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A STUDY ON IMPACT OF NANOMATERIALS ON ENVIRONMENT

[1]Dr. Shalini Sharma, [2]Dr. Kavita Yadav, [3]Dr.Vishal Pathak,
[1,2]Narain (P.G.) College, Shikohabad Distt. Firozabad
[3]Paliwal (P.G) College, Shikohabad Distt. Firozabad

ABSTRACT

Nanotechnology encompasses a wide range of Nano scale technologies, including medicines, biotech, genetics, neuroscience, robots, and information technology. In global discussions on risk regulation & international cooperation, nanotechnology is considered as the most recent technical advance. Biocides, cosmetics, food additives, food labeling, and materials in interaction with foodstuffs all now have special nanomaterial provisions. The key difficulties are public trust, potential hazards, and environmental issues, as well as information transparency and ethical Nano science and nanotechnology research. The purpose of this essay is to examine the major issues surrounding nanotechnology regulation as well as some ethical issues. The introduction of nanotechnology in the previous two decades has raised the risk of nanomaterial exposure by breathing, ingestion, skin absorption, and medication delivery utilizing engineered nanomaterials.

Keywords: Nano-material, nano-technology, environmental impact, risk and regulation and health impacts

INTRODUCTION

Nanotechnology is a field that has shown rapid growth in recent years. Individual nations are expanding their investments in R&D in this field. Nanotechnology's solutions are applied in a variety of fields, including medical, electronics, energy, the food industry, information and technology, aerospace engineering, and communication. Nanotechnology is classified as a dual-use technology since it provides both chances for human advancement and development while also posing a major threat to human and environmental health and well-being. It is a relatively new subject, and the long-term effects of nanomaterials on human bodies and the environment are not always understood. Because nanomaterials can quickly infiltrate biological membranes, they may have increased biological activity. As a result, nanoparticles may have hazardous qualities, posing a risk to animals and humans. (Gicheva & Yordanov, 2014) Presently, the greatest concern linked with nanotechnology is the lack of responsibility over it; there have been no technical tools to monitor the existence and effects of nanoparticles and nanomaterials, for example, in the environment. Although the European Union (EU) has had rules relevant to nanotechnology since 2004, there seems to be no suitable regulation. Nanotechnology is a field that has shown rapid growth in recent years. The goal of EU regulation is to give open access to breakthrough nanotechnology uses while also safeguarding public safety, healthcare, and environmental protection. (Al-mutairi, 2013)

Exposure of Nanomaterials to Environment and Humans

With increasing manufacturing volumes and a growing number of commercially available nanotechnology-based goods, nanomaterial exposure to employees, customers, and the environment becomes inevitable. Exposure is an important factor in determining the danger of nanomaterials since it is a prerequisite for the development of toxicological and Eco toxicological consequences. The nanoparticles can enter into the body from air, water, food, clothes or drug delivery systems. Most of these nanoparticles travel through the blood stream to reach organs such as kidney, brain and liver.(Uk & Partnership, 2012)

Free nanoparticles could either get into the environment through direct outlet to the environment or through the degradation of nanomaterials (such as surface bound nanoparticles or Nano sized coatings). There are numerous ways to be exposed to the environment. Drugs are frequently coated, however studies have also shown that these coverings can be destroyed either by metabolism within the human body or by UV-radiation in the environment. Nanoparticles can be discharged into the atmosphere as aerosols, as well as into the soil and groundwater, based on the type. Nanoparticles can be released to the environment as bare nanoparticles, functionalized nanoparticles, aggregates, or embedded in a matrix. Nanoparticles that are intentionally or unintentionally discharged into the environment scatter throughout the environment, reaching water, land, and the air, where they might remain for a long time or be picked back by biological organisms. They can act as Eco toxicological hazard on undergo biodegradation or bio accumulate in the food chain.(Uddin, 2007)

Table 1: Potential risks of exposure in nanoparticle production processes

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Synthesis Process	Particle Formation	Potential Risks	Potential Dermal/Ingestion Risks
Gas Phase	In air	Direct leakage from reactor Product recovery Post recovery processing and packing	Airborne contamination of workplace Handling of product Cleaning/maintenance of plant
Vapour Phase	On substrate	Product recovery Post-recovery processing and packing	Dry containment of workplace Handling of product Cleaning/maintenance of plant
Colloidal	Liquid suspension	Drying of product (processing and spillage)	Spillage/containment of workplace Handling of product Cleaning/maintenance of plant
Attrition	Liquid suspension	Drying of product (processing and spillage)	Spillage/containment of workplace Handling of product Cleaning/maintenance of plant

Sustainability and Nanotechnology

Nanotechnology is usually recognised as one of the main facilitators for sustainable development, like boosting the efficiency of numerous manufacturing processes, due to its immense potential for advantages. Nonetheless, it is acknowledged that the use of new nano-based technologies may result in new issues and problems in all aspects of sustainability. (Biswas & Wu, 2005)

Thus, when designing products and processes for sustainability, or during their implementation, production and final disposal, is of paramount importance to avoid unintended consequences of what may initially appear to be beneficial, when first introduced in the marketplace. Of these unintended consequences, the majority of the concerns arise from adverse health and environmental effects because of widespread dispersion of the material in nature creating spontaneous exposure to living beings.(IGARASHI, n.d.)

Unsuspected health and environmental impacts, created by lack of foresight, occurred in past situations due to the utilization of particular substances that offered solutions to many industrial and societal needs but over some time their deleterious effects began to emerge, such as asbestos, lead, methyl tertiary butyl ether (MTBE), dichlorodiphenyltrichloroethane (DDT), perfluorooctane compounds (PFOs), and polychlorinated biphenyls (PCBs), among others. The reduction or even the elimination of the introduction of these pollutants into the environment without considering their long-term impacts represented a missed opportunity of investing in research to prevent their undesired legacy. Because nanotechnology is still in its early stages, it would be smart to look for negative environmental and health repercussions before introducing a nanomaterial into the marketplace, as these impacts may be noticed and/or recognized in the future. (Hull, 2007)

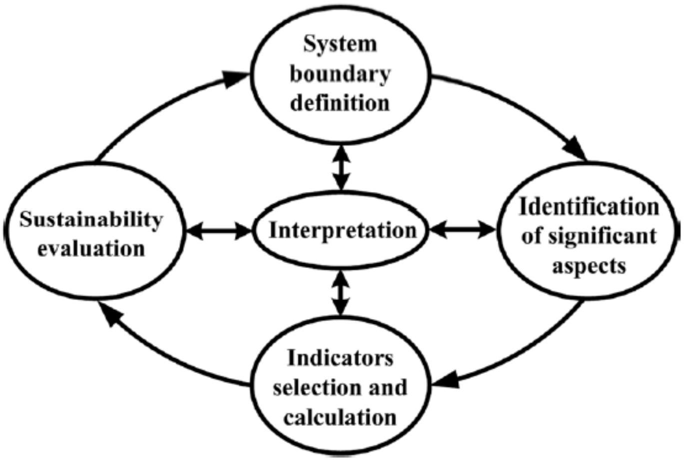

Figure 1: Method used for the sustainability assessment of nanotechnology based products and processes.

LITERATURE REVIEW

(Baran, 2016) Nanotechnology encompasses a wide range of nanoscale technologies, including medicines, biotechnology, genetics, neuroscience, robotics, and information technology. In worldwide discussions on risk regulation and international collaboration, nanotechnology is the most recent technical advance. Regulatory agencies have begun to address the possible dangers posed by nanoparticles. The European Union has been working on a regulatory policy to tighten control and increase regulatory sufficiency and knowledge of nanotechnology concerns since 2004. Biocides, cosmetics, dietary supplements, food labeling, and materials in interaction with foodstuffs all now have particular nanomaterials provisions. The key difficulties are public trust, potential hazards, and environmental problems, as well as information transparency and ethical Nano science and nanotechnology research. The purpose of this essay is to examine the major issues surrounding nanotechnology regulation as well as some ethical issues.

(Mata, 2015) overviewed the present state of the art in terms of nanotechnology sustainability evaluation, including existing methodologies, concepts, and indicators, with an emphasis on human health and the environment Special emphasis is placed on identifying significant gaps

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in the existing state of knowledge that must be addressed in the near future in order to assure accurate judgments and strategies for the development of this rapidly growing and vital field. Some crucial factors need to be considered when evaluating the long-term viability of nanotechnology-based goods and processes, both now and in the future. It introduces and examines a set of three-dimensional (3D) indicators that take into account the 3d of sustainability (economic, environmental, and societal). From a sustainability standpoint, unique issues faced by nanotechnology are also discussed.

(Sajid et al., 2015) Nanotechnology has changed the world by introducing a new class of materials as well as consumer items in a variety of fields. It has resulted in the development of novel materials and technology. Despite their significant benefits and uses in the home and industrial sectors, the usage of Nano scale materials has prompted concerns about worker, consumer, and environmental safety. Nanoparticles have the potential to harm humans and wildlife through a variety of processes due to their small size and other unique properties. We looked at the features of nanoparticles that determine their toxicity. The effects of dermal contact, inhaling, as well as ingestion have all been thoroughly discussed. Because there is so little evidence on long-term human exposures, it is critical to develop methodologies for determining the short and long-term effects of nanoparticles on humans and the environment. In addition, we briefly explore options for limiting human exposure to hazardous nanoparticles. We've reviewed the current state of nanoparticle toxicological research, as well as its accomplishments, flaws, and potential difficulties.

(Bloch et al., 2014) The goal of this paper is to provide an overview of current knowledge about processes related to ENM environmental destiny and behaviour. The importance of key environmental processes as inputs for ENM fate modeling will be recognised, explored, and prioritized. Furthermore, information gaps will be prioritized based on their importance in predicting ENM concentrations in the environment. In addition to serving as a project output in and of itself, the report's findings and conclusions will be fed into following subprojects on environmental fate modeling and risk assessment, ultimately resulting to an environmental impact assessment of the selected ENMs.

(Kühnel et al., 2014) Evaluating the environmental impact of new technologies or newly generated compounds is difficult, especially when the test methods used - both toxicological and analytical - are frequently discovered to be inadequate and require adjustments or even new inventions, as is the situation with nanotechnology. Several works in the field of nano-ecotoxicology demonstrate this, as they practically never allow unambiguous statements on potential hazards of these nanoparticles, despite the fact that they are examining the influence of a number of nanomaterials on a variety of creatures. This issue not only makes it difficult to communicate scientific knowledge to non-scientists (e.g., customers), but it also makes it difficult for scientists to disseminate their findings to other scientists.

(Iavicoli et al., 2014) The current economic development paradigm, which is based on ever-increasing resource consumption and pollution emissions, cannot be sustained in a world with finite resources and ecosystem capacity. The idea of the "green economy" has provided an opportunity to transform how society regulates the connection of the economic and environmental realms in this setting. The affiliated notion of "green nanotechnology" aims to capture nano-innovations in materials engineering to produce processes and products that are energy efficient as well as efficient and ecologically sustainable, in designed to facilitate social structure to create and strengthen a green economy. These applications are projected to have an impact on a wide range of industries, including energy generation and storage, clean-tech, and construction and infrastructure facilities. These solutions may provide opportunity to minimize raw material trading pressures, enhance power delivery systems to make them more reliable, effective, and reliable, and use unconventional water sources or nano-enabled construction equipment, all of which would enhance ecosystem as well as livelihood situations.

CONCLUSION

The development of nanotechnology in India has largely been predicated on the theory that this current and innovative technology has enormous potential to assist the country in addressing sustainability issues such as water supply, healthcare, and so on, while also generating economic benefits through development in the nanotech-based industrial sector. Since before the early 2000s, the government has made a concentrated effort to cultivate and encourage nanotechnology in India. Despite the constraints of assessing the sustainability of nanotechnology goods and processes, qualitative techniques that suggest which areas are more important and therefore should be addressed as research priority are still viable. The majority of them are directly related to risk assessment and nanotechnology's effects on the environment and people's health.

Meanwhile, it should be underlined that the toxicological profile of the corresponding bulk material cannot be used to assess the safety of nanoparticles and nanostructures. Nanotechnology would only be enabled to reach its full potential if the challenges revealed by toxicological studies on nanomaterials are addressed, opening the door for safer products and a better standard of living. It is highly essential that a regulatory framework should be developed based on the outcomes of scientific research which will limit human exposure to unwanted engineered nanomaterials in the environment to safer levels. Interdisciplinary research approach involving materials scientists, toxicologists, medical practitioners and environmental engineers is recommended for understanding the future impact of nanomaterials on human health and environment.

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