Turning wastewater into a resource: a key to food security and climate action

**By Daniel Ddiba**

At a time when water scarcity poses a significant threat to food security in many parts of the world, a transformation has been taking place over the past three decades in the arid regions of Spain. Spain has been facing water scarcity challenges, particularly in its south-eastern regions. [As a strategic response](https://idadesal.org/water-reuse-in-spain/), the country has adopted wastewater reuse in the region of Murcia where chronic water shortages are prevalent. Approximately 98% of wastewater is now [treated in a network of 100 WWTPs and reused](https://phys.org/news/2023-06-spain-crops-wastewater.html), primarily for agricultural irrigation. This practice emerges from the need to address local water scarcity and sustain crucial fruit and vegetable production. The extensive use of reclaimed water in Murcia not only addresses local water scarcity but also fuels a significant portion of Spain's agricultural exports, with a large share of these sustainably irrigated fruits and vegetables reaching global markets. While Spain’s proactive approach in wastewater reuse presents a solution to the global water scarcity in agriculture, it's important to note that this challenge is global, although responses from different countries vary.

As the world grapples with a growing population, the food and clean water demand intensifies. While agriculture and food production use over 70% of the global fresh water supply, [four billion people experience severe water scarcity.](https://www.science.org/doi/10.1126/sciadv.1500323). At the same time, [soil degradation](https://www.weforum.org/agenda/2020/12/a-tangible-plan-to-restore-soil-health-in-the-next-ten-years/), to rise to 90% by 2050, and volatile fertilizer prices and supplies swing with contemporary geopolitical tensions. All these challenges threaten agricultural production and food security.

At the same time, our existing sanitation and wastewater management systems are faltering, buckling under the strain of urbanization and industrialization. A [recently published UNEP report](https://www.unep.org/resources/report/wastewater-turning-problem-solution) that I contributed to, states that about 400 billion cubic metres of wastewater is generated annually, but less than half undergoes treatment. The remainder, laden with pollutants, finds its way into our natural ecosystems, wreaking havoc and contributing to a cycle of environmental degradation.

# The links between sanitation and food security

However, significant amounts of nutrients and well water, are embedded in wastewater and can be recovered and used in agriculture, as done in Spain. Traditional agricultural practices lean heavily on chemical fertilizers, posing challenges with dwindling phosphorus reserves and the environmental impact of nitrogen fertilizers, produced through energy-intensive processes like the Haber-Bosch process. Wastewater reuse in agriculture and other types of agricultural resource recovery, can mitigate these dependencies, offering a sustainable solution to enhance food security, particularly in water-scarce regions.

# Climate mitigation and adaptation through resource recovery

The benefits of recovering resources from sanitation and wastewater systems extend beyond agricultural yields. It represents a dual force for climate action: mitigation and adaptation.

In an era where droughts and erratic weather patterns are increasingly common, the reuse of treated wastewater enhances agricultural resilience to climate change on agriculture as shown in the example above from Spain. Other examples of agricultural wastewater reuse initiatives have been documented in the UNEP report from [Colombia](https://gefcrew.org/participating-countries/antigua-barbuda), [Egypt](https://files.grida.no/wp-content/uploads/2023/08/SickWater_CS-3.pdf), [Tunisia](https://files.grida.no/wp-content/uploads/2023/08/SickWater_CS-9.pdf), and [Tanzania](https://files.grida.no/wp-content/uploads/2023/08/SickWater_CS-6.pdf), as well as initiatives from many other countries that have been [documented elsewhere](http://dx.doi.org/10.53325/MMII9537). Initiatives for the reuse of nutrients and organic matter from human excreta in [Burkina Faso](https://files.grida.no/wp-content/uploads/2023/08/SickWater_CS-4.pdf) and [Georgia](https://files.grida.no/wp-content/uploads/2023/08/SickWater_CS-16.pdf) have contributed to restoring soil fertility in degraded soils and ultimately, towards enhancing rural farmers’ livelihoods.

Moreover, substituting chemical fertilizers with the nutrients recycled from sanitation systems can significantly reduce greenhouse gas emissions. Wastewater contains [16.6 million tonnes of nitrogen, 3 million tonnes of phosphorus and 6.3 million tonnes of potassium](https://doi.org/10.1111/1477-8947.12187). Discharging these nutrients into surface waters can harm marine ecosystems.. Nutrient enrichment in marine ecosystems such as mangrove forests, coral reefs, and seagrass beds impedes their ability to serve as carbon sinks absorb [up to 5 times the amount of carbon](https://doi.org/10.1038/ngeo1123) that terrestrial forests absorb.

It is further estimated that through recycling the nutrients available in human urine, [up to 25%](https://res.slu.se/id/publ/111777) of the global demand for nitrogen and phosphorus in agriculture could be covered. In many countries, treated sludge from sanitation systems is applied to agricultural land as a soil conditioner. Ongoing initiatives in [Sweden and elsewhere in Europe](https://doi.org/10.1016/j.scs.2016.09.013) aim to take this further by developing and scaling up source separation sanitation systems to capture the nutrients in urine upstream without further contamination or dilution, hence enabling higher nutrient recovery efficiencies and ultimately lower GHG emissions from substituting artificial fertilizers.

# Challenges and opportunities in scaling up

Maximizing resource recovery's benefits for food security and climate action necessitates overcoming barriers to its scaled implementation.

It is estimated that only 11% of wastewater generated globally is currently being reused, although informal reuse could be much higher but difficult to monitor and quantify. The availability of actionable and good quality data about wastewater generation, treatment and reuse varies across countries. Existing data and information availability deficits create difficulties in the design of resource recovery initiatives , tracking implementation progress and informing policy agendas about wastewater reuse.

The financing of wastewater treatment and resource recovery initiatives is challenging due to the upfront capital required for building and adapting infrastructure for resource recovery. Public funds have traditionally supported wastewater infrastructure, but resource recovery opens avenues for private investment. However, the long-term economic viability of resource recovery initiatives is often uncertain, especially in low- and middle-income countries where sanitation infrastructure investments have not kept pace with urbanization and population growth. Furthermore, the misalignment of financial incentives, such as subsidies for synthetic fertilizers but not for excreta-derived ones, complicates resource recovery initiatives.

Public perceptions around the environmental and health risks associated with contaminants in wastewater present substantial challenges beyond mere risk management. These concerns, often rooted in misconceptions rather than actual risk levels, act as significant barriers to wastewater reuse, touching upon cultural taboos, social stereotypes, perceptions of quality, and alternatives to reclaimed resources. Addressing these issues requires a broader approach to risk governance, which should not only be about risk management, but also about risk communication i.e. how we communicate about the risks and benefits linked to wastewater reuse.

# Forging Ahead: Resource Recovery in the Climate and Food Security Nexus

Following COP28 in Dubai, one of the declarations called for increased global action to address the inter-connected challenges across climate change and the global food system. Several major global initiatives like the Race to Zero Food Systems, the Global Alliance for Climate-Smart Agriculture and the Global Alliance for the Future of Food were unveiled to make food systems more resilient and low-carbon.. It is clear that making interventions towards recovering resources from sanitation and wastewater management systems are crucial for aligning with these initiatives. However, scaling up resource recovery initiatives faces the challenges described above, requiring action in three areas;

* Innovations in communicating wastewater issues: Enhance public engagement through compelling stories, creating tighter linkages between water and related sectors for reuse, like agriculture and energy.
* Innovations in separating the waste streams that go into wastewater to enable more efficient resource recovery: Foster collaborations between academia, industry and other water practitioners to enhance resource recovery.
* Innovation in financing mechanisms and strategies: Explore new economic incentives, public-private partnerships, or even crowdfunding campaigns to attract investment and funding from various sources to enable more robust wastewater management and resource recovery systems.

For more info, the link to the UNEP report <https://www.unep.org/resources/report/wastewater-turning-problem-solution>