

# How human urine can disrupt soil health and water quality

August 23 2024, by Jess Davies

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Credit: Unsplash/CC0 Public Domain

Festival season is in full flow, and like any self-respecting plant-soil biogeochemist attending a local music festival, I'm curious about how these outdoor events might modify important nutrient cycles.

With crowds gathering in fields, consuming lots of food and drink, then excreting these in, shall we say, not exactly ideal facilities, extra nutrients from urine and feces could easily escape into the environment.

This [human waste](#) contains significant amounts of two macronutrients, [nitrogen and phosphorus](#). Other human activities, including using fertilizers, overflows of sewage, and fossil fuel burning, also lead to large releases of [nitrogen](#) and [phosphorus](#) into [soils, air and water](#) causing ecological imbalances, water quality problems and biodiversity loss. [Research suggests that](#) humans have disturbed these nutrient cycles enough to threaten the long-term habitability of our planet.

So how much nitrogen and phosphorus do festivalgoers produce? Wee is more likely than poo to not be fully captured by festival toilets, so I've focused on urine. In a typical day, a person produces about [11g of nitrogen and 1g of phosphorus](#) in their urine. At a festival, people tend to eat and drink more, but for this calculation, I assumed everyone is doing their average amount of tinkling.

Around 40,000 punters and 5,000 staff attended my local music festival, Kendal Calling in the Lake District this August. The site covers around 800 hectares, including campsites. Over four days, Kendal Calling festivalgoers wee'd out around 2 tons of nitrogen. That's approximately 2.5kg per hectare, which is [around a quarter](#) of what typically enters natural grassland in England from rainfall and the atmosphere annually. However, that's much less than the [50kg of nitrogen](#) per hectare or more that farmers might add to a agricultural grasslands in a year.

Lots of urine is captured in festival loos—thankfully, it doesn't all reach the soil. To gauge how often people might urinate in open air rather than use a loo, I canvassed opinions from ten of my festival-going friends and colleagues—estimates varied wildly between 1 in 100 to 50:50. Even if just one in five whizzes were done au naturale, that's 5% of the average

annual dose of nitrogen that comes from the atmosphere.

What happens next? Depending on [soil conditions](#), rainfall and temperature, nitrogen may be released to the atmosphere as ammonia gas or [nitrous oxide](#) which is a potent greenhouse gas, it may wash into waterways as nitrates, or it may get taken up by plant roots. So, it could pollute air or water, warm our atmosphere or increase plant growth.

During this festival, people produced around 0.225kg of phosphorus per hectare. That's equivalent to a year's worth of [phosphorus from the atmosphere](#) in just four days—much more than nitrogen. A typical rate of fertilizer input for an agriculturally managed grassland is much higher though, upwards of [5kg per hectare](#).

Phosphorus cycles differently from nitrogen as it doesn't readily transform into a gas. It strongly sticks to soil surfaces, so soils could become over-enriched with phosphorus. If ground conditions aren't well managed, soil erodes and phosphorus-rich sediments end up in streams, or heavy rainfall transfers dissolved phosphates from pee to waterways.

Rivers, lakes and oceans are ecologically sensitive to [phosphorus levels](#), and these extra nutrients could cause [algal blooms](#)—when this happens, algae rapidly grow, blocking sunlight and depleting [oxygen levels](#) in the water, affecting and often killing other aquatic life.

## **Number one pee hotspots**

My back-of-the-envelope calculations suggest that a few days of festival fun could result in a small addition to nutrients across the whole site compared to how much it normally receives over the course of a year.

In reality, wild wees are not evenly sprinkled over an entire festival site but concentrated at particular hotspots. It's likely that nitrogen and

phosphorus levels would be much higher in the hotspots compared to natural conditions, with more potential for disrupting nutrient cycles and environmental damage.

These unmanaged chemical flows could have other consequences too. The urea could change the [pH of soils](#). Other more exotic substances could pop up in your average [festivalgoer's pee](#), with unknown effects on worms and billions of microbes in healthy soils.

My plea to festival patrons is to pee in a portaloos, preferably into the hole and not all over the floor. To festival organizers, please provide nice loos, perhaps even compost loos or other [innovative solutions](#). At Glastonbury, people are actively discouraged from weeing outside and organizers are trialing ways to recycle those valuable human-derived nutrients.

Even with good facilities, there will likely still be some smelly nutrient hotspots across a festival site after everyone has gone home. Take care of soils before, during and after an event to reduce the amount of nutrients that escape and perhaps consider moving the location of key infrastructure (bars, loos and stages) year-on-year to avoid the build-up of these nutrient hotspots over time.

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