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Taking stock: Sanitation sector needs to take greater responsibility to mitigate greenhouse gas emissions

Paul Hutchings

Sanitation is a significant contributor to greenhouse gas emissions

In the run up to UN Climate Change Conference 2021 (COP26), various position papers have been published on climate change and sanitation (and broader WASH) (WaterAid, 2020; IRC and Water For People, 2021). For logical reasons they have largely focused on climate resilience and adaptation strategies. There is a clear need to adapt sanitation systems to deal with climate impacts and to provide high quality sanitation services to underpin societal resilience.

Yet the recent report by the Intergovernmental Panel on Climate Change (IPCC, 2021) shows the absolute urgency with which rapid reductions in greenhouse gas emissions are required. It presents the underpinning science that demonstrates that by 2050 the world needs to move to net zero carbon dioxide (CO_2) emissions to avoid catastrophic global changes. It also emphasizes the short-term need to rapidly reduce the release of methane (CH_4) and nitrous oxide (N_2O) emissions, as they play a significant role in near-term global warming.

The IPCC report is clear that what they term the 'wastewater sector' is a significant source of greenhouse gas (GHG) emissions, especially the direct release of CH_4 and N_2O from biogenic processes as organic waste breaks down within treatment or the environment, as well as the indirect release of CO_2 via fossil fuel-based energy and products. This must be a triggering moment for the international sanitation sector. We cannot just focus on adaptation and resilience but need to take responsibility for mitigation to eliminate, reduce, and, if necessary, offset GHG emissions (see box for definition of key terms).

Key definitions:

Adaptation: In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities.

Resilience: The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure while also maintaining the capacity for adaptation, learning, and transformation.

Mitigation: A human intervention to reduce emissions or enhance the sinks of greenhouse gases.

Source: IPCC, 2018

However, there remain important gaps in what we know about emissions from the sanitation sector, while there are huge moral dilemmas about how best to deliver mitigation. So, in this editorial, we offer some brief reflections on the current evidence and suggest some possible sources of inspiration and learning that we can draw on as we seek to face up to this immense challenge.

What is the current evidence on emissions from sanitation?

There is a growing body of evidence on GHG emissions from sanitation. The most widely cited estimate for emissions from wastewater suggest it accounts for ≈1.6 per cent of total global emissions but around 5 per cent non-CO_2 emissions (Lu et al., 2018), with most of these emissions coming from high-income countries and only 8 per cent from low-income countries. These estimates come from a scientific understanding of emissions that is biased towards sewerage systems with centralized wastewater treatment, as compared to on-site sanitation systems (Dickin et al., 2020).

There remains significant uncertainty about emissions from on-site sanitation and this obscures our understanding of the GHG contribution in the Global South. Estimates of emissions for some GHGs are available for pit latrines (Reid et al., 2014) and septic tanks (Huynh et al., 2021); however, these are largely based on country-specific studies and what evidence is available indicates that environmental conditions and variation in operation and maintenance can dramatically change emissions even from the same facility type. There is therefore a need for further studies to support more robust evidence and guidance on emissions for on-site sanitation, which are estimated to account for the majority of future growth in sanitation systems (WHO and UNICEF, 2021).

There is also a need to identify and chart feasible routes to reducing emissions. On one hand, reductions can come from changing the conditions under which organic waste breaks down, which is determined by how waste is collected and treated, and how facilities are sited, operated, and maintained. For example, aerobic conditions result in lower methane emissions than anaerobic conditions (IPCC, 2019), so pit latrines below groundwater levels will produce more CH_4 than pits above the water table. On the other hand, circular economy and related approaches provide an opportunity for indirect emission reduction via the production of energy or fertilizer or other products, replacing fossil fuel-based ones (Dickin et al., 2020). There is significant momentum behind the concept of the sanitation circular economy; however, evidence indicates that approaches are often beset by operational difficulties and many initiatives do not prove viable (Mallory et al., 2020). This poses questions about whether increasing the technical and operational complexity within the sector is really a viable route for mitigation.

How can we move from improved scientific understanding to action?

As the evidence builds around the significance of sanitation as a source of GHG, we will face ever greater pressure to adjust practice and take action to meet the challenges of the climate emergency. However, we cannot forget that the sector already faces many nearly intractable problems that have long prevented the realization of the human right to sanitation. This includes developing viable and robust financial systems to fund sanitation services for all, having the right skills and personnel to run professional systems in safe and equitable ways, as well as dealing with emergent health risks such as anti-microbial resistance and novel pathogens such as SARS-CoV-2 (Howard, 2021), among many other issues. Faced with such problems it is easy to be disheartened.

However, we are not alone. Many other sectors are facing such existential problems and it is worth reflecting on how they are responding to climate mitigation challenges. The agricultural sector, especially its livestock arm, is the most directly relatable as it faces the same challenge of dealing with large amounts of organic waste. It has also been identified as a priority sector for reform to reduce GHG emissions for longer than the sanitation sector, which means that it has experience in trying to address these issues. A review of mitigation in the global livestock sector highlighted carbon sequestration through land management changes, altering livestock feed to reduce enteric fermentation, adjustments in manure management, modifying fertilizer practices for animal feed, and influencing human dietary trends to reduce meat consumption, as possible routes for mitigation (Rojas-Downing et al., 2017). Although the precise mechanics of mitigation are clearly different, the most worrying conclusion from this review was that although there are many options available, these are not widely used and there is a need to scale up and enforce mitigation through policy.

Here, we can draw analogies with the use of regulation for wastewater standards. We may need to avoid the period of inaction that has largely been seen in the agricultural livestock sectors and shift towards the establishment of guidelines and regulatory standards on GHG emissions from wastewater, rather than wait for operators to adopt them. We know that in many contexts such regulations are rarely enforced and do not reach beyond the sewerage-wastewater treatment systems. In this sense, such top-down action is only likely to be partially effective in leading to direct change, but it would present an important normative move to create such standards, which could galvanize action and support professionalization. As we look forward to the post Sustainable Development Goals global policy setting process, it would not be surprising to see sanitation (and broader WASH) development goals that include ambitions for net-zero systems.

There is also another important lesson from the livestock agriculture sector. That is, the identification of the most polluting forms of livestock and an attempt to shift away from these or develop bespoke solutions to reduce emissions from these sources. Ruminant meat, especially beef herds, are especially polluting in terms of GHGs with cattle (including meat and dairy) estimated to account for 35–40 per cent of global CH_4 release each year (FAO, 2006). We therefore need to make further progress in unpacking the black box of emissions from on-site sanitation and identify in what circumstances the most widely used facilities, such as VIP latrines and septic tanks, emit the most GHGs and how we can adjust their design or support the rollout of alternative facilities. As we look forward, novel ways of capturing gaseous streams or preventing them in the first place may emerge; however, there are simple steps that can be taken now, such as improving the siting of facilities and the frequency of and techniques for emptying them, that we must promote and support.

Taking responsibility for the hand we are dealt

Climate change – to borrow a famous phrase – is an inconvenient truth. Mitigation will probably make things harder in a sanitation sector that already struggles to live up to its own ambitions, yet it is the existential problem the world currently faces, and we cannot run away from it. We need to step up to the challenge and reduce the emissions from the sanitation sector.

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