

Op-Ed Contributor

## Yellow Is the New Green

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In the far reaches of Shaanxi Province in northern China, in an apple-producing village named Ganquanfang, I recently visited a house belonging to two cheery primary-school teachers, Zhang Min Shu and his wife, Wu Zhaoxian. Their house wasn't exceptional — a spacious yard, several rooms — except for the bathroom. There, up a few steps on a tiled platform, sat a toilet unlike any I'd seen. Its pan was divided in two: solid waste went in the back, and the front compartment collected urine. The liquids and solids can, after a decent period of storage and composting, be applied to the fields as pathogen-free, expense-free fertilizer.

From being unsure of wanting a toilet near the house in the first place — which is why the bathroom is at the far end of their courtyard — the couple had become so delighted with it that they regretted not putting it next to the kitchen after all.

What does this have to do with you? Mr. Zhang and Ms. Wu's weird toilet — known as a “urine diversion,” or NoMix (after a Swedish brand), toilet — may have things to teach us all.

In the industrialized world, most of us (except those who have septic tanks) rely on wastewater-treatment plants to remove our excrement from the drinking-water supply, in great volumes. (Toilets can use up to 30 percent of a household's water supply.) This paradigm is rarely questioned, and I understand why: flush toilets, sewers and wastewater-treatment plants do a fine job of separating us from our potentially toxic waste, and eliminating cholera and other waterborne diseases. Without them, cities wouldn't work.

But the paradigm is flawed. For a start, cleaning sewage guzzles energy. Sewage treatment in Britain uses a quarter of the energy generated by the country's largest coal-fired power station.

Then there is the nutrient problem: Human excrement is rich in nitrogen, phosphorus and potassium, which is why it has been a good fertilizer for millennia and until surprisingly recently. (A 19th-century “sewage farm” in Pasadena, Calif., was renowned for its tasty walnuts.) But when sewage is dumped in the seas in great quantity, these nutrients can unbalance and sometimes suffocate life, contributing to dead zones (405 worldwide and counting, according to a recent study). Sewage, according to the United Nations Environment Program, is the biggest marine pollutant there is. Wastewater-treatment plants work to extract the nutrients before discharging sewage into water courses, but they can't remove them all.

And there's also the urine problem. Urine, like any liquid, is a headache for wastewater managers, because most sewer systems take water from street drains along with the toilet, shower and kitchen kind. Population growth is already taxing sewers. (London's great network was built in the late 19th century with 25 percent extra capacity, but a system designed for three million people must now serve more than twice as many.) When a rainstorm suddenly sends millions of gallons of water into an already overloaded system, the extra must be stored or — if

storage is lacking — discharged, untreated, into the nearest river or harbor. Each week, New York City sends about 800 Olympic-size swimming pools' worth of sewage-polluted water into nearby waters because there's nowhere else for it to go.

This probably won't kill us, but it's not ideal. Environmental scientists in California have calculated that sewage discharged near 28 Southern California beaches has contributed to up to 1.5 million excess gastrointestinal illnesses, costing as much as \$51 million in health care. We can do better.

Urine might be one way forward. Before engineers scoff into their breakfast, consider that since at least 135,000 urine-diversion toilets are in use in Sweden and that a Swiss aquatic institute did a six-year study of urine separation that found in its favor. In Sweden, some of the collected urine — which contains 80 percent of the nutrients in excrement — is given to farmers, with little objection. "If they can use urine and it's cheap, they'll use it," said Petter Jenssen, a professor at the Agricultural University of Norway.

The price of phosphorus fertilizers rose 50 percent in the past year in some parts of the world, as phosphate reserves, the largest of which are in Morocco and China, dwindle. (The gloomiest predictions suggest they'll be gone in 100 years.) Although half of sewage sludge in the United States is already turned into cheap fertilizer known as "biosolids," urine contains hardly any of the pathogens or heavy metals that critics of biosolids claim remain in mixed sewage, despite treatment.

The rest of Sweden's collected urine goes to municipal wastewater plants, but in much smaller volume so it's easier to deal with. Research by Jac Wilsenach, now a civil engineer in South Africa, found that removing even half of the nutrient-rich urine enables the bacteria in the aeration tanks to munch all the nitrogen and phosphate matter in solid waste in a single day rather than the usual 30. Urine diversion also makes for richer sludge and produces more methane, which can be turned into gas or electricity, Mr. Wilsenach said. In short, separating urine turns a guzzler of energy into a net producer.

Putting urine to use is not new. A friend's grandmother remembers the man coming round for the buckets 60 years ago in Yorkshire, which were then sold to the tanning industry. The flush toilet ended that, and no one — my friend's nan included — wants outside privies again. "Any innovation in the toilet that increases owner responsibility is probably seen as downwardly mobile," said Carol Steinfeld, of New Bedford, Mass., who imports NoMix toilets into the United States

Then there's the sitting problem: in most urine-diversion toilets, a man must empty his bladder sitting down. This wouldn't be a problem in some countries — Germany recently introduced a toilet-seat alarm that admonishes standers to sit — but it has been in others. Professor Jenssen was flummoxed by one participant at a training workshop in Cuba who said firmly, "If a man sits, he is homosexual."

For now, "ecological sanitation" — or more sustainable sewage disposal — thrives mostly in fast-industrializing countries like China and India, which have money to invest in alternatives but few sewers. A subculture of composting toilets exists in the United States, but only a few hundred urine-diversion toilets have been imported, Ms. Steinfeld said.

Necessity — whether occasioned by fertilizer prices, carbon footprints or crippling capital investments — could bring change. At a recent wastewater conference, I watched in astonishment as dour engineers rushed to question a speaker who had been talking about stabilization ponds, which clean sewage using water, flow control, bacteria and light. Normally, such things would be cast into the box of hippie-ish ecological sanitation. But to managers struggling with energy quotas and budget limitations, more sustainable, less energy-intensive sanitation may be starting to make sense.

As Mr. Zhang told me with a smile: "For me, whatever the toilet is, I use it. For example, here we eat wheat. When we go to the south of China, we eat rice. Otherwise we starve."

It's been more than 100 years since Teddy Roosevelt wondered aloud whether "civilized people ought to know how to dispose of the sewage in some other way than putting it into the drinking water." The Zhang family toilet is not the perfect answer to Roosevelt, as it still uses some water, though 80 percent less than a regular flush toilet uses. But at least it's the result of someone asking the right questions.

*Rose George is the author of "The Big Necessity: The Unmentionable World of Human Waste and Why It Matters."*