

A MISTRA Policy Brief



*A research project
by The Mapungubwe
Institute for Strategic
Reflection (MISTRA)
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Beyond Imagination:

The Ethics and Applications of
Nanotechnology and Bio-Economics in
South Africa

THIS BRIEF SEEKS TO DESCRIBE the policy implications of a newly completed MISTRA research project on the advancement of emerging technologies in South Africa, and the lessons we can draw from relevant international experiences.

South Africa has made substantial progress in the research and development of nanotechnology and biotechnology. In developing countries, these emerging technologies have the potential to increase productivity and advance human progress in an increasingly technology-driven world. They are reshaping the landscape of science and technology. However, the potential benefits of these technologies

also pose risks to human health and the environment and it is therefore important that consideration is given to protecting users, researchers and others who interact with nanomaterial and biomaterial. In addition, the progress of these technologies requires support and collaboration from a vast pool of stakeholders.

Looking at the imperative for collaboration, at both the potential benefits and risks of emerging technologies and at current policy, this brief distils the policy implications for nanotechnology, biotechnology and the National System of Innovation (NSI) in South Africa arising out of MISTRA's research.

*Nanotechnology should develop in parallel
with studies in nanoethics and nanotoxicity*

Background

Nanotechnology and biotechnology are emerging technologies that promise new and exciting possibilities for the developing world. However, in order for these promises to be realised, a collaborative effort that includes extensive investment and synchronised, well-thought-out policies, as well as an active private sector, is crucial. South Africa needs to position itself strategically as a knowledge economy, which relies heavily on the nation's research agenda and its alignment with its National System of Innovation (NSI). It is thus important for South Africa to have an efficient NSI that is able to address adequately the country's developmental needs.

Simultaneously, the risks posed by these emerging technologies to human health and the environment necessitate a transdisciplinary approach to their research and development. This means that the development and application of nanotechnology should occur parallel to studies in nanotoxicity and nanoethics, while the development and application

of biotechnology needs to concurrently consider the bioethics and risks of genetic modification.

It is in this context that the Mapungubwe Institute for Strategic Reflection (MISTRA) initiated a research project, Beyond Imagination: The Ethics and Applications of Nanotechnology and Bio-Economics in South Africa, to assess the progress South Africa has made and the lessons it can draw, from relevant international experiences, in advancing its emerging technologies. The research project aimed to develop policy recommendations intended to support current policy interventions and the broad national system of innovation.

Identify and reconsider obstructive regulations and policies

Policy Challenges

Advancing emerging technologies like nanotechnology and biotechnology is crucial for a country's development. Innovation requires an enabling environment created through policies and the effective implementation of plans.

Collaboration is crucial to realising the promises of nanotechnology

There are, however, challenges posed where technological advancement does not occur

holistically. The development of nanotechnology, for example, is far ahead of the development of nanoethics. This poses risks for human health and the environment. The way in which nanotechnology and biotechnology are researched and applied in South Africa, and the rest of the continent, needs to take cognisance of the context in which these technologies are developed.

A relevant research approach must ensure that the needs of the majority are addressed and must encourage collaboration between government departments, the private sector and research institutions. Each of these sectors has an impact on the extent to which emerging technologies are developed in a socially responsible way, and it is therefore important that they work collaboratively.

Policy Context

A relevant research approach must ensure that the needs of the majority are addressed

Various plans and/or policies aimed at reversing historical atrocities and addressing the issues of development and inequality were drawn up post-1994, including policies looking at science and technology. The White Paper on Science and Technology, launched in 1996, provided the roadmap for reviewing science and technology policy with the aim of developing relevant strategies and the launching of a successful National System of Innovation in South Africa. The use of technology and innovation to drive development and economic growth was emphasised. Policies specific to advancing the emerging technologies of nanotechnology and biotechnology were introduced years later. The National Biotechnology Strategy (NBS), launched in 2001, was not as effective as envisaged, and in 2014

the National Bio-economy Strategy replaced it.

The National Nanotechnology Strategy (NNS), which aims to put South Africa on the global map of technological innovation, was launched in 2005. Various nanotechnology characterisation centres, research and innovation networks, and capacity-building programmes have been established since then. However, not enough of these innovations go beyond the research phase and deliver tangible outcomes.

The Ten-Year Innovation Plan was published in 2008 to help transform South Africa into a knowledge-based economy in which knowledge drives economic growth and human development. The plan aimed to contribute to the development of the NSI and to address socio-economic issues within the country. It acknowledged that South Africa was still significantly behind in its attempts to develop a knowledge-driven economy and to commercialise products from scientific research. The Ten-Year Innovation Plan focused on developing new and innovative technologies and on fostering multi-disciplinary approaches.

The recommendations below, arising out of MISTRA's research, are aimed at plugging some of the gaps in South Africa's policies to date, as described above.

Policy Recommendations

Regulatory Framework

1. Identify and reconsider obstructive regulations and policies in order to encourage research and the innovation of Public-Private Partnerships (PPPs). Tight regulations and bureaucracy in South Africa are slowing down the ability of PPPs to operate effectively and will greatly hinder innovation in the country.
2. Establish rigorous regulatory systems and quality controls. South Africa needs strong regulatory controls in order to manage the production and use of nanomaterials. This can be achieved

by undertaking further, extensive research into the interactions between different types of Engineered Nanomaterials (ENMs) (non-degradable or slowly degradable) and cells, in relation to their physicochemical properties. Knowledge of the preliminary material will eliminate the incorrect attribution of toxic effects to certain properties of nanomaterials.

3. Foster collaboration between the expanding nanotechnology industry in South Africa and risk-management bodies in order to achieve a balance between the unfavourable and the

beneficial effects of ENMs.

4. Develop nano-related databases, which must be consolidated in order to create definitive reference points.
5. Enforce existing laws relating to nanoethics in order to provide guidance for companies generating nanotechnology products, and to ensure that they develop products ethically.

Areas for Research

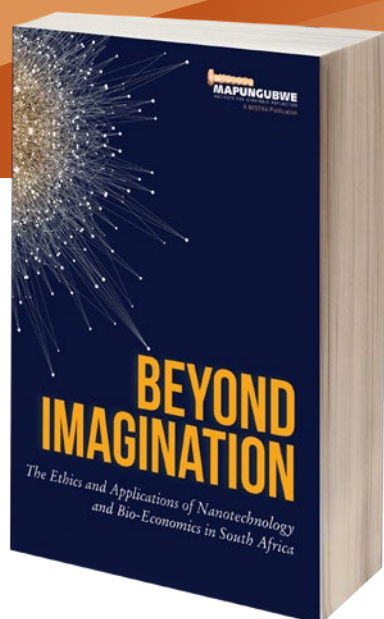
6. Create guidelines for measuring the toxicity of ENMs. This entails developing the possible best ways of measuring the toxicity of ENMs in studies and risk analyses in order to set safe exposure limits and so limit occupational exposure to ENMs.
7. Strengthen nanowaste management proposals in order to facilitate the rapid growth of nanotechnology. While occupational exposure limits are being developed, a precautionary approach should be introduced to safeguard both the environment and the health of researchers and workers handling nanomaterials.

Policy Strategy

8. Promote the development of nanotechnology in the rest of Africa in order to allow the continent to benefit from South Africa's developed nanotechnology infrastructure and network. South Africa could also help sub-

Saharan countries to develop socially inclusive nanotechnology governance aimed at the promotion of equality and equity.

9. Link nanotechnology research efforts to the Public-Private Partnerships (PPPs) operating in South Africa's poor and rural communities to foster nanomedicine in the country.
10. Provide additional funding for training and for nanomedicine scholars to work with PPPs – involving both local and international partners – and to collaborate with them to develop programmes that promote innovation and public safety.
11. Implement more productive strategies to enhance local research capabilities, help diversify specialities, and support partnerships with global innovation networks. Build local research capacity to develop and transform South Africa's nascent bio-economy.
12. Establish South–South partnerships and cooperation.
13. Ensure the effective coordination of research efforts including via PPPs, and joint research and entrepreneurship programmes.
14. Provide incentives for foreign firms to conduct R&D operations within South Africa. These would include the development of a skilled workforce within the country.



The MISTRA book containing the research findings and detailed recommendations, entitled Beyond Imagination: The Ethics and Applications of Nanotechnology and Bio-Economics in South Africa, can be purchased from:
sales@jacana.co.za | Tel: +27 011 628 3200

To contact MISTRA

Tel: +27 11 518 0260 | **Fax:** +27 11 518 0266
Email: web@mistra.org.za | **Web:** www.mistra.org.za
Address: Cypress Place North,
Woodmead Business Park,
142 Western Service Road,
Woodmead, Johannesburg, 2191

