APPROPRIATE NANO-INNOVATION

A Schumacher Institute Challenge Paper

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The Challenge: If nanotechnology is to play an appropriate role in addressing the health-related challenges faced the world's poorest people in the 21st Century, there will need to be a much greater focus on some of the more equitable ways in which it can be developed.

1. Nanotechnology and the Millennium Development Goals

Nanotechnology – defined as engineering on the level of atoms and small molecules – has been proposed as playing a significant role in addressing many of the health-related targets set by the Millennium Development Goals[1] (MDGs).[2] This paper argues that if it is to do so in an appropriate manner there needs to be much greater focus on some of the more equitable ways in which it can be developed.

Table 1: Nanotechnology and the Millennium Development Goals

Claimed benefits of nanotechnology	*Related MDGs*
Cleaner water	1, 4, 5, 7
Improved disease diagnosis	4, 5, 6
More efficient drug delivery	4, 5, 6
Cleaner energy	4, 5, 6, 7

Key
MDG 1: eradicate extreme poverty and hunger
MDG 4: reduce child mortality
MDG 5: improve maternal health
MDG 6: combat HIV/AIDS, malaria and other diseases
MDG 7: ensure environmental sustainability

As shown in Table 1, the health-related benefits of nanotechnology are said to exist directly in terms of providing cleaner water, enabling more rapid and accurate disease diagnosis, and creating more efficient drug delivery systems (relating to MDGs 1: eradicate extreme poverty and hunger; 4: reduce child mortality; 5: improve maternal health; and 6: combat HIV/AIDS, malaria and other diseases). But nanotechnology is also envisaged as having indirect benefits, such as providing 'cleaner' energy, thereby reducing respiratory diseases caused by the use of less clean fuels (linked to MDG 7: ensure environmental sustainability).

It has also been suggested that health benefits will trickle down from the ability of nano-innovation to spur economic growth in the global South, through various levels of engagement with research and development (R&D). Countries as widespread as Costa Rica, Nigeria and Thailand are already engaging in nano-innovation, with the Thai government having allocated 300 million baht (around US$10 million) to nanotechnology R&D in 2010.[3] The country has already produced

1 Salamanca-Buentello, F., Persad, D.L., Court, E.B., Martin, D.K., Daar, A.S., and Singer, P.A. (2005). Nanotechnology and the developing world. PLoS Medicine 2(4): 300–303.

2 The eight Millennium Development Goals (MDGs) – which range from halving extreme poverty to halting the spread of HIV/AIDS and providing universal primary education, all by the target date of 2015 – form a blueprint agreed to by all the world's countries and all the world's leading development institutions. See http://www.beta.undp.org/content/undp/en/home/mdgoverview.html for an overview.

3 See Sandhu, A (2008) 'Thailand resorts to nanotech' in *Nature Nanotechnology* 3, 450 – 451.

nanotechnology products for export in areas including food packaging, water purification and herbal medicine and is now seeking to apply nanotech in disaster relief.[4]

2. Biotechnology revisited

However, many of the optimistic claims accompanying the emergence of nanotechnology are eerily reminiscent of those made for biotechnology and its attempts to address global inequities.[5] This presents considerable challenges:

- Presenting nanotechnology as offering blockbuster 'solutions' for the MDGs gives little consideration to the complex socio-political nature of health challenges. Such challenges demand more than technological 'fixes' — they also need awareness of the gender, geographic, cultural, societal, philosophical and religious biases that are built in to technologies throughout the various phases of R&D.

- Harnessing nanotechnologies for the MDGs is largely presented as a process of transferring nanotechnologies from rich, developed settings to poor, “undeveloped” ones. International debates say little about the potential for local, village development of 'appropriate' nanotechnologies. This is despite recent acknowledgement that many traditional Chinese medicines contain metal nanoparticles, as do certain *bhasmas* — Ayurvedic traditional medicines resulting from the combination of metals with herbal extracts, and used for millennia in India. In this way, mainstream approaches connecting nanotechnology to the MDGs perpetuate deficit thinking within international health, technology and development policy. The immense knowledge already existing across the South is unconsciously denied, as is the ecological wisdom inherent in subsistence lifestyles.

- Little consideration is made for what Southern populations might lose through trade liberalisation (MDG 8A: part of developing a global partnership for development) accompanying developments in nanotechnology. If carbon nanotubes replace copper wiring, for example, what detrimental impacts might this have on the economies of Chile, Indonesia, South Africa and Zimbabwe if such countries have little recourse for protecting their important markets in such commodities?

In a similar vein, the international patent system presents immense barriers for accessing relevant nano-innovations. The world has already experienced a 'land grab' in nanotechnology patenting that far surpasses what was seen in the equivalent historical period for biotechnology patenting. These matters are all the more critical because the value of nano-enabled products was US$166 billion in 2008 and is anticipated to rise to US$2.6 trillion by 2014.

4. Equitable futures?

However, more equitable avenues for the development of nanotechnologies already exist.[6] For example, the process of constructive technology assessment — in which technological development is simultaneously influenced by technology users, developers, investors, procurers and decision-makers — is already being used in the Netherlands for the development of nanotechnology-based treatments in oncology.[7] Similarly, the 2006 'Nanodialogues', held in Zimbabwe,sought to inspire

4 See Sarmiento, P (2012) 'Thailand's nanotech research tackles disaster prevention' SciDevNet (http://www.scidev.net) 25th January 2012

5 For more about nanotechnology's development within an historical context, see: Maclurcan, D. (2012) *Nanotechnology and Global Equality*. Singapore: Pan Stanford Publishing (World Scientific).

6 For greater exploration of more equitable avenues for the development of nanotechnologies, see: Maclurcan, D. and Radywyl, N. (2011) Eds. Nanotechnology and Global Sustainability. Boca Raton, FL.: CRC Press (Taylor Francis)

7 See Retèl VP, Hummel MJ, van Harten WH. (2008) 'Early phase Technology Assessment of nanotechnology in oncology' in *Tumori* 2008 Mar-Apr;94(2):284-90.

bottom-up approaches to nano-innovation by concurrently engaging local community groups and scientists from both the South and the North to assess the appropriateness of nanotechnologies for community needs.[8]

To bypass the inequity-creating patent system, the open source movement offers new avenues for the distributed creation of health-related nanotechnologies. The nanoHUB,[9] for example, is an online gateway providing over 100,000 annual users from more than 150 countries with information and tools, largely free of charge, for use in nanotechnology R&D. Furthermore, sites such as Open Source Nano[10] provide do-it-yourself instructions for creating simple nanotechnology-based devices for use in addressing challenges such as the removal of arsenic from water.

A more critical approach to nano-innovation that consciously considers the concept of in-built bias and the prospect of alternative paths towards its development could offer a beacon for new approaches to science and technology, and boost the role of innovation in achieving many of the MDGs. Ultimately, such changes could fuel broader movements for global health equity, and the possibility of innovation that is de-linked from national economic growth yet remains meaningful to people's lives — 'innovation without growth'. Such an approach would seem the only realistic alternative for humans living in a world with biophysical and productivity limits.

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8 Organised by researchers from Demos, the University of Lancaster and Practical Action (one of the Schumacher Circle of organisations) and held in Harare, Zimbabwe, 15, 16 and 22 July 2006, the Nanodialogues were a process designed to engage Zimbabwean community groups and scientists from both the North and South in debates about new (nano) technologies. For details of this and similar events around the developing world see http://practicalaction.org/nanodialogues-1.

9 See http://nanohub.org/

10 See http://opensourcenano.net/