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African Scientists & Entrepreneurs towards the BioEconomy Era

INTRODUCTORY PAPER

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Introduction

A planet where 90% of all the resources, including knowledge, know-how and intellectual property, belong to the 17% of its inhabitants is falling apart. The symptoms of this are not merely economic indicators.

The never ending enlarging areas of conflicts and terrorism, the flow of millions of refugees escaping from their territorial communities, the imminent climate change, and the exhaustion of the vital natural resources, together with the positive emergence of new clusters of technologies, such as the environmental and white biotechnologies, are paving the way to the emergence of an entirely new life model.

We are all at the starting line and we acknowledge the need for a re-designed alliance between citizens in all the different roles they play (policy makers, scientists, entrepreneurs especially, but also designers, educators, artists) to allow the birth of a new civilization based on the decoupling of economic growth from the destruction of the natural and cultural heritage and the principles of reciprocity, respect and value of cultural identity and environmental heritage.

The term **BioEconomy** sums up the vision: a radical change (of systemic nature) towards a fully integrated natural resources management, based on the life cycle of the use of materials, i.e. towards the sustainable management of materials in the sense that is more ambitious:

- Responsible, fair extraction of natural resources and use of materials, including responsible land and water use, safeguarding soil quality and biodiversity;
- Establishment of absolute decoupling of materials & resources use (including production of waste and emissions) from economic growth ('beyond GDP');
- Behavioural changes in the production *and* consumption patterns.

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This transformation will act as a trigger for the regeneration and development of economies and labour, besides the general improvement of the life quality.

BioEconomy includes all the industries and the economic compartments that produce, manage and, to some extent, exploit biological resources related to activities of consumption and service supply, including agriculture, food production, fishing and all the aquatic resources in general, forests, and so on.

The advancement and wise and inclusive governance of Plant, Environments & White Biotechnology is **the enabler science and technology field.** It covers a broad and expanding enabling cluster of S&T that includes scanning the microbial diversity of various environments (e.g. desert, oceans and deep seas) and deciphering their genetic information aimed at isolating micro-organisms that could be used in a variety of agricultural, environmental and industrial uses. A broad technological areas articulated in 4 large field of research: (1) study of biomass and optimisation of uses; (2) bioprocessing & biorefining; (3) end products; (4) life cycle analysis, and a transversal subject area, 'bioinformatics'.

We will not be able to achieve this goal of fostering the **BioEconomy** era if the solutions for a responsible and sustainable utilisation of the resources are seen as a new barrier to protect strong economies and their leading multinational companies, if it would not be the **challenge of all**, the so called developed, including transition and poor regions of the planet.

Still too many think that it is possible to transfer pre-made know how from the more advanced economies, and still too many are ready to build structures and physical infrastructures, but not to share the knowledge and the know-how.

We envision the **BioEconomy era of societies**, which would prevent the misleading interpretation of the the **BioEconomy** view based on the **industry based BioEconomy**.

Despite efforts to diversify their economies, 86 of 144 developing countries still depend on commodities for more than half of their export earnings. Prevailing development strategies have yet to succeed in generating expected levels of socio-economic development for these countries. The challenge is to find feasible development options that take into account their specific realities: both their cultural and environmental heritage (strengths) and their scarcity of skilled labour, lack of basic infrastructure (especially those technologies exploiting resources in a sustainable way to produce energy ensure food safety and security).

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How to promote the emergence of the BioEconomy era as the chance to build a better world for all?

BioEconomy represents a major opportunity for innovation, jobs' creation in developing countries as well for the regeneration of old economies, such as Europe, but we need the emergence of a "**federative elite**", which share a crucial set of competences both technological and connected to citizenship and participatory model of democratic governance, able to lead the formation of a healthy and fertile local entrepreneurial fabric focusing on **BioEconomy;** a new generation of scientists, technologists, entrepreneurs, local administrators and policy makers in general, with a wide multi disciplinary perspective, able to mutually learn from best examples without mechanical transfer of pre – confectioned solutions, build share vision instilling conciliation instead of conflict and mobilising citizens aware participatory involvement, through the disclosure of new spaces, new forms, new instruments of cooperative work among EU and African Stakeholders.

This vision must go together with an high contextualised approach to **BioEconomy,** while a model based on societal involvement must supersede a the current one based on big multinational leaderships imposing their interests.

The time has come to go beyond economics and look for a more holistic development approach that considers different cultural identities, economic aspirations, social disparities and technological disadvantages.

Development strategies also must be updated in order to cope with the far-reaching cultural and technological shifts under way in our society, introducing a radical change in the relation between economic advance and environment. In this view, the advancement of all those technologies that harness biological resources throughout bioprocesses and produce a whole range of bio products is particularly relevant.

The world needs to adapt to this new scenario by bringing issues relating to culture and technology into the mainstream of economic development thinking. Achieving the new Millennium Development Goals calls for dealing with cross-cutting development issues by introducing concerted multidisciplinary approaches to the issues of a sustainable and inclusive new pattern of development, which will open a new horizon to poor regions.

There is a clear need to better grasp the complex interactions among the economic, cultural, technological and social aspects guiding the dynamics of the world economy and the way people live in the twenty-first century. In this era of transformation, creativity and knowledge are quickly becoming powerful means of

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fostering development gains. In this context, the interface among creativity, culture, economics/entrepreneurship and technology, as expressed in the ability to create and circulate intellectual capital, but also arts & crafts capacities has the potential to generate income, jobs and export earnings while at the same time promoting social inclusion, cultural diversity and human development.

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Open hot issues to be addressed by speakers and all participants

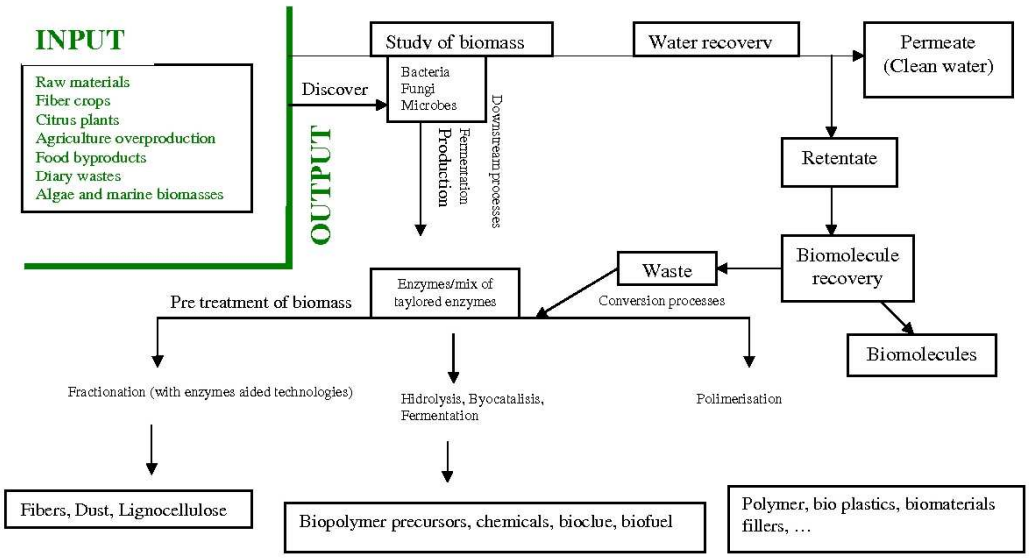
In order to facilitate and direct the discussion during the seminar session, hereafter we present a series of key questions upon which we invite participants to reflect. We encourage the panellists of the session and all participants to contribute to a constructive debate by expressing their opinions and bringing their point of view.

(1) Which are the priority requirements (at policy making, science and technology, entrepreneurial level) to ensure an inclusive systemic global agenda for BioEconomy which fully meet the challenge of building a radical new societal model of sustainable development and answer concerns on prevailing role of strong economies and industrial groups?

(2) Which are the relevant fields of science and technology which must be developed in Sub Saharan Africa to ensure an aware active participation of African societies to the building of the BioEconomy era?

Please consider the graphic to follow to indicate priority scientific and technological fields

White Biotechnology Value Chain
Research Excellence for Competitiveness



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(3) Which are the key profiles lacking in Africa?

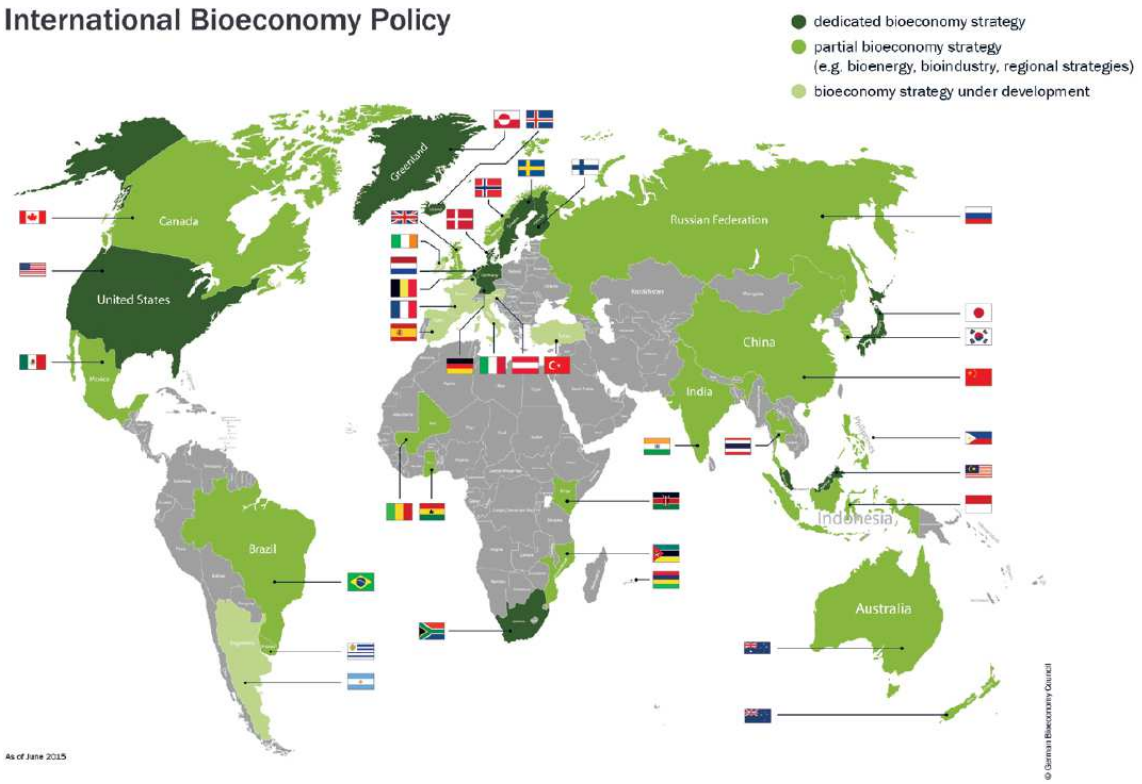
Please consider the following list of the major competences required:

enzymology, genetic engineering, microbiology, system biology, biology, metabolic engineering and modelling, chemical engineering, plant biotechnology, material microbiology, nano-biomaterial, innovative fermentation science, downstream processing, polymer processing.

See a list of profiles to support young research career development in the field of BioEconomy Box 1.

(4) Which are the key common components of an ideal policy agenda and specificities to consider by regions and countries and how we could foster a wider adoption of national BioEconomy shared agenda?

Please consider the following graphic and link: http://www.biooekonomierat.de/home-en.html



Bioeconomy Strategies Around the World

Source: German Bioeconomy Council, June 2015.[10]

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(5) Which infrastructures are lacking in terms of laboratories? Which is a possible model to create a network of shared infrastructures, which avoids duplications but ensures vital scientific infrastructures especially to address the needs to support a robust competitive fabric of local green businesses?

(6) How should the development aids' resources be channelled towards the priority of the BioEconomy agenda for Sub Saharan Africa? How should the international cooperation help learning from best practices? How to measure accountability ?

(7) Which lesson could we learn from errors? How to support societal involvement and participatory democracy while avoiding instrumental use of democratisation campaign run by occidental intrusive approaches?

(8) How to build a federative leadership in Sub-Saharan Africa, fully aware and capable to network and actively participate at the world wide debate on BioEconomy and its societal challenges?

Box 1 – *of profiles to support young research career development in the field of BioEconomy*

Industrial Biotechnology graduate

Must have:

- In-depth knowledge of specific technology platforms of the Industrial Biotechnology;
- knowledge of experimental methods and the use of complex instrumentation; familiarity with the experimental scientific method on biological systems and chemical agents;
- knowledge of the different chemical mechanisms, physical and biological basis of life of the cell, solid knowledge of the structure and function of biological macromolecules and cellular processes in which they are involved; specific knowledge about the effects of biotechnology products on the environment and know-how of the development and implementation of biotechnological processes;
- knowledge about the fundamental aspects of operational processes that follow the design of industrial biotech products;
- familiarity with bioinformatics methods for the organization, construction and access to databases, particularly in genomics, proteomics and metabolomics;
- theoretical and methodological training based on latest research; an open, critical and focused approach on choosing the most suitable solution for solving complex problems and articulate;
- knowledge in the context cultures, with particular reference to issues of development of

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intellectual property, sociology and communication;
- ability to work autonomously, also assuming responsibility for projects and facilities.

Agricultural and Environmental Sciences Graduate

He/she is aware of scientific and operational disciplines relating to the conservation of natural resources and the technological and economic aspects of rural areas and possesses the cultural tools to address the systemic analysis of the environment in all its biotic and abiotic components and their interactions.
He will then be able to:
- examine and resolve problems of planning and management of natural resources, using advanced computer tools for the representation and analysis of environmental data and spatial and mathematical models;
- plan and coordinate actions for the protection and enhancement of the environment and the countryside;
- conducting research, basic and applied, and the promotion and development of scientific and technological planning, conservation and exploitation of natural resources and sustainable development of rural areas;
- assess the rural and forestry resources and the environmental impacts of agricultural activities through the formulation of models and also with the use of conceptual and methodological tools provided by economics, law and environmental planning;
- use modern technologies of investigation and monitoring of the environment and land;
- carry out complex and interdisciplinary coordination and direction relating to one or more of the following areas:
  - planning and sustainable management, eco-certification and conservation of rural and forestry resources;
  - work design and management in the field of soil protection and forest engineering;
  - design and management of urban and peri-urban “green”;
  - design and management of improvement works, rebuilding and ecological restoration of degraded environments;
  - management plans for protected areas and ecological planning;
- operate with wide autonomy in the areas mentioned, in the a coordinating role and assuming direct responsibility.

Plant Biotechnology Graduate

He/she must:
- have thorough knowledge of the molecular and cellular mechanisms of biological systems;
- possess a deep understanding of the molecular mechanisms that underlie the growth and differentiation of organisms of agricultural interest, these mechanisms related to production quality and quantity of agro-food and non food products, their pro-cessing and the ability to work with innovative biotechnological techniques on these processes in order to modify the

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characteristics in relation to established risk to human health and the environment;

- be able to carry out biotechnology, including transgenic, in order to optimize production efficiency and productivity of the organ-isms of interest in agriculture and improve the quality of its products;
- be to develop analytical methods for biotechnological research, particularly for the characterization of organisms and agri-food and control their quality and safety;
- have a good grasp of the scientific method of investigation and design;
- have a good knowledge of traditional analytical and Biotechnological tools;
- possess sound knowledge on the structure and function of biological macromolecules and cellular processes in which they intervene;
- know the effects of biotechnological products on the environment and prevent and minimize any negative impact;
- be able to use biotechnological tools in monitoring the quality of the environment and implementation of conservation and restoration;
- have good knowledge of the information tool with particular emphasis on bioinformatics;
- be qualified to conduct basic and applied research, promotion and development of scientific and technological work, professional and project activities related in the fields related to the disciplines of biotechnology agricultural sectors;
- possess basic knowledge of business economics and expertise in economic analysis of agro-industrial system;
- possess the specialized knowledge of political-economic framework at both national and international level, within which is develop the agricultural biotechnology innovation;
- know the law and bioethical issues associated with the application of biotechnology.

Agricultural Sciences Graduate

He/she must:

- design, manage and certify systems and processes of agricultural production, even at low environmental impact;
- plan and manage the sustainability of agricultural production, including consideration of issues relating to the protection and preservation of soil resources through the use of traditional and innovative technology;
- know and use the techniques, including laboratory quality control for the different sectors of agro-livestock;
- design and manage the technological aspects of agricultural production, with particular reference to the most suitable methods for protection, conservation and management of agricultural products and their marketing;
- use the tools of economic analysis for the evaluation and the estimated profitability of enterprises, the agricultural policy choices and appraisals;
- use information technology for monitoring and modeling, also for the purpose of identifying and evaluating development projects;
- operate autonomously, taking responsibility for design and structure;

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Material Science Graduate

He/she must have:

- solid skills in chemistry and physics, knowledge of the materials' physical and chemical properties, but also elements of the engineering;
- ability to organize molecular and atomic structures in organized solid structures to meet specific requirements;
- ability to design, plan, carry out experiments, collect data, critically frame results and measures, under the guidance of teachers and within groups with similar goals, and finally to prepare an original thesis for public discussion;
- mature knowledge of materials (elastomers, polymers, insulators, semiconductors, alloys, ceramics) and new materials (fiber optics, ionic conductors, superconductors, electronic and photo-chromic materials and nonlinear optics);
- knowledge of the systems of production, transformation and development of metallic materials, polymers, ceramics, semiconductors, glassy, and molecular composites for applications in the fields of chemical, mechanical, electronic, microelectronics, optoelectronics and photonics, telecommunications, energy , environmental and cultural heritage.

Chemistry graduate

He/she must have:

- an in-depth cultural background in different fields of organic chemistry, inorganic chemistry, physical chemistry, analytical chemistry in their theoretical and experimental aspects;
- knowledge of innovative techniques for synthesis and characterization of chemical compounds, such as bioinorganic and bioorganic molecules, new materials, homogeneous and heterogeneous catalysts, and the main principles of safety, including handling and disposal of chemicals;
- the acquisition of useful techniques for understanding phenomena at a molecular level of expertise in a specific field of chemistry and biochemistry;
- mastery of scientific method and knowledge of mathematical and computer support;
- ability to recognise, study and manipulate inorganic, organic and organometallic composites of any kind both by means of experimental methods and computational approaches; ability to experimentally apply synthesis strategies to chemicals composites of various kinds;
- autonomy in the workplace, which provides a high level of responsibility in projects and facilities;
- a strong preparation for the application of theoretical methods to chemical systems simulation and computational modeling.

Molecular Biology Graduate

He/she must have:

- integrated skills with reference to the specific context of the molecular and cellular biology and related fields of application, advanced scientific training in cellular molecular biology, with

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particular reference to structural and functional aspects, genetics, physiological, developmental; critical re-elaboration of knowledge;

- multidisciplinary in-depth application expertise to biological analysis, methodological, technological and instrumental, with reference to the master of: instrumental methods, analytical tools, techniques for acquisition and data analysis, mathematical and computer support, scientific method with particular reference to the field of cellular and molecular biology;
- independence of opinion with regard to the management of projects, facilities and staff, identifying new perspectives and innovative strategies for the development, evaluation, interpretation and revision of literature data, professional ethics, critical and responsible approach to bioethical issues;
- ability to continuous examination of competencies, with reference to: access to specialized databases, innovative learning, cognitive tools developed for the continuous updating of knowledge;
- mastery of the scientific method and ability to work independently, also assuming responsibility for projects and facilities, bringing a vital contribution in all areas of employment (scientific research, technology management and design, manufacturing and quality control, industrial marketing and technical- scientific information, publishing and science divulgation), in which are requested a thorough understanding of both cellular and molecular biology issues and the most modern analytical methods, techniques and equipment.

Molecular Biology and Bioinformatics Graduate:

He/she must:

- possess advanced knowledge of the molecular and cellular mechanisms of biological systems, structure and function of biological macromolecules, the cellular pro-cesses in which they are involved, the analytical tools and methods in mathematics and biotechnology, physics and chemistry to biotechnology applications; good computational and bioinformatics skills, including for the organization, construction and access to databases, in particular for the analysis of genome, proteome and metabolome, the basic technical knowledge in various fields of biotechnology industry and the environment;
- master specific technology platforms in genomics and proteomics, design and development of new biologically active molecules, with the use of nanostructured materials, techniques of fermentation and bio-conversion for the production of metabolites, proteins of interest and renewable energy sources, purification and analysis of biomolecules; development of processes for monitoring and remediation;
- know the basics of operating processes that follow the design of industrial biotechnological products in compliance to eco-friendly processes
- possess advanced knowledge of patent systems and procedures of technology transfer;
- be able to work autonomously, also assuming responsibility for projects and facilities;
- know the laws relating to bioethics, validation / certification of goods / biotechnological process, the protection of inventions in biotechnology and security

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