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The problems of scientific research in Africa

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Abstract: Scientific research in Francophone Africa and its impact on development is a growing concern for public authorities and research actors. While it is true that governments and individuals are sometimes pessimistic about the possibility of progress towards solving these problems, there is no denying real progress. The number of researchers in developing countries is infinitely greater than it was 20 years ago. There is, however, a significant gap between what is desirable and what has been achieved.

Keywords: scientific research, problems of scientific research, developing countries, Africa.

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1. Introduction

Scientific research in Francophone Africa and its impact on development is a growing concern for public authorities and research actors.

Reading the various documents produced by the African Union (AU-NEPAD, 2010; 2014) reveals that African leaders have become aware of the need to invest in research, science, technology and innovation to address the socio-economic challenges they face. This awareness has resulted in the strengthening of Africa's scientific and technological capacities over the past 20 years. Indeed:

- regional research centres have been established;
- a few thousand national research and higher education institutions have been set up;
- Thousands of scientists and engineers have been trained.

According to UNESCO (2015), Africa had 187,500 researchers in 2013, representing 2.4% of the global workforce. From 2007 to 2013, this workforce increased by about 26%. Despite this strengthening of scientific and technical capacities, research and innovation lag behind in terms of scientific and technological outputs.

The UNESCO Science Report published in 2015 (UNESCO, 2015), indicates that the growth rate in the number of publications by researchers from Africa was 60.1% between 2008 and 2014 and 51% in sub-Saharan Africa. But Africa's share of publications in the world was only 2.6% in 2014 and that of sub-Saharan Africa accounted for only 1.4% in the same year. A report published in 2014 jointly by the World Bank and Elsevier (WORLD BANK & ELSEVIER, 2014) provides the following information on the quantity and quality of publications by researchers from sub-Saharan Africa (excluding South Africa) between 2003 and 2012:

- publications in science, technology, engineering 15 and mathematics (STEM) accounted for only 29% of scientific research in this part of sub-Saharan Africa during this period;
- the share of research in STEM fields has decreased by 0.2% per year since 2002;
- In 2012, the quality of STEM research, as measured by its citation index, was 0.68 (32% below the global average). This citation index has remained virtually unchanged since 2003.

Africa has lost "market share" in the arena of global publications in two decades. Some African countries have regressed in all areas. Entire areas of expertise have regressed, or even seem to have disappeared, even if the potentials remain latent. The fields of scientific production are very typical: agriculture and health largely dominate, with more than 80% of production. The exact sciences and engineering are progressing very slowly. Universities are pretty much the only ones dedicated to this. The production of the social sciences is weak, not very interpretive, especially ruralist or devoted to heritage.

It should be noted that Africa's share of global science continues to decline. The few African countries where scientific production is substantial and even growing are not as productive as developing countries elsewhere in the world.

In terms of technological innovations, the African Union and the United Nations, in a working paper published in 20141, note that:

- Africa accounted for 0.8% of patent applications filed worldwide in 2012 and three-quarters of applications filed were by non-residents;
- Africa's high-tech exports account for about 5% of its total goods exports to the world.

Overall, Africa carries little weight in scientific articles, patents and trade in high-tech products. The main causes of this situation will be presented in the following sections.

2. The main causes of scientific research problems in Africa

2.1 The absence in most countries of a public research and innovation policy

The absence of a research and innovation policy is the first major obstacle in the development of a genuine national research and innovation system (NRIS). The organisation of research and innovation is implied, upstream, by the research and innovation policy defined by the country.

2.2 The absence in most countries of a structured and efficient national research and innovation system.

An unstructured national research and innovation system, i.e. one made up of a set of scattered mechanisms, fragmented funding and multiple compartmentalisations, does not allow research and innovation to express itself fully and effectively.

2.3 A research and innovation system functioning, in most countries, without a real legal framework

Research and innovation need a legal framework that organises them, promotes them and guarantees their funding. This framework also serves as the foundation for building an NRS.

2.4 Administrative and technical supervision of research and innovation fragmented in most countries

The dispersion of research and innovation among many ministries and agencies, coupled with the lack of a permanent and effective structure at the highest level to ensure horizontal coordination between these ministries and agencies, makes it difficult to achieve coherence in the system as a whole.

2.5 Low level of investment in research and innovation

Insufficient funding for research and innovation dilutes scientific quality. One of the most common and cited research and development (R&D) indicators is the amount of money a country allocates to R&D. in terms of percentage of its GDP. This indicator is gross domestic expenditure on research and development (GERD). African countries have set a target of spending 1% of their GDP on research and development. But according to the NEPAD Coordination and Planning Agency, no country has achieved this goal.

According to UNESCO's 2015 Science Report, Africa's GERD in 2013 accounted for 0.45% of GDP. This corresponded to 1.3% of global R&D spending, while Asia's share was 42% in the same year.

Moreover, financing mechanisms in most countries are inefficient and not very transparent. Indeed, the granting of budgetary appropriations to higher education institutions and research establishments is automatic. It is neither based on criteria known to all parties, nor subject to performance contracts. Budgets are now often only used to pay the salaries of researchers and teacher-researchers. As for project-based financing (competitive funds), it generally only supports a few projects. Private sources of financing from companies are almost non-existent.

2.6 Lack of adequate research infrastructure

The lack of an adequate research ecosystem does not allow researchers to flourish. It is at the root of the qualitative and quantitative weakness of research work, the drain of trained talent and the current weakness of African researchers in cooperation and collaboration with their partners in developed countries.

2.7 Structures for valorization and transfer of research results to the economic world that are often non-existent or inefficient in most countries

The main missions of the structures for the valorization and transfer of research results to the economic world are to help researchers and their institution identify and manage their intellectual assets, including the protection of intellectual property and the exploitation of rights derived from the latter to third parties through licenses or the creation of companies in order to improve development prospects, to support relations between the public research sector and industry, to promote the dissemination of scientific and technological results. These structures also serve as a point of contact for industrialists, conduct marketing operations and develop networks and partnerships with the socio-economic environment. To promote the economic exploitation of research results, some countries have set up agencies responsible for this activity. But these structures struggle to play the role expected of them because their missions are too diverse in relation to their means.

2.8 The absence, in most countries, of mechanisms for monitoring and evaluating public research and innovation structures, programmes and policies

The lack of evaluation and monitoring by the public authorities of structures, programmes and public policies for research and innovation reduces the performance of the NRIS and its

contribution to the development of the country insofar as it does not allow the reorientation and improvement of the system.

2.9 The research structures of higher education institutions in most countries are informal

The creation of research structures in higher education institutions in some countries is more linked to the personal efforts of teacher-researchers, rather than to a real institutional or national policy of research organization. The structures created do not enjoy legal recognition and are free of any regulations of the guardianship institution. This situation has a negative impact on the credibility of the research structures concerned.

2.10 Research and research infrastructure are often dispersed across multiple teams within the same institution

The fragmentation of research efforts and the dispersion of research infrastructure within a single institution have a negative impact on the quality, effectiveness and efficiency of research. In many higher education and research institutions, research efforts are often fragmented among several loosely structured research teams. In addition to this fragmentation of research in terms of execution, there is a dispersed physical research infrastructure due to the absence, on the one hand of pooling of the equipment acquired and, on the other hand, of the coordination of the acquisition of equipment between the research teams of the institution.

2.11 The low level of private research from companies

Industrial R&D plays an essential role in a country's economic development. One need only look at the number of multinationals setting up R&D centres in emerging markets in Asia and South America. Generally speaking, African companies are not innovative. According to the African Union and the Economic Commission for Africa, research and development activities are limited in the private sector. More than 70% of these activities are carried out in research and educational institutions.

3. Governance models of the national research and innovation system around the world

The governance of research and innovation is closely linked to the specificities of each country. There is no single optimal model. It can therefore be risky to want to copy the models of other countries without taking into account the specificities of the latter. Indeed, many countries regularly modify the governance framework of their research and innovation policies in order to improve and adapt it to changes in the political, social and economic environment.

The models presented here are intended to inform research and innovation actors in French-speaking West Africa.

The countries taken as examples are: France, Tunisia, Morocco, South Africa and the United States. The study of the organization of the research and innovation system of these countries is based on the synthesis of information from books published by various authors but also information collected on the web. Sources of information were selected based on criteria of relevance, reliability and freshness.

As the level of access to information varies, it was decided to treat each country independently, without comment and without seeking comparison. For each country, the following elements are presented:

- Legal and regulatory frameworks;
- Guidance and planning bodies;
- Advisory, coordination and programming bodies;
- Funding structures and mechanisms;
- Evaluation bodies;
- Research execution institutions;
- Operational research structures;
- Structures and mechanisms to support the economic exploitation of research results.

4. Policy and planning bodies

The Ministry of Higher Education, Research and Innovation designs, develops and implements the national research and innovation policy. It sets broad guidelines and allocates resources to general objectives. It supervises research organizations and higher education institutions.

It is in line with this responsibility that this Ministry has developed, with the contributions of all actors in research, innovation and socio-economic development, a Strategic Research Agenda "France Europe 2020" which defines national priorities as well as specific measures to respond to identified societal challenges in coherence with the European Union's Horizon 2020 research and innovation programme. These challenges are:

- sober resource management and adaptation to climate change;
- clean, safe and efficient energy;
- industrial renewal;
- health and well-being;
- food security and demographic challenge;
- sustainable transport and urban systems;

- information and communication society;
- innovative, integrative and adaptive societies;

These priority orientations are intended to be taken into account in the programming of the National Research Agency and in the multi-year contracts concluded by the Ministry of Higher Education, Research and Innovation with research organizations and higher education institutions.

5. Conclusion

Ultimately, public research in Africa, particularly in French-speaking West Africa, is currently facing objective difficulties, some of which are related to its methods of organization, evaluation and financing. It is therefore important to support French-speaking West Africa in building well-structured and efficient NRIS.

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