NANO-DEV Nanotechnology for development

POLICY BRIEF

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Nanotechnologies for development

Towards a framework for democratic governance of risks and benefits in the global South

In recent years billions of dollars have been invested in nanotechnology research. Nanotechnology, usually defined as the understanding and control of matter at the nano-scale, is said to have such pervasive consequences that the 21st century is already proclaimed to become the 'nano-century'. Scientists and engineers across the globe are currently exploring the new characteristics that materials acquire at the nano-scale.

Nanotechnology may also contribute to development in the global South. The new characteristics of nanotechnologies are also said to offer solutions for problems faced by people in the global South, especially in the fields of water, energy, and health. For instance water filters, energy storage systems, solar powered electricity and portable diagnostic tests may be developed and improved using nanotechnology.

But the very same features that give rise to new opportunities may also generate new risks. There may be risks to the human body and environment. But for instance also investing in nanotechnology itself can be seen as a risk. After all, it is not guaranteed that nanotechnology will deliver the desired

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solutions, nor that it will do so in a better or cheaper way than existing technologies.

Much is still unknown about the relation between technologies at the nano-scale and development. In order to understand the potential role of nanotechnologies for development, several issues need to be addressed. For instance, how can different stakeholders engage in thinking about nanotechnologies? How are risks and benefits taken into account? How and why do laboratories engage in nanotechnologies? And how can nanotechnologies travel from the laboratory to the market or from one geographical context to another?

This policy brief reviews the existing literature on nanotechnology for development. On the basis of this literature the NANO-DEV project identifies a number of gaps in our understanding of the relation between nanotechnology and development.

Nanotechnology

Technologies at the nano-scale are very small. The width of a human hair is about 80,000 nanometers wide, whereas nanotechnology is concerned with phenomena taking place within the range of 1 to 100 nanometers.

Several breakthroughs in microscopy in the 1980s, most notably the development of the scanning tunnelling microscope

enabled scientists to visualize and manipulate materials at the nano-scale in an unprecedented manner.

At this scale, some materials acquire new properties due to a combination of scale effects and the operation of quantum laws.

Benefits for development

The new properties that materials acquire at the nano-scale can be used in all sorts of applications. After the launch of the United States nanotechnology initiative in 2000, several commentators also started drawing attention to the application of nanotechnology to non-Western contexts.

One major issue that has been raised with respect to the global South is the effect of nanotechnology on global inequalities (Cozzens and Wetmore 2010). Negatively phrased, engagement in nanotechnology by countries in the global South is said to be required in order to avoid that this new technological wave deepens, rather than helps bridging the global divide. In this context, some authors have already spoken of a newly emerging 'nano-divide' (RS/RAE 2004).

Taking a more positive perspective, studies such as Mnyusiwalla, Daar and Singer (2003), Meridian Institute (2005) and Salamanca-Buentello *et al*. (2005) have focused on the benefits of particular nanotechnology applications.

Especially in the fields of water, energy and health, it has been pointed out that nanotechnology can contribute to the creation of cheaper and more efficient technologies that can help the poor, such as improved water filters, energy storage systems, solar powered electricity, and portable diagnostic tests (Mnyusiwalla, Daar and Singer, 2003; Meridian Institute, 2005; Salamanca-Buentello *et al*., 2005).

Besides direct benefits for the poor, many commentators and policy-makers in the global South also regard nanotechnologies as a source for economic growth. These new technologies may disrupt vested interests and technological trajectories, opening up windows of opportunity for new players.

Nanotechnology in developing countries

Several countries in the global South have meanwhile invested in nanotechnology. The ICPC NanoNet has identified over fifty countries in Latin America, Africa, Asia, Eastern Europe and the Caribbean engaged in nanotechnologies.

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There are large differences amongst countries in the global South. Some countries, like India, Egypt, Brazil and South Africa, have invested substantial sums of money through dedicated programs. Often these are large countries with emerging economies. Dedicated programs and strategies have been generated with strong political support.

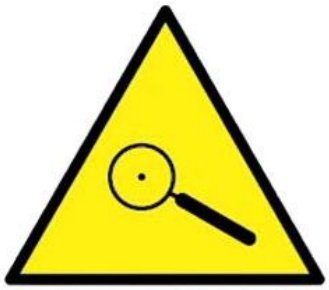
In other countries in the global South things look different. Several African countries, like Nigeria, Kenya, Uganda and Zimbabwe have expressed their interest in nanotechnologies and some activities can indeed be observed. But generally this activity does not exceed the level of individual researchers and incidental funding.

The world map below shows the number of publications in nanotechnology in 2009. The map was created using figures from the Annual Reports on Nanotechnology compiled by ICPC NanoNet

Risks for development

But nanotechnologies may not only bring benefits. The potential consequences of this future technology may also frustrate development. For instance the same properties that make nanotechnology so promising may also entail new risks to human health and the environment. Several studies have shown that some nanomaterials are toxic and also countries in the global South should deal with these risks.

Furthermore, properties at the nano-scale may be used to imitate the properties of rare minerals, thus affecting the export rates of their main producers, usually countries in the global South.



Nanotechnologies may thus have reverse effects on material demands and consequently on the export of raw materials by countries in the global South (Schummer 2007).

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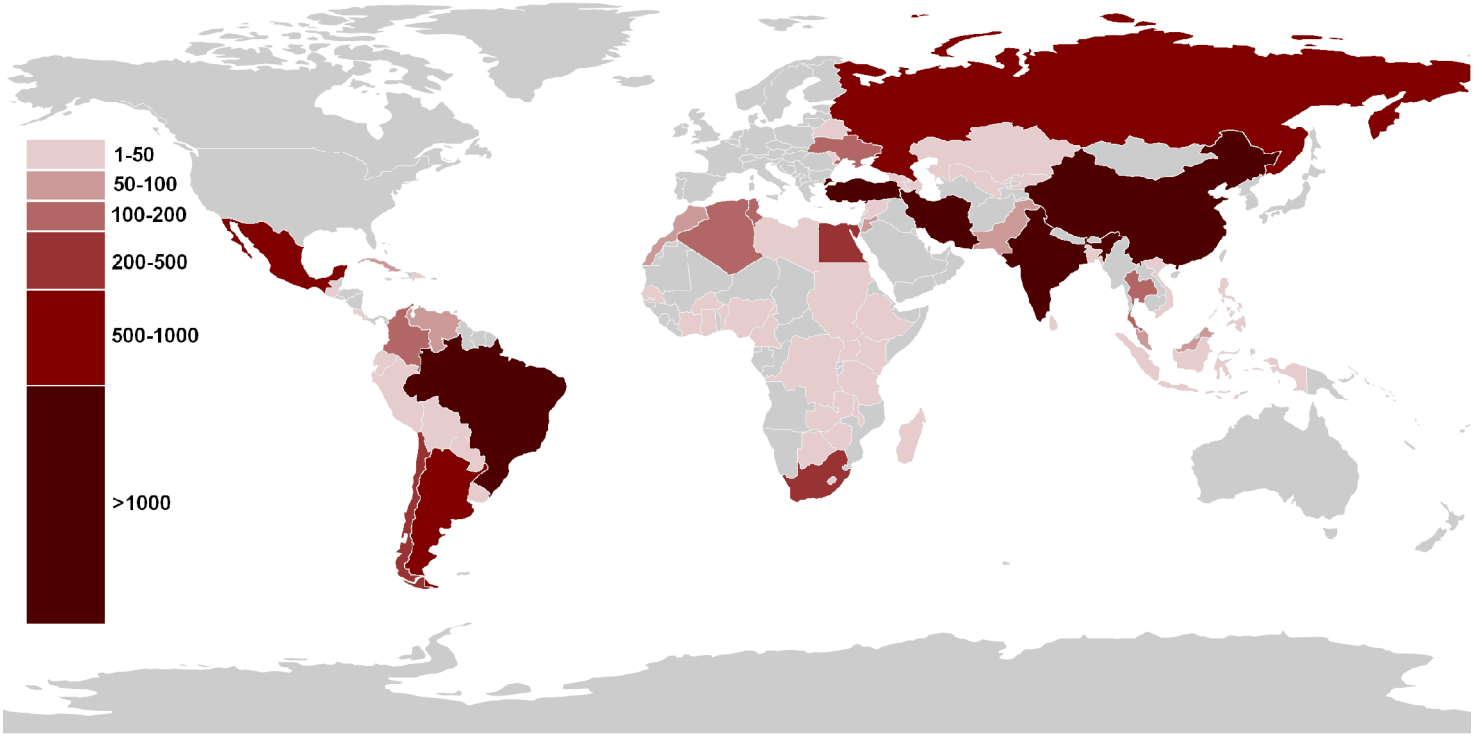

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In a series of insightful articles, Noela Invernizzi and Guillermo Foladori have tempered the enthusiasm for nanotechnology as a technological fix and have instead drawn attention to the importance of the social context in which it develops (Foladori and Invernizzi, 2005; Invernizzi and Foladori, 2005; Invernizzi, Foladori and Maclurcan, 2008). Neglecting the socially embedded nature of nanotechnologies may cause developments to fail and thus to a waste of resources.

More specifically, the NANO-DEV project identifies four main challenges in the governance of nanotechnology for development.

1. Cultures of innovation
2. Travelling technology
3. Knowledge brokerage
4. Risk governance

These four challenges need to be dealt with in order for nanotechnology to contribute to development.

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Addressing these challenges is crucial for nanotechnology to contribute to development. But little is known about how these challenges are and should be dealt with. The NANO-DEV project therefore aims to improve our understanding about the governance of nanotechnology for development in these domains.

One point of departure is that each country should participate in advanced modern technologies in their own, culturally specific ways. The project therefore aims to investigate nanotechnologies for development in four distinct cultural environments (India, Kenya, South Africa and the Netherlands).

Key message: Nanotechnology can have both positive and negative consequences for countries in the global South. These should be pro-actively dealt with.

- The positive consequences of nanotechnology include direct benefits in the form of solutions to the problems of the poor and indirect benefits in the form of economic growth
- The negative consequences of nanotechnology include direct risks to human health and the environment and indirect risks such as a deepening of the global divide.
- Core challenges to harnessing nanotechnology for development include risk governance, cultures of innovation, knowledge brokerage and travelling technology.

About us

The NANO-DEV project is a partnership of three research institutes led by Maastricht University. Besides Maastricht University (the Netherlands), it includes the University of Hyderabad (India) and the African Technology Policy Studies Network (Kenya). Further details about the project, contact details, results and publications are available at **WWW.NANO-DEV.ORG**

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NWO Netherlands Organisation for Scientific Research
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