Overview Document – Nanotechnology, Commodities and Development

Nanotechnology, Commodities, and Development

Many developing countries depend heavily on commodities for export earnings and as a primary source of employment and income for their citizens. Nanotechnology applications are being developed that could impact global markets for agricultural, mineral, and other non-fuel commodities. These applications could, in some instances, reduce demand for some commodities and, in other instances, create new or wider markets for commodities. These changes could have potentially far reaching socio-economic and other implications, both positive and negative, for developing countries.

Ninety-five out of the 141 developing countries derive at least 50 percent of their export earnings from commodities. Many commodity-dependent developing countries (CDDCs) also appear low on the United Nations Development Programme's Human Development Index. Furthermore, UNCTAD estimates that a total of 2 billion people – a third of the global population – are employed in commodity production, with half in agriculture. Awareness and understanding of the potential implications of nanotechnology for commodity-dependent developing countries (CDDCs), and developing countries in general, is of paramount importance to ensuring that the opportunities of nanotechnology for these countries are maximized, while its risks are minimized.

This document is intended to raise awareness and inform decision-makers from all sectors of society at the international, regional, national, and local levels. It describes a set of key issues that should be considered when evaluating the potential implications of nanotechnology for a developing country or commodity sector. Additional resources are listed on the last page of this document.*

What is Nanotechnology?

Perceived by many as the next "transformative technology," like electricity or the Internet, nanotechnology encompasses a broad range of tools, techniques, and applications that manipulate or incorporate materials at the nanoscale (a nanometer is one billionth of a meter) in order to yield novel properties that do not exist at larger scales.

These novel properties may enable new or improved materials, products, and processes that are more efficient, effective, and inexpensive than those currently available. For example, nanomaterials are being developed that provide greater strength, durability, and flexibility than steel, but are also lighter-weight and less expensive to produce. Additionally, nanotechnology may significantly increase production capacity by enabling manufacturing processes that create less pollution and have modest capital, land, labor, energy, and material requirements. Nanotechnology applications for agriculture, mining, minerals, fibers and textiles are already on the market and many more will be available in the next few years.

Both the public and private sectors in developed and developing countries are investing heavily in nanotechnology research and development. More than 20 countries, including middle-income developing countries such as China, South Africa, Brazil, and India, currently have national nanotechnology programs, and many more are developing or expanding nanotechnology research and development capacity. The collective public and private sector investment in 2005 was approximately USD10 billion, up 10% from 2004. Additionally, patents on nanotechnology-related inventions, scientific literature citations, and nanotechnology-based products reaching the market are skyrocketing globally.

Nanotechnology, Commodities, and Developing Countries: Opportunities and Risks

Nanotechnology has been identified as a promising area of technological advancement for CDDCs, and developing countries in general, because it may enable more efficient, effective, and inexpensive materials, products, and processes, including manufacturing processes that have modest capital, land, labor, energy, and material requirements. Nanotechnology may also create new or wider markets for commodities produced by developing countries and opportunities to produce value-added commodity products.

Concerns have also been raised that the same characteristics that make nanotechnology promising for developing countries also create the possibility that it may displace commodities, labor, and industries and worsen the overall position of developing countries. Some organizations have also expressed concerns that nanoscale

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materials could pose unknown risks, including risks to human health and the environment, which might be particularly difficult to identify and manage.

The following tables provide examples of nanotechnology applications and possible implications for commodities. The net effects of nanotechnology on supply and demand markets for commodities are difficult to predict and will likely vary for different commodities, technologies, and countries.

Examples of Nanotechnology Applications and Possible Implications for Commodities

Applications of Nanotechnology for Agriculture	
Applications	**Potential Implications**
Nano-based food additives	Value Addition
Nanosensors; nano-pesticides and fertilizers; nano-based smart delivery systems	Improved Productivity
Biofuels and biodegradable plastics	New Markets as Feedstocks
Nano-based packaging	Improved Product Quality
Functional foods; nutraceuticals	New Industrial and Commercial Markets
Functional food substitutes	Reduced Demand
Nanotechnologies for development of new acreage	Increased Supply
Nanoparticles for biomedical diagnostics, treatments, and coatings.	New Industrial and Commercial Markets
Nanoscale metal oxides for personal care products, water treatment, and energy production	New Industrial and Commercial Markets
Substitute materials such as carbon nanotubes and quantum dots.	Reduced Demand

Applications of Nanotechnology for Metal and Mining Sectors	
Applications	**Potential Implications**
Silver, titanium, and other metal nanoparticle coatings for antimicrobial properties.	Value Addition
Phytomining and microbial methods of metal nanoparticle production.	Improved Productivity; Increased Supply
Nanocatalysts for emissions control systems, environmental remediation, fuel cells, chemical processing; and petroleum production.	New Industrial and Commercial Markets
Nanoparticles for circuitry, semiconductors, optics, electronics, sensors, and other electronic devices.	New Industrial and Commercial Markets

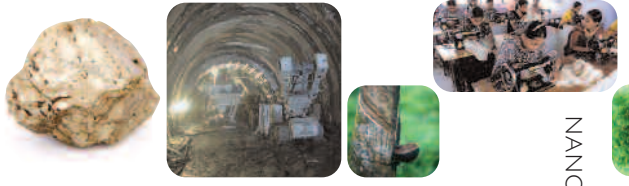
Applications of Nanotechnology for Fiber, Textiles, and Apparel	
Applications	**Potential Implications**
Nanocoatings and treatments for performance fabrics.	Value Addition
Nanotechnology-based improvements for sewing machines and other production equipment.	Improved Productivity
Nanofibers for environmental remediation filters.	New Industrial and Commercial Markets
Thermally and electrically conductive fibres and textiles.	New Industrial and Commercial Markets
Synthetic fiber and textile substitutes.	Reduced Demand

Applications of Nanotechnology for Rubber, Plastic, and Composite Materials	
Applications	**Potential Implications**
Nano-additives and fillers for materials with improved vulcanization and physical, thermal, and electrical properties.	Value Addition
Nano-enhanced materials with novel thermal, magnetic, or electircal properties for use in electronics, environmental remediation, and other industries.	New Industrial and Commercial Markets
Nano-based biodegradable plastics.	New Industrial and Commercial Markets
Nanoclays, aero-gels, and engineered nanocomposite substitute materials.	Reduced Demand
Improved life of nano-enhanced materials.	Reduced Demand

Key Questions and Issues for Consideration

A number of cross-cutting issues and questions should be considered in evaluating and making more informed decisions about the potential implications of nanotechnology applications for specific economies and commodity sectors. While these issues may be generally applicable to technologies, the unique characteristics of nanotechnology may result in different considerations for each cross-cutting issue, which, in turn, could require new and different strategies for addressing these issues. These issues and questions include, but are not necessarily limited to:

- Product research and development
  - What is the technology's stage of development (e.g., on the market, field tested, lab tested, or in early research stages)?
  - What will it take for the technology to move from the lab to the market?
  - Does the technology support commodity-based industries? Which industries?
  - Is the research and development aimed at meeting development needs?
  - What incentives, if any, should be provided to encourage responsible research and development, as well as adoption and adaptation, of new technologies?
- Environmental, human health, and safety (EHS) risks
  - What are the technology's potential EHS risks?
  - How extensively have the EHS risks been evaluated and how can EHS information be accessed?
  - What is the need for EHS risk studies and development of risk management approaches?
- Socio-economic issues
  - What are the country's national development needs and strategies and how can the technology play a role?
  - Will the technology function as a complement or substitute for existing commodities?
  - How equipped are commodity producers and markets to predict and adjust to market changes precipitated by technology?



  - How, if at all, will the technology affect the socio-economic position of workers and (poor) communities involved in the production, trade, or consumption of commodities?

- Ethics
  - Will the benefits and/or risks disproportionately effect a segment of the population?
  - Are the potential human enhancement, privacy, and other ethical implications of the technology?

- Intellectual property rights and access
  - What are the potential impacts of patents (e.g., scope, type (product or process), ownership, management) on the ability of developing countries to access or develop new technologies and to benefit from them economically?
  - What are the potential effects of the technology and its patents on the consolidation of multinational companies and their levels of horizontal and vertical integration?
  - With whom and to what degree is ownership of the technology concentrated and how will that affect the ability for commodity producers and commodity producing countries to benefit from the technology?

- Public participation and engagement
  - Who should be involved in discussions on nanotechnology?
  - What information is needed for an informed public dialogue?
  - How can access to information about the technology and its potential implications be maximized?
  - What are the infrastructure and human capacity challenges to public participation and engagement?

- Governance
  - What are the roles of key stakeholders (e.g., government, industry, NGO, academia, etc.) in nanotechnology governance?
  - Should nanotechnology applications be regulated and, if so, by whom?
  - How and by whom should research efforts be guided to meet national sustainable and human development needs and goals?
  - Who should fund and conduct nanotechnology risk assessments?
  - How and by whom should the opportunities and risks be communicated to industry, workers, and the public?
  - What mechanisms (e.g., monitoring, forecasting, research, policy development, and other strategies) exist or are needed to help developing countries and commodity producers anticipate and adjust to changes that may result from technology-induced changes in demand for commodities?

- Capacity building
  - What are the needs and potential strategies for ensuring that developing countries have the educated and trained workforce and access to information to evaluate technologies and select the best available option(s) to meet their near- and long-term needs?
  - What are the appropriate roles of communities, governments, researchers, companies, and other groups in capacity building processes?

- International collaboration and cooperation
  - How can international collaborations and cooperation best be used to enhance research and development, capacity building, and other issues?

- Scalability, delivery, and sustainability
  - How can scale-up, distribution, and business sustainability be ensured so products reach the people that need them?
  - How can the public and private sector work together to distribute and facilitate use of the technology?

Background Materials

The following background materials are available online at http://www.merid.org/nano/commoditiesworkshop/backgroundmaterials.php:

Nanotechnology, Commodities, and Development – This paper, developed by Meridian Institute, provides a brief introduction to issues at the intersection of commodity dependence, development and technology; general information regarding the opportunities and challenges nanotechnology offers for developing countries and, in particular, commodity-dependent developing countries; descriptions of commodity markets that are important to many developing countries (e.g., agriculture, mining and minerals, textiles, and rubber and composites); an overview of nanotechnology applications relevant to those sectors; and, specific examples of relevant nanotechnology applications.

Commodities, Development, and Technology – Developed by Meridian Institute as a supplement to "Nanotechnology, Commodities, and Development," this paper provides an overview of commodity markets, commodity dependence and poverty; the history, trends, and key issues in global commodity markets and how these issues affect commodity-dependent developing countries; and key issues at the intersection of commodity dependence, development, and technology.

Nanotechnology and Commodities Database – An online database developed by Meridian Institute to catalog specific examples of nanotechnology applications relevant to agricultural, mining and mineral, fiber and textile, rubber and composite, and other commodities.

Overview of the Situation of Commodities in Developing Countries – Written by the Common Fund for Commodities, this paper provides information on the problems faced by commodity producers in developing countries.

The Potential Impacts of Nano-Scale Technologies on Commodity Markets: The Implications for Commodity Dependent Developing Countries – Written by the ETC Group for the South Centre, this paper provides a brief introduction to nanoscale technologies and examines their potential impacts on commodity dependent developing countries.

Additional Resources

International Workshop on Nanotechnology, Commodities, and Development

Provides more information on the Commodities Workshop, including access to the meeting agenda, participant list, background materials, and presentations.
http://www.merid.org/nano/commoditiesworkshop/

Meridian Institute Nanotechnology Portal

Provides additional information on Meridian Institute's nanotechnology-related projects and activities.
http://www.merid.org/nano/

Nanotechnology and Development News

Meridian Institute's Nanotechnology and Development News (NDN) is a free, daily electronic news service covering the most important global developments at the nexus of nanotechnology, poverty alleviation, and the role of science and technology in development. NDN draws information from a diverse range of sources on scientific innovations and technological applications; policy issues; risk-related information; intellectual property rights and access to data; technology transfer and capacity building; global and regional networks; and economic development.
http://www.merid.org/NDN/