Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Perspective

Discussion on 'Challenges, opportunities, and innovations for effective solid waste management during and post COVID-19 pandemic, by Sharma et al. (2020)'

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We agree with Sharma et al. (2020) with the fact that during- and post-global pandemic due to coronavirus disease 2019 (COVID-19), management of solid waste that includes medical and health care waste (M&HCW), food waste and plastic waste becomes cumbersome for concerned authorities. Though Sharma et al. (2020) have suggested employing incineration, autoclaving, gas sterilization, chemical disinfection, microwave treatment, irradiation, thermal inactivation and hydrothermal carbonization to manage the contagion wastes properly, it is challenging to implement them in lower-income countries due to low budget for management of solid waste. Further, many of these technologies are limited to research at a laboratory scale and they have not proven their efficiency at handling bulk quantities of solid waste (i.e., thousands of tonnes per day) with inconsistent physical composition, which is a very pertinent issue during COVID-19 pandemic. Also, Sharma et al. (2020) have suggested creating a small pit (refer to Fig. 3 of the original article) for the burial of M&HCW during emergency conditions like COVID-19 for the low-income or developing countries (Nigeria, Kenya and Jamaica), where thermal treatment of solid waste is not feasible owing to various issues related to the logistics and cost. Authors do agree with this idea of creation of a small pit; however, the design provided for this purpose will not be sufficient to ensure the safety of the geoenvironment. Generally, a vertical cut of three meters is not stable and it should be stabilized or supported by struts and requires special attention.

Furthermore, additional precautions should be adopted to ensure no release of wastewater (leachate) from such pits and protect the geoenvironment from the highly pathogenic strain severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). In this context, the pit can be covered with a layer of fly ash zeolites having the potential for detoxification of SARS-CoV-2. Also, laying a proper liner system (at bottom and sides) using geomembrane would be prudent to ensure the appropriate sealing of the pit. Authors further recommend providing a drainage layer for the removal and appropriate periodic sampling of leachate to ensure inactivation of viruses. Keeping these modifications in view, a revised sketch of the pit is presented in Fig. 1.

We do agree with the fact that the increase in recycling cost, reduction in crude oil prices in the international market posed several questions on the recycling of plastic waste produced during the COVID-19 pandemic. On the other hand, energy recovery from plastic waste by employing thermal treatment (viz., incineration, gasification and pyrolysis) has been suggested by Sharma et al. (2020), which is a welcoming scheme for developed nations. However, many middle and lower-income countries can valorize plastic waste produced from M&HCW or household activities as a *neo-construction* material for manufacturing civil engineering composites (viz., tiles, bricks, wood-plastic composites) as described by Goli et al. (2020) after suitable disinfection. It is worth mentioning that the high temperatures (≈110-250°C) and pressures (<180MPa) involved during this process (Goli et al., 2020) would ensure complete sterilization of plastic waste and ensure virus free composites. This would also facilitate utilization of multi-layered plastics, films, foam and other blended plastics, which have meagre recycling rates otherwise. Further, we argue with Sharma et al. (2020) on the transition to the centralized M&HCW management system (in the absence of the regulations) to comply with the pollution standards because transportation of infected M&HCW to the central facility would seek more human involvement and thus more chances for the spread of infection. This risk of spread of disease will increase with the aerosol formation during transportation if proper care is not taken (Vaverková et al., 2020). Hence, decentralized facilities/on-site treatment are much practicable to manage SARS-CoV-2 laden M&HCW under pandemic situations, and portable incinerators would be prudent in this context (Vaverková et al., 2020). However, per capita gross domestic product influences the economic sustainability of such facilities that need prior consideration.

Further, we would like to ponder on the fact that partially eaten packaged food, which is often discarded in a sealed polymer bag, is a significant fraction of the total waste generated. Under such conditions, even biochemical decomposition of perishables (food waste) would take a prolonged duration compared to their direct exposure to the environment. Moreover, authors appreciate the idea of Sharma et al. (2020) to employ artificial intelligence (AI) for the collection and segregation of solid waste post COVID-19 period. However,

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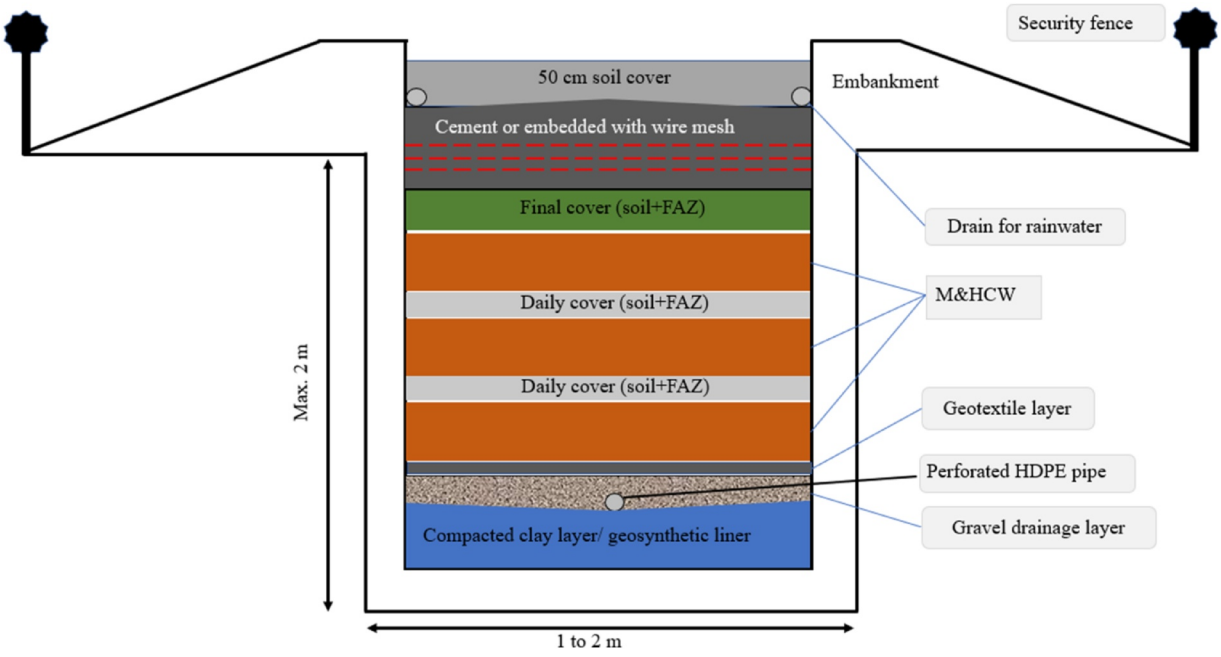

Fig. 1. Construction of a pit for on-site waste burial during CODIV-19 pandemic (Modified from Sharma et al., 2020).(note: FAZ: fly ash zeolite; HDPE: high density polyethylene; M&HCW: medical and health care waste).

development of AI should be done wisely as there are several instances of failure of AI solutions developed by reputed IT firms (viz., Google, Microsoft and Apple) after spending millions of dollars. Also, Ye et al. (2020) have reported that the AI system adopted for the environment-related issues could fail because of lack of data for validation and standardization due to diverse situations, computationally time-consuming and black-box approach. Hence, it should be realized that without a proper and authentic dataset (which is very difficult to ensure under lockdown conditions) for training and validation of a model for AI, it could be deleterious for society's benefit.

Furthermore, though we welcome the suggestion of using drone delivery for the home supply of food and medicines during the lockdown period, getting permissions from various governing and security agencies during the pandemic might become a major handicap. Also, drone delivery might get affected due to fluctuation of air density, weather conditions, theft/mischief, range of transportation, damage of drone and subsequently packages, weak GPS, operational and maintenance costs, obstacles due to power lines, lack of space for landing and take-off of a drone in highly populated regions. In addition, vehicle routing problems, which are due to the insufficient drone delivery, either by multiple trips to depot or battery and payload capacity on energy consumption, is not appropriately established (Torabbeigi et al., 2020). In order to adopt this scheme in the pandemic, studies on the traffic management system, standardization of the delivery method should be initiated on a top priority basis. In addition, keeping in view the possibility of SARS-CoV-2 being air-borne, the drone and delivery packages should be properly sanitized before and after delivery to avoid another potential route for transmission of viruses.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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