict crop harvesting. Most farmers are required to implement a 30-day waiting period after application to "ensure" the pathogens are killed. For root crops, which come into contact with the soil, the waiting period can be as long as 38 months.[30]

Pesticide Law and Biosolids

EPA regulates pesticides under the *Federal Insecticide, Fungicide, and Rodenticide Act* (FIFRA), which requires EPA to ensure that pesticides do not pose unreasonable risk to human health and the environment. EPA has interpreted its authority under FIFRA's "unreasonable adverse effect" standards by conducting risk assessments on pesticides. Unfortunately, EPA's risk assessment process does not fully take into account the environmental fate and effect of pesticide use and the potential risks of pesticide reintroduction into the environment via biosolids, especially those pesticides that are persistent, and cannot be removed from sludge through treatment outlined in the *Biosolids Rule*. Additionally, pesticide residues which make their way into crops grown in biosolids, contaminate food. These residues must then adhere to standards set by the *Food Quality Production Act* (FQPA), which regulates the residue allowed on crops with tolerance levels. However, pesti-

Biosolids application site in Saskatoon, Canada. After the treatment process, the biosolids are stored in asphalt-lined storage cells until the spring and fall when they are spread on nearby farmers' fields by a process called liquid injection. Image Courtesy City of Saskatoon, Canada. http://bit.ly/TKdjSc.

Branded products that contain sewage sludge/biosolids*

Source: Sludge News. 2006. About Sewage Sludge. http://bit.ly/w2n8bh

- Agresoil (MA)
- All-Gro (Synagro)
- Bay State Fertilizer (Boston, MA)
- Chesapeake Sunshine
- CompostT (Pennsylvania)
- ComPro (Washington, D.C.)
- Dillo Dirt (Austin, TX)
- EarthBlends (New York City, a product of Synagro, sold by WeCare)
- Earthlife (New England, a product of New England Organics)
- EarthMate (Philadelphia, PA)
- EKO Compost (Missoula, Maui, Lewiston plant on Idaho-Wahington border)
- Glacier Gold (Olney, MT)
- Granulite (Synagro)
- GroCo (Seattle, WA)
- Growers' Blend by Earthwise Organics (a Synagro subsidiary)
- Hou-Actinite (Houston, TX)
- Kellogg Nitrohumus, Gromulch, Amend and Topper (Kellogg Garden Products, Los Angeles, CA)
- Landscapers' Advantage (Camden, NJ)
- MetroGro (Madison, WI)
- Milorganite (Milwaukee, WI)
- Mine Mix (Philadelphia, PA)
- Miracle-Gro Organic Choice Garden Soil
- Nutri-Green (Virginia Beach, VA)
- N-Viro BioBlend
- N-Viro Soil
- Oceangro (NJ)
- ORGRO (Baltimore, MD, Veolia Water North America)
- SilviGrow (Seattle, WA)
- SoundGro (Pierce County, WA)
- TAGRO (Tacoma, WA)
- TOPGRO (Los Angeles, CA)
- Unity Fertilizer (Unity Envirotech LLC, Florida-based)
- WeCare Compost (NY)

**Sewage sludge or biosolid products can be disguised in many different ways, sometimes it is sold as "compost," while other times it's dried into pellets and bagged, or blended into other fertilizers. There are no labeling requirements for biosolid-containing fertilizers. Additionally, there is no federal rule that prohibits the use of the term "organic" on biosolids, despite the fact that there is no USDA organic certification of biosolids.*

cide tolerances have been severely criticized for not being stringent enough, allowing ingested residues to pose short and long-term risks to the human population. Furthermore, ensuring that chemical contamination of crops grown with biosolids does not exceed tolerances requires that such crops be tested regularly for residues. In addition, although food tolerances may cover pesticide residues in foods, they do not affect other avenues of exposure, including inhalation and dermal exposure to dust. Nor do they cover ecological impacts. While the Biosolids Rule provides the guidelines for biosolid treatment, disposal, and reuse, biosolid recycling is a key example of the inadequacies of federal pesticide (and other chemical) risk assessments.

National Academy of Sciences Critique

The regulatory pitfalls are best enumerated in the 2002 biosolid assessment by the National Research Council (NRC) of the National Academy of Sciences (NAS).[34] This group reports that there are major data gaps in the science underlying current rules, as well as a lack of epidemiologic studies on exposed populations, and inadequate programs to ensure compliance with biosolid regulations. Under the *Clean Water Act*, EPA is required to review existing biosolid regulations every two years in order to identify pollutants that need to be regulated. However, EPA has only researched a fraction of the chemicals that are known to exist in sludge and, of those researched, only some have risk assessments.

While chemical regulations are based on traditional risk-based limits established in the Integrated Risk Information System (IRIS) and the Office of Pesticide Programs (OPP) for human health risks, as yet there are no regulations for chemical pollutants in biosolids, with the exception of heavy metals. By contrast, established pathogenic regulations are based on treatment and site restrictions, completely divorced from traditional risk-based assessments. Instead of explicitly delineating acceptable pathogen risks concentration, EPA developed a risk characterization process that ignores complex chemical-pathogen and pathogen-pathogen interactions that are known to occur. For instance, workers exposed to silica dust (chemical-based) have a higher likelihood of tuberculosis infections (pathogen-based). Such enhanced adverse interactions are not addressed or explored by EPA assessments.

NRC's report, "Biosolids Applied to Land: Advancing Standards and Practices," reflects skepticism over the biosolid assessment process:

"Even if a summary index of the risk of an adverse response to mixtures was available, it would not necessarily reflect the total hazard of exposure to biosolids because of the inability to identify all of its hazardous constituents and their potential for interaction *in vivo*. Moreover, the composition of biosolids is susceptible to unanticipated changes from time to time and place to place. *Thus, it is not possible to conduct a risk assessment for biosolids at this time (or perhaps ever) that will lead to risk-management strategies that will provide adequate health protection* without some form of ongoing monitoring and surveillance."[35] (emphasis added)

EPA's reliance on mathematical estimates of individual pathogens and chemicals ignores secondary transmission potential for pathogens. Currently, only the direct transmission of pathogens is considered, despite the fact that interactions between people and through environmental pathways can cause population-wide transmission. In summation, NRC concludes that EPA's biosolids risk-assessment and regulatory process is cumbersome and slow, with large information gaps on complex pathogenic interactions, and ignoring important secondary transmission pathways.

In 2003, EPA responded to NAS recommendations by releasing an action plan to determine the potential risks of select pollutants, measure those pollutants, characterize potential volatile chemicals and improve risk management practices. Since then, EPA has released its TNSSS and is in the processes of evaluating 26 of the 49 pollutants identified in the 2009 Biennial Review, including important hormones, antibiotics, PBDEs, and antimicrobials.[36] While EPA has identified 31 pollutants as candidates for further regulation during its second round of pollutant evaluation, it has not regulated any of these pollutants that are commonly detected in biosolids. According to the EPA, its action plan has been undermined by "budget constraints and competing priorities within the Agency, [such that] EPA is not able to implement all of the NRC's recommendations."[37]

Application site advisory sign. Image courtesy Florida Department of Environmental Protection.

The NRC proposed improvements to EPA's risk assessment process, and it proposed monitoring and surveillance as a means of dealing with the uncertainties in assessing risks of complex mixtures, including mixtures of chemicals and pathogens. However, the approach is still one of assessment and management of risks, as opposed to prevention. The NRC identified inherent limitations of risk assessment when applied to mixtures and combinations of chemicals and pathogens, but proposed only a band aid approach. A preventive (or precautionary) approach is more likely to lead to solutions that are truly protective. This approach would ask, "Is there anything we can do differently in order to eliminate problems associated with sewage sludge?" One problem is that the system encourages the mixture of pathogens and toxic chemicals. So, how do we separate the two? What if we created a system in which human "wastes" were composted and the compost used locally? We would still need to establish pathogen requirements and requirements for pharmaceuticals, but we would avoid mixtures with industrial chemicals and lawn pesticides. What if we prohibited the use of toxic pesticides that might get flushed down drains or washed into combined sewers? Creative solutions are possible if we define the problem as avoiding that complex mixture of toxic chemicals and pathogens, rather than searching for a place to put it and a way to make it "acceptable."

Alternative strategies for the future

Biosolid use for energy production

As the discussion around biosolids rages on, innovators have focused on alternatively using biosolids as a renewable energy source, arguing that biosolids can displace fossil fuels for powering waste water treatment plants, reduce dependence on oil, reduce costs for energy and demand on the power supply, and solve a waste management problem. On the other hand, others believe utilizing biosolids this way is not a solution for fossil fuel dependence, cleaner air, and by extension global climate change. This, too, will require more thorough assessment.

Conclusion

Organic foods: an escape from biosolids

For now, organic certification is the last safe haven from biosolids for consumers. Farms that are USDA organic certified are expressly prohibited from applying biosolids under the National Organic Standards Rule, which ensures that raw foods are grown without hormones or synthetic fertilizers and only approved synthetics in an organic soil-building system. When the proposed Rule first came out in 1997, EPA feared that it would deter new users from using biosolids as a fertilizer and pressed the USDA to exempt biosolids from the ruling. In fact, in 1998, USDA released proposed organic standards that would allow bioengineered crops, irradiation, and sewage sludge in organic production, which became known as the "big three." The release sparked 325,603 mostly horrified public comments. USDA reconsidered and prohibited the "big three" in the final rule.

We know now that biosolids have a complex array of biological pathogens, chemical contaminants, pharmaceuticals, hormones, and emerging contaminants that are not completely eliminated by waste water treatment plants. The land application of biosolids should be abandoned immediately, considering that the current regulatory restrictions and biosolid treatment programs allow for the continuing contamination of the environment and threaten human health. That means we stop using them and stop making them. In lieu of those immediate changes, at the very least, the waste streams for toxic chemicals should be separated from human organic wastes that are applied to agricultural fields.

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