



United Nations
Economic Commission for Africa

Meeting Report of the Expert Group Meeting

On

Towards an African Nanotechnology Future: Capacity, Policies and Regulation to meet SDGS



13 and 14 November 2018, Addis Ababa, Ethiopia

I. Background

Emerging new technologies are currently transforming every aspect of life and presenting new opportunities and challenges for Africa's development. Among them is nanotechnology that has grown from a research field to an industrial sector with a global market estimated at \$2-3 trillion¹. Unlike other emerging technologies such as biotechnology and ICT, nanotechnology has received less attention in Africa. Nanotechnology has been undergoing a 'quiet revolution' on the continent although Africa's contribution is relatively low and is likely to remain so if urgent policy actions are not taken by governments and the private sector.

Nanotechnology is the unseen powerful undergird of digital applications and products such as big data storage and processing, robotics and smart materials), advances in medicine, electronics, cosmetics and pharmaceuticals. Ordinary household products such as soaps, sunscreen lotions, floor tiles and water filters have also been found to use nanotechnology. Notwithstanding the wide use of nanotechnology in high-tech applications such as cancer treatments, heat resistant sensors, and security features, the application of nanotechnology in everyday products is the driving force of its market growth.

As a platform technology, nanotechnology could play an important role in the efforts of African countries to achieve the targets of the Sustainable Development Goals (SDGs) and realize the Aspirations of the African Union Agenda 2063. However, despite its potential, very few African countries have articulated national nanotechnology policy. This lack of policy urgency has considerably slowed the development and application of nanotechnology on the continent.

Africa needs to follow in the steps of several countries that have embraced nanotechnology and established a policy framework to support its development and use. China launched its national strategy in nanotechnology in 2001 while the European Union adopted its strategy on nanotechnology in 2004 following similar assessments and ambitions. Meanwhile, the United States launched its National Nanotechnology Initiative (NNI) in 2000 with the main objective being to establish the national direction in advancing nanotechnology development and to coordinate funding for nanotechnology research and development. The establishment, objectives, and works of NNI were informed by the Interagency Working Group on Nanotechnology through its 10-year vision.

With the preceding in view, the United Nations Economic Commission for Africa (ECA) organized a two-day experts group meeting (EGM) on Nanotechnology and the Achievement of the Sustainable Development Goals in Africa under the theme "*Towards an African Nanotechnology Future: Capacity, Policies and Regulation*" on **13 and 14 November 2018**. The EGM addressed the role of nanotechnology in meeting the African Union Agenda 2063 and the United Nations 2030 Agenda for Sustainable Development. Specifically, the EGM looked at how African countries can address the economic, social and regulatory issues arising from nanotechnology to generate new ideas at how best African countries can deploy, manage and harness nanotechnology to meet their development aspiration.

¹ Lux Research (2014) **Market report on emerging nanotechnology**
(https://www.nsf.gov/news/news_summ.jsp?cntn_id=130586)

II. Objectives of the Expert Group Meeting

The overall objective of the Expert Group Meeting was to identify the current trends and the opportunities that nanotechnology realistically offers African countries and to explore the scope for regional and national collaboration and cooperation to bridge the nanotechnology skills, research and infrastructure gaps to meet the Sustainable Development Goals (SDGs). Specifically, the Expert Group Meeting aim to:

1. Assess the current state of nanotechnology in Africa as well as provide an overview of nanotechnology development globally;
2. Explore opportunities to enable innovation using nanotechnology to develop safe and effective products that could make significant impacts in achieving the 2030 Agenda and national aspirations;
3. Explore strategies and other arrangements that African countries can use to harness global and regional knowledge in nanotechnology to drive innovation in Africa;
4. Identify the possibilities of regional blocks in building research infrastructures and industrial capacities in nanotechnology in African countries;
5. Discuss the effectiveness of regulatory approaches, if any, to nanotechnology in African countries to meet the challenges that could arise from the use of products containing nanomaterials;
6. Assess the potential social and regulatory challenges that nanotechnology development present to African countries; and
7. Provide policy recommendations for the leveraging of international cooperation and collaboration to develop Africa's scientific, technological and industrial performance in nanotechnology to achieve the 2030 Agenda.

To achieve this goal and inform the meeting, ECA drafted a background document that was circulated and an additional five papers were prepared by African experts, academics and policy makers. These papers form part of the proceedings attached to this report. In addition, 24 experts were requested to make presentations on the different themes of the EGM.

III. Highlights

The Expert Group Meeting (EGM) attracted participants from Angola, Cameroon, Egypt, Equatorial Guinea, Ethiopia, Ghana, Mauritius, Nigeria, Senegal, Seychelles, South Africa, Tunisia and Zimbabwe as well as from the African Union Commission and United Nations. Of these, delegates from Ethiopia, Mauritius, Nigeria and South Africa contributed technical submissions that will be included in the technical report.

This section provides a summary of the statements, presentations, discussions and recommendations made during the EGM. A comprehensive list of selected reports, briefs and materials prepared for the EGM is included in a separate technical report.

Opening remarks

The United Nations Economic Commission for Africa (ECA), on behalf of its partners, welcomed the participants to Expert Group Meeting with a special focus on how nanotechnology can be used the goals of the 2030 Agenda for Sustainable Development. ECA highlighted the various nanotechnology applications that are transforming healthcare, electronics and computing, energy production and storage, and the environment and their potential to drive transformation in Africa. Indeed, products that include nanotechnology are in African shops, markets and homes. They range from detergents to washing machines, pharmaceuticals and cosmetics. However, it was feared that Africa was remaining behind in scientific, technological and industrial development in nanotechnology and thus limited knowledge on how to use and govern nanotechnology.

In part, the private and public sector in Africa has fewer researchers and investment in research and development (R&D) is low. For instance, the continent has about 198 researchers per million people and expenditure of R&D is less than 0.5% of GDP – about 5 times lower than the world average in both cases. This is limiting the potential of technology to help the 43% of Africans that are classified poor, 150 million that are food insecure, and many more that have limited or no access to safe drinking water, clean energy, modern health facilities and housing, among others.

ECA noted that Agenda 2030 does not only recognize science, technology and innovation as key means of implementation but also calls for increased investment in science and technology as well as increase cooperation between and among developed and developing countries. Africa is in danger of failing to meet the targets of Agenda 2030 to increase investments and number of researchers and scientists.

ECA called on the participants to utilize the EGM as an opportunity to review and share experiences on how nanotechnology can be harnessed to meet national, regional and global development aspirations; how the technology could be governed; and the extent to which regional networks and collaborations could help ameliorate and enrich national nanotechnology development efforts.

Nanotechnology as an emerging Technology for SDGs and Science Technology and Innovation Strategy for Africa (STISA 2024)

The Africa Union Commission highlighted the work of the AU High Level Panel on Emerging Technology. The Panel has identified three emerging technologies that can significantly contribute towards the attainment of the SDGs and Agenda 2063 and have the potential to drive Africa's transformation and growth. These are: (i) *Gene Drives for Malaria Control and Elimination in Africa*; (ii) *Drones to transforming Africa's Agriculture*; and (iii) *Micro-grids for community empowerment and Enabling Transformation in Africa*.

Participants observed the emerging technologies identified were largely applications of technologies and the list was limited. They called on AUC to review and expand the list of emerging technologies. In response, the AUC stated that this was not an exhaustive list and did not represent the technologies so far identified. However, the three technologies have been studies and the reports are available online at the NEPAD website.

Recommendation 1: nanotechnology should be recognised as one of the emerging technologies to support Africa's transformation and development.

Africa Remains a Small Player in Global Nanotechnology Industry

Based on existing data compiled and presented by ECA in the background report, Africa remains a small player in terms of skills, knowledge and intellectual asset development in nanotechnology and in the export of nanotechnology-enabled goods and services, even amongst other developing countries such as Iran which is now among the top 20 publishing and patenting countries in the world. Data limitations should not prevent Africa to participate in the race of nanotechnology research to meet its sustainable development goals. South Africa, Egypt and Tunisia, the three leading African countries in nanotechnology are still way behind their corresponding peers. The importance of nanotechnology as part of development strategy is observed as countries that have national nanotechnology policy and initiatives tend to have better research and industrial performance.

Recommendation 2: Governments and regional economic communities to consider developing national strategies and initiatives to drive the growth and development of the nanotechnology sector.

Capacity Building Initiatives in Nanotechnology

A number of African countries are considering the design and implementation of national nanotechnology strategies and initiatives. To provide some insights on the design and development of such strategies, presentation and discussion on emerging and established national efforts were undertaken. This is particularly important as nanotechnology is a multidisciplinary research intensive field of training, research and industrial development and the costs, skills and infrastructure as well as the industrial needs are expensive and diverse. The session was informed by presentation by Nigeria, Tunisia, South Africa and Zimbabwe.

The case of Nigeria highlighted the early steps that a country takes, such as motivations, drivers and preparatory processes. Recognizing that a number of institutions in the country were undertaking research in and applying nanotechnology solutions to areas of importance to development, Nigeria inaugurated the National Steering Committee on Nanotechnology to oversee the process of crafting the National Nanotechnology Policy in 2018. The Steering Committee will undertake consultations, create awareness and prepare a number of documents for the government that will inform the National Nanotechnology Policy. The Policy will help identify areas where national investment may have higher economic and social returns or meet development aspirations. It is hoped that nanotechnology policy will be key in helping the country develop nanotechnology in a coherent and comprehensive manner.

The case of South Africa highlighted efforts already undertaken and where they may be headed. The National Nanotechnology Strategy of South Africa split its efforts into industrial and social sectors. The industrial sector focuses on developing nanotechnology applications for mining and minerals, chemical processing, bioprocessing, and manufacturing while the social sector looks at applications for clean water, affordable and renewable energy, and improved primary health care. In order to achieve these goals, the government invested in training of human capital, in research and development and in encouraging industry-academia collaboration in the areas of interest. One such centres is the Nanotechnology Innovation Centre (NIC) established in 2007 consists of three Science Councils for mining, water and health and

three universities serve as nodes to collectively develop research platforms, collaboration networks, human capital development initiatives and commercialization of nanotechnology.

Recommendation 3: African countries to take steps in developing nanotechnology policies, strategies and policies. African countries encouraged to utilise existing nanotechnology research centres to build their nanotechnology capacity through training, research and industrial applications. It is critical for African countries to identify areas where they can make use of nanotechnology successfully.

Building Regional Research and Industrial Networks in Nanotechnology

In the context of the Africa Continental Free Trade Area (AfCFTA) and the rise of regional science, technology and innovations activities at RECs levels, it was noted that regional blocks can serve as vehicles for developing common strategies, research infrastructure, innovation spaces and industrial nanotechnology platforms. In addition, such networking could increase chances of success, reduce risks and increase access to resources for implementing R&D and innovation project in a knowledge-intensive field by promoting mutual collaboration between least- and most-advanced countries in nanotechnology.

Some African countries have been the frontrunners in advanced nano-technological research such as Egypt, Morocco, Tunisia, and South Africa. Meanwhile, other African countries such as Ghana, Botswana, Namibia, Kenya, Mauritius, Nigeria and Uganda, have emerged in nanotechnology development by rapidly building their nanotechnology national innovation systems. These countries could act as the anchors for regional collaborative nanotechnology network related to research, innovation and product launches and marketing.

Currently, the few African countries with more advanced nanotechnology capacities are collaborating more often with countries outside the continent than their neighbours. For instance, Nigeria is the only African country in the top 20 collaborators with South Africa measured in terms of co-authorship (publications on nanotechnology between 2005-12) – with the top five being India (266), United States (190), China (127), Germany (123) and England (112)². Given the fact that many African countries have smaller economies, limited financial resources and small research and industrial bases, regional collaboration is key in reducing the risks and costs associated with R&D in an emerging field like nanotechnology.

Recommendation 4:

- *African countries to take measures to create a platform or inventory of nanotechnology research facilities and experts to enhancing intra-regional collaboration.*
- *African countries to provide efforts to promote and accelerate intra-African collaboration in building nanotechnology research, innovation and entrepreneurship at continental and regional level, including relevant policies to help guide member States.*

² <http://www.scielo.org.za/pdf/sajs/v113n11-12/12.pdf>.

Social and regulatory challenges of nanotechnology in Africa

The development and use of nanotechnology comes with varying social and regulatory challenges. Such challenges are even more pronounced for African countries that lack a robust nanotechnology research and industrial bases and the absence of a globally agreed regulatory regimes to manage the risks and uncertainties posed by nanotechnology in its multiple stages: research and development (e.g. handling and manipulating nanomaterials); industrial applications (e.g. production, usage, labelling and intellectual property) and social issues (e.g. employment, security, environmental etc), among others. The regulatory challenges are more pronounced for every day products that implement nanotechnology such as nano-enhanced detergent, glass, phone, television, lotion drug and clothing.

The session noted that nanotechnology is catalysing the revolution in other technologies and occupies a pivotal position in the convergence of different technologies. Nanotechnology has been the driving force in the innovations in energy technologies (e.g. batteries that are 1 millimetre in across), fuelling the rapid evolution in electronics (e.g. a nano-detector for heart attacks), transforming pharmaceuticals and cosmetics industry (e.g. a pill with its one power supply and sensors that track drug levels), improving healthcare (e.g. a nano-robot for eye surgery, surface with nano-spikes the pierce and kill bacteria) and enhancing security (e.g. military clothing embedded with sensors, bulletproof and chemical/biological agent proof), among others.

Notwithstanding the rapid progress in using nanotechnology as catalyst for different technologies, the meeting observed that the regulatory, legal, ethical, societal, environmental, economic and geo-political ramifications of nano-technological innovations have not received proper attention and care. Furthermore, the few debates on nanotechnology that have taken place so far have tilted towards the concerns of the advanced economies instead of poor countries.

Recommendation 5:

- *Africa could follow the examples of South Korea and South Africa that initially focussed on building nanotechnology capabilities to ensure they are not left behind or marginalized.*
- *Africa should participate fully in global institutions that are developing and setting new regulations for nanotechnology to ensure the continent's interests are considered.*
- *As a latecomer, efforts to build nanotechnology capabilities should be accompanied by efforts to develop the appropriate and conducive regulatory environment to encourage the development and use of nanotechnologies.*
- *Regulation, ethical engagement, socio-economic and environmental governance of nanotechnology should be viewed as indispensable dimensions to any nanotechnology research and industrial development.*

Leveraging of international cooperation and collaboration in nanotechnology

International collaboration is important for accessing global knowledge and resources such as advanced infrastructure, funding, markets, practices, and networks, all of which can

inform and drive nanotechnology development. This is particularly useful in an R&D intensive field such as nanotechnology. However, there are fears that such collaborations have driven the agenda of funding agencies and thus, do not built the necessary competencies of the emerging countries needed to innovate. This session looked at how such international collaborations could be structured at different governance levels to ensure minimised dependence and maximised capacity development and contributions to Africa's development aspirations.

Mauritius underscores how African countries could leverage international partnerships to build domestic nanotechnology base. Mauritius promoted nanotechnology application in biotechnology. To drive this effort, the government created the Center for Biomedical and Biomaterials Research in 2011. The Centre trains human resources and R&D facilities focused on nanotechnology in biomedical applications such as use of biomaterials for tissue regeneration and nanomedicine. To achieve this milestone, the Centre was supported by a global network of experts that initially supported its training, research and innovation programmes. These include Edith Cowan University (Australia), Zhejiang Sci-Tech University (China), University of Siegen (Germany), La Reunion's CYROI, University of Witwatersrand (South Africa) and Northeastern University (United States). With financial support from the European Union, the Centre convened workshops to identify the strengths, opportunities and weaknesses of Mauritius' national innovation system to supporting bioscience-based industries. At the policy level, nanotechnology was championed by the Ministry of Technology, Communication and Innovation (MTCI). In 2017, the European Union approved funding to the Centre, through the Government, to support innovation capacity, develop a skilled workforce and encourage the emergence of small and medium enterprises (SMEs) in nanotechnology industry.

At the continental level, South Africa has dozens of research collaboration supported largely by funding from its Department of Science and Technology. Institutions that receive support from their respective governments tend to have the most dynamic partnerships in nanotechnology development. Example of such partnership was between the University of Pretoria (South Africa) and University of Zambia (Zambia) that has been financially co-funded by the governments to undertake research on alternative energy (solar) nanomaterials.

Recommendation 6 to leverage international cooperation and collaboration:

- *African countries need to identify areas of nanotechnology research and innovation given their limited human, financial and institutional resources.*
- *Governments and their institutions should be willing to invest resources in international collaboration with clear targets and goals.*
- *African countries should identify and carefully select international partners that complement, advance and help build national efforts, preferably from a range of countries.*

Looking ahead and Way Forward

It was agreed that nanotechnology is a key component and a viable option for Africa's industrialization ambitions to achieve the 2030 Agenda for Sustainable Development and the African Union Agenda 2063. African countries should not only be users of nanotechnology applications in shops and homes appliances but also to engage in nanotechnology research, development, application and use. Africa has the opportunity to use alternative low cost and

environmentally friendly nanotechnology solutions to meet is water and sanitation, health, transport, energy and industrial and social service needs. African countries, regions and continental bodies need to determine their nanotechnology priorities, and the necessary strategies and policies to develop their nanotechnology base and industries. Equally important is the identification of potential regional and international strategic collaborators and the corresponding cooperation agreements to guide the national involvement, investment and participation in the global nanotechnology industry.

Annex 1

List of Participants

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21	Mr. Asfaw Yitna, UNECA
22	Mr. Gedion Workneh, UNECA
23	Ms. Rahel Minda, UNECA
24	Ms. Hidat Mebratu, UNECA

DRAFT PROGRAMME OF WORK FOR THE

Expert Group Meeting

On

**“Exploring an African Nanotechnology Future:
Capacity, Policies and Regulation”**



Date: 13 and 14 November 2018

**Venue: Conference Room 5,
United Nations Conference Centre,
Addis Ababa, Ethiopia**

Day one: 13 November 2018

8:30 – 9:30

Registration

9:30 – 10:00

Opening Session

- Introduction
- Opening remarks
 - Kasirim Nwuke, Chief-New Technologies and Innovation Section
 - Oliver Chinganya – OIC SID and Director- African Centre for Statistics

10:00 – 10:30

Tea / Coffee Break

10:30 – 12:00

Session I: SETTING THE SCENE: Emerging Technologies, SDGs and STISA 2024

The AU High Level Panel of Emerging Technology identified three emerging technologies that have the potential to benefit Africa: (i) *Gene Drives for Malaria Control and Elimination in Africa*; (ii) *Drones on the Horizon: Transforming Africa's Agriculture*; and (iii) *Micro-grids: Empowering Communities and Enabling Transformation in Africa*. This session will offer an overview of the three technologies and their contribution to SDGs and Agenda 2063. What role would nanotechnology play in the identified technologies?

Dr. Monica Ebele Idinoba, Principal Scientific Officer, African Union Commission

Harnessing nanotechnology to achieve the sustainable development goals

Governments, either individually or as members of regional communities, have developed mechanisms to harness the potential of nanotechnology to the development aspirations of their people. These steps underscore the belief that nanotechnology could improve and reinforce national competitiveness and achieve sustainable development. This session will explore the current, emerging and future developments in nanotechnology and their roles and contributions to achieving the SDGs and the Aspirations of the AU.

Kasirim Nwuke, Chief-New Technologies and Innovation Section

Discussion

Moderator: Victor Konde

12:00 – 13:00

Session II: Africa in the Global Nanotechnology Industry

This session will present evidence on the state of nanotechnology scientific, technological and industrial base using global and continental trends. It will explore the extent to which Africa is and can participate in general of nanotechnology research and technology outputs and industry to meet its sustainable development goals. It will explore the relationship between policy making and research performance, industrial development and outcomes, where available.

Dr. Victor Konde, UNECA

Discussion

Moderator: Kasirim Nwuke, Chief – New Technologies and Innovation Section

13:00 – 14:00

Lunch Break

14:00 – 15:00

Session III: National strategies for nanotechnology development

Recognizing the potential that nanotechnology offers, a number of governments and regional communities developed national strategies and initiatives to drive the growth and development of the nanotechnology sector. Building on session II, this session will explore strategies and other arrangements that Africa have used or can use to design strategies and initiatives to grow their own nanotechnology sectors.

Prof. Odireleng Martin Ntwaeaborwa, University of the Witwatersrand, South Africa

Mr. Akinyemi Olumuyiwa Oyefeso, Director, Federal Ministry of Science and Technology, Nigeria

Discussion

Moderator: Mr. Josephraj Xavier, Principal Research Officer – Innovation, National Institute for Science, Technology and Innovation, Mahe, Seychelles

15:00 – 15:30

Tea / Coffee Break

15:30 – 17:30

Session IV: Capacity building in Nanotechnology

Nanotechnology is a multidisciplinary research intensive field of training, research and industrial development. This session will look at the experience of different countries and institutions. These may address the challenges, costs, skills, infrastructure and opportunities for collaborations and commercialization, among others.

Prof. Ayoub Haj Said, Scientific Director, Center for Research on Microelectronics and Nanotechnology, Tunis, Tunisia

Prof. Anthony Amaechi Attama, Dean - Faculty of Pharmaceutical Sciences,

University of Nigeria, Nigeria

Ms. Rujeko Masike, Chairperson / Lecturer IME Department, Harare Institute of Technology, Harare, Zimbabwe

Discussion

Moderator: Prof. Ricardo Filipe De Queiros, Coordinator of the Science and Technology Development Project, Ministry of Higher Education, Science, Technology and Innovation, Luanda, Angola

Day two: 14 November, 2018

9:00 – 10:30

Session V: Building regional research and industrial networks in nanotechnology

In the context of the emerging Africa Continental Free Trade Area as well as in the rise of regional science, technology and innovations arrangements at RECs levels, regional blocks can serve as vehicles for developing common strategies, research infrastructure, innovation spaces and industrial nanotechnology platforms. The capital and skills needed to develop nanotechnology research centres and the competencies needed to commercialize research outputs are likely to be beyond the reach of some African countries. This session will draw examples from other sectors on how to implement such regional approaches to ensure the needs of the least and most nanotechnologically advanced member states are met in a mutually beneficial ways.

Presentations

Prof. Mmantsae Moche Diale, SARCHI University of Pretoria, Johannesburg, South Africa

Dr. Abdou Karim Diallo, Responsable du groupe Nantechnologie et Nanosciences, University Gaston Berger, Dakar, Senegale

Discussion

Moderator: AUC

10:30 – 11:00

Tea / Coffee Break

11:00 – 13:00

Session VI: Social and regulatory challenges of nanotechnology in Africa

Like other emerging technologies, the social and regulatory challenges concerns require equal and fair attention. To what extent will nanotechnology further increase the knowledge, gender and poverty divides, among others? What are the safety concerns and how can they best be addressed in a continent with limited skills and resources? This session may address issues of awareness, safety,

intellectual property and other regulations of nanotechnology applications.

Dr. Hailemichael Teshome Demissie, Associate Professor, University of Gondar, Ethiopia (30 minutes)

Discussants:

Mr. Xolani Makhoba (10 minutes)

Prof. Gehad Genidy Mohamed (10 minutes)

Mr. Acacio Mba Ndong Eseng (10 minutes)

Moderator: Professor Gilbert Lamblin Taguem Fah, Technical Advisor No. 2, Ministry of Scientific Research and Innovation, Cameroon

13:00 – 14:00

Lunch Break

14:00 – 15:30

Session VII: Leveraging of international cooperation and collaboration in nanotechnology

International collaboration is important in accessing global knowledge and other resources (e.g. advanced infrastructure, funding, markets, practices, networks etc), all of which can inform and drive nanotechnology development. This is particularly useful in a R&D intensive field such as nanotechnology. However, there are fears that such collaborations have driven the agenda of funding agencies and thus, not built the necessary competencies needed to innovate. This session may look at how such international collaborations could be structured at regional, national and institutional levels to ensure dependence is minimized, capacity development maximized and contributions to Africa's development aspirations enhanced.

Presentations

Dr Archana Bhaw-Luximon, Associate Professor, Department of Chemistry, Biomaterials, Drug Delivery and Nanotechnology Unit, Center for Biomedical and Biomaterials Research (CBBR), University of Mauritius, Mauritius

Prof. Gehad Genidy Mohamed, Executive Director of Egypt Nanotechnology Center, Chemistry Department, Faculty of Science, Cairo University, Egypt

Ms. Lindiwe Gama, Deputy Director: Multilateral Cooperation, Department of Science and Technology. South Africa

Discussion

Moderator: Mr. Joel Hudson Okwir, Agriculture Economist, COMESA

15:30 – 16:00

Tea / Coffee Break

16:00 – 17:00

Session VIII: Looking ahead – Opportunities for a regional policy community of practice

Open Discussion

Session IX: Closing session

Closing remarks - ECA