Towards managing nanotechnology-related water pollution in India

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Rapid consumption of nanotechnology-related products has increased everywhere, which is a cause of concern. Engineered nanoparticles (ENPs), for example, TiO_2, ZnO, CuO, Ag, etc. have been found in environment[1,2] and are shown to pose risks to ecological systems and humans[2]. The objective of this note is to identify research and regulatory priorities for managing nanotechnology-related water pollution in India. This information is important as unlike developed nations, the response to nanotechnology-related water pollution in developing nations, such as India, is not structured and formalized. For example, information about the presence of nanotechnology-based products in the market is not available for all countries[3], which is important for managing pollution in the environment.

In India, not much information is available on the types of industries and other agencies which might be contributing to nanotechnology-related water pollution. For example, a preliminary review of Indian companies on nanotechnology-related products and services indicates that out of 28 companies identified, most were found to be of 'Nanomaterials manufacturing' type (64.29%), followed by companies related to 'instrument and technologies' (17.86%), to services (14.29%) and finally to 'drugs and medicines' (3.57%). This initial distribution indicates that manufacturing companies could possibly be the highest source of nanoparticles-related pollution in Indian waters, if any. In addition, defence sector, academic institutions, etc. also use nanotechnology-related products; however, their contributions in nanotechnology-related pollution have not been documented so far. A review of studies on nanotechnology-related activities in India shows that most of them focus on the following areas: bacterial toxicity, policy, application, education, concentration prediction and health impact assessment. Very few studies have focused on the occurrence of nanoparticles in environment. For example, Baranidharan and Arun Kumar[4] have identified the need for ENPs occurrence data in water, indicating a knowledge gap.

Very few laboratories in India have instruments to properly characterize the occurrence of ENPs in water. Although some centralized facilities have been opened in the country through the funding support from the Government of India, these are overburdened and not easily accessible for water quality analysis. Thus, concerted efforts are needed to integrate all centralized nanotechnology-related facilities under the umbrella of the Indian central regulatory agency (i.e. Central Pollution Control Board) for involving them in water quality monitoring for building a database on ENPs occurrence in Indian waterbodies. Upon successful monitoring and building of the database on ENPs occurrence for Indian waters, it would be important to know the frequency and extent of ENP monitoring in water. This information can be obtained through efforts on prioritization of ENPs in water[5]. Further, it is also important to know whether wastewater treatment plants are able to remove ENPs from wastewater, or if they need retrofitting or additional units for their removal from wastewater. In India, there are more than 230 wastewater treatment plants operating on different processes. However, information about their effectiveness in removing ENPs is not available, indicating a need to obtain these data in order to understand the baseline situation.

The lack of information on the occurrence of nanoparticles in Indian waters makes it difficult to know the current status of nanoparticles-related water pollution in India. Further, it also limits any efforts towards estimating exposures of nanoparticles from Indian waters. Thus, it is extremely important to determine nanoparticles concentration in Indian waters, an important first step towards quantitative nanoparticles-based risk assessment for humans.

To respond to this issue, a nanotechnology-related water quality framework NP-WQ (nanoparticles–water quality) is proposed (Figure 1), which consists of two important components: (1) analytical capacity building of water utilities and regulatory laboratories, and (2) initiation of studies on long-term monitoring of ENPs in water and exposure studies. Once these data are available, the proposed framework can be used for identifying nanoparticles that require immediate attention.

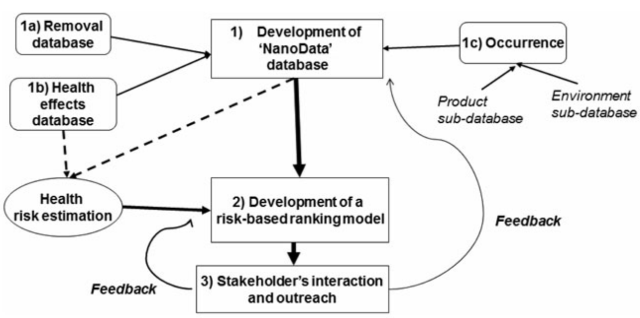

Figure 1. Schematic of the proposed 'NP–WQ' framework.

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