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Insights from Africa-Europe Cooperation in Higher Education Institutions

Sustaining a Wise Use of Geological Resources

WP9 REPORT

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Abstract

Currently, Higher Education Institutions (HEIs) are expected to play multiple roles, not just for knowledge production and training but also for regional development, innovation systems strengthening, and sustainability. Although these roles are crucial for territories, regions, and economies to be increasingly competitive, HEIs often face a set of constraints that do not allow them to develop all of these dimensions. The present report is part of the Work Package 9 "Sustainability actions" of the project “SUGERE – Sustainable Sustainability and Wise Use of Geological Resources”, an ERASMUS+ project. This WP9, coordinated by the Centre for Social Studies of the University of Coimbra (CES), aims, on one hand, to identify and understand the current situation of the partner universities in the SUGERE network concerning higher education and research barriers, and on the other hand, to identify synergies in solving common problems, particularly within the participant African universities located in Mozambique, Cape Verde, and Angola, in articulation within the partnership. The study developed is inspired by some principles of complexity theory and based on two data collection activities, namely a set of semi-structured interviews with partner representatives and a focus group. The results show that African universities included in this study still face significant internal and external challenges, which hinder their performance as drivers of development. The challenges that stand out the most are the lack of research facilities and equipment, lack of financial and material resources to keep up with the demand of students looking for training and to boost the quality and quantity of research and training, weak relationship with industry and governments, and limited levels of qualification in the faculty members (both in teaching and research). Assuming a key role in socioeconomic development, African governments and enterprises should cooperate more with local HEIs and invest more in value creation based on knowledge.

Keywords: Africa; challenges; capacity; higher education; resources.

1. Introduction

The recent existence of wide recognition of the essential contribution of knowledge to economic competitiveness and social welfare has increased attention to the role of universities in the production and dissemination of knowledge, including African higher education institutions (HEIs) (Ondari-Okemwa, 2011). Nowadays, it is expected that HEIs play multiple roles, both for knowledge production and training but also for regional development, for strengthening innovation systems, and even for sustainability. Although these roles are crucial for territories, regions, and economies to be increasingly competitive, HEIs often face a set of constraints that do not allow them to develop all of these dimensions. It is considered that a one-year increase in higher education (HE) completion would raise the long-run steady-state level of African GDP per capita ten times (Bloom, Canning, & Chan, 2006).

Higher education in Africa is primarily a product of its colonial past, with its structure and language of education stemming from it (Darley & Luethge, 2016). The relationship between the universities of the metropolis with colonial power and the African HEIs ended up conditioning their development. Despite the explicit intention in their mission statements, African universities, seem to have some difficulty in strengthening the role of research, creating a research-intensive culture, and implementing community-oriented research activities (Zeelen, 2012). This difficulty is mainly due to the old-fashioned and alienating nature of governance structures historically created through the inspiration of European or Western models (Assie-Lumumba, 1996; Zeelen, 2012).

In Sub-Saharan Africa, higher education plays an essential role in promoting both technological advancement and improving a country's ability to capitalize economically, underlining the economic growth and development in the competitiveness of youth in an increasingly global society (Drape et al., 2016).

Universities, in general, may be seen as complex organizations that function at the service of an unstable and frenetic environment, with increasing societal demands whereas they have less and less access to public financing (Sousa Santos, 1999). HEIs are under pressure to change many, if not all, of their traditional ways of conduct. However, responses to such pressures differ in developing regions such as sub-Saharan Africa, with its universities having to find their answers to address the challenges related to their role in producing and transferring relevant knowledge for local and national development (Ondari-Okemwa, 2011).

Providing higher education to all sectors of a nation's population means confronting social inequalities deeply rooted in history, culture, and economic structure that influence an individual's ability to compete. Quality in higher education has risen to the top of the policy agenda in many nations, where the preparation of graduates with new skills affirm the broad knowledge base to deal with a more complex and interdependent world (Altbach et al., 2019).

African HEIs have been growing in recent times, with an increase in quantity and relevance of the research being produced, in the visibility of publications, and its international recognition. However, despite these encouraging indicators, they still face innumerable challenges, in their internal composition and ability to interact productively and confidently in the context of international academic networks (Harle, 2013). The importance of HEIs lies in their ability to contribute to the socio-economic development of their countries. Nevertheless, there is an

inconsistency between needs and competencies, with inadequate funding and poor availability of qualified faculty hindering universities' capacity to act and extend (Alabi & Mba, 2012). Gaps in governance and leadership are highlighted in a long list of disconnection causes that replicate the challenges experienced in African HEIs (Zhou, 2020). As suggested by Kruss et al. (2015) universities need to focus more on what their own capabilities are; how they capture their own tacit knowledge more effectively; and how they develop their capabilities more strategically, concerning priority sectors that match their expertise.

Therefore, the present report, which is part of WP9 of the SUGERE project, aims to understand the current situation of the partner universities in the African countries involved, in order to identify weaknesses, strengths, opportunities, and threats in their performance. In addition, the analysis intends to bring insights into their role and contribution to the sustainability, as well as their capacity to produce and transfer knowledge. The mining and mineral resources were latent preoccupations during the implementation of the study, even if the results point to issues that are mainly transversal, and not limited to this particular economic sector and scientific domain. To achieve these objectives, a qualitative in-depth approach is mobilized, using two data collection techniques: semi-structured interviews and a focus group with strategic partners.

This report is divided into four main parts. The first part presents a brief literature review on the multidimensional role of Higher Education, with emphasis on African HEIs and the particular challenges they face. Next, the methodological strategy that guided the analysis is explained. The third part embodies the analysis of the results, both from the interviews and the focus groups. The report ends with a discussion of the results, and a summary of the main conclusions and some implications for public policy.

2. Theoretical background

2.1. Inspirations from complexity theory

Currently, in more complex, globalized, and turbulent times, it has become increasingly difficult to collect high-quality data to provide information that contributes to the adoption of transformative strategies. Regional actors need to improve their sense-making capabilities which should include the ability to read economic indicators, indexes, and rankings, and make regional inventories of resource assets linked to the rational choice of domains, but also include other sense-making tools needed for participatory monitoring and a deeper understanding of dynamic responses at the level of local innovation ecosystems (Laranja et al., 2019).

Throughout the last decade, complexity theory has become increasingly prevalent in the evaluation literature. The study of complexity, particularly of Complex Adaptive Systems (CAS), is gaining momentum with broader, cross-disciplinary examinations of complexity, particularly regarding subjects such as socioeconomic development, health or social policy (Walton, 2014; Kallemeyn et al., 2019). Complexity theory has been interpreted in different ways by different scientific traditions. These different points of view – social, physical, and natural - have led to a lack of consensus on a strict definition of complexity. In a broad sense, complexity theory is a generic term for a wide range of concepts that share similar statements about the nature of reality and how researchers come to know it (Kallemeyn et al., 2019). Complexity science is based on the view that there is a considerable number of variables that underpin a specific problem. Their interaction produces non-linear cause-effect outcomes that are almost unpredictable (Sarriot & Kouletio, 2014). Nevertheless, among a myriad of factors, some are dominant and influence the identity and characteristics of a given system. In this way, to develop more strategies that can produce solutions to overcome this challenge, the role of research is to dig deeper into the complexity challenge (Wimsatt, 1994), and identify the significant cause-effect relationships that embody the system (Wong, 2013). These significant relationships are the levers that may help to change the functioning of a system (Burman et al., 2016; Williams, 2019; Kallemeyn et al., 2019).

Complexity theory may be used to analyze the world as composed of complex systems. “Starting with the definition of a system as a `set of inter-related elements’, a complex system is one where the whole, all the elements, and their interrelationships together, are greater than the sum of the parts” (Byrne & Callaghan, 2014, p. 4). These complex systems are composed of multiple agents, objects, and processes that interact and contribute to the achievement of a common interest or function (Gare, 2000), and require feedback processes that enable the system to move from one state to another in a way that exceeds linear representation. In this context, feedback can be seen as a type of circular causality or loop, where an effect is fed back into its cause (Heylighen & Joslyn, 2001). It is common for complex systems to nest together, meaning that there may be elements within a complex system that are also complex systems or that are shared among more than one complex system (Byrne & Callaghan, 2014). In this kind of system, the interaction of components leads to emergent properties that are difficult to understand based on an examination of individual components (Goldstein, 1999; Kallemeyn et al., 2019). In this way, the focus should be on understanding the system as a whole, identifying the elements within it and their interrelationship, to then understand the emerging phenomenon (Walton, 2014).

The Complexity Theory underlines that complex systems are characterized by linear and nonlinear interactions between open and closed systems, which can produce unexpected outcomes. Complex systems that exhibit non-linear features are qualitatively different from systems that are underpinned by predictable, linear, and cause-effect interactions among variables, which makes it difficult to choose the most appropriate research method to dynamically impact the challenges existing in these contexts (Burman et al., 2016). It has been argued, according to Burman et al. (2016), that nonlinearity within open systems leads to a specific context becoming intrinsically volatile, making predictions, in turn, more questionable. However, it is possible to build resilience to reduce the impacts of a challenge and change the emergent outcome (Lynam & Fletcher, 2015), through an ontological and epistemological reorientation from an exclusive dependency on reductionist scientific research methods to approaches that identify and respond to the unbalanced properties and characteristics of this kind of complexity, which involves adopting experimental techniques to facilitate sensory production that progressively influences or alters the interactions that underpin the challenge (Snowden & Boone, 2007).

Reality is shaped by complexity as being non-linear, with no obvious cause and effect ties, which implies that changes may produce unanticipated or multiple effects or even no effects at all, and the same events may also lead to different outcomes. Thus, inputs are not proportional to outputs, meaning a minor change may have a significant impact (Kallemeyn et al., 2019). In other words, very small changes in the system's initial conditions can result in meaningly different outcomes, supporting the properties of emergence and feedback, the creation of unstable states, and in the long run the ability of complex systems to be submitted to processes of self-organization (Walton, 2014; Williams, 2019). As a result, instead of predicting events, complexity theory focuses on understanding and explaining change over time (Kallemeyn et al., 2019). In this way, unlike linear systems in which changes occur chronologically, proportionately, and additively, nonlinear systems can undergo multiplicative changes, with the outcome exceeding its inputs (Gleick 1987, cited by Williams, 2019; Kallemeyn et al., 2019).

In Africa, universities are called upon to find their own answers to face the challenges related to their role in the production and transfer of relevant knowledge. Unlike linear models of technological development that privilege the frontier of knowledge as the locus of economic growth, in Africa, innovation becomes a non-linear and non-sequential process, where change and technical growth depend on both social and technical innovations (Kruss et al., 2015).

Complexity Theory encompasses a plentiful set of concepts and assumptions (i.e., dynamic, chaotic, and embedded systems, among others), that can be integrated into a theoretical framework to inform the conceptualization and investigation of a phenomenon (Kallemeyn, et al., 2019; Williams, 2019). Thus, it can be seen as a set of theoretical concepts and methodological approaches that can be an alternative paradigm to science-inspired in simple linearity and causation. Complexity theory has distinct implications for its application in mixed methods research. According to Kallemeyn et al. (2019), theorists have suggested participatory and partnership-based research, and action research that uses mixed methods, and some noted that the complexity theory calls for case-study and other qualitative techniques in which the units of analysis in research merge. The above-mentioned authors also added that such methods, through the interactions among several research members, enable agency and the emergence of new knowledge in the long term. It is important

to emphasize that, complexity–congruent methodologies and methods are quantitative, qualitative, and mixed, so although the complexity theory does not need mixed methodologies, these approaches match its goals.

2.2. HEIs role and a brief historical context of African universities

In Western societies, the university was created as an institution to provide essential knowledge to the understanding of the surrounding environment, being originally legitimized to produce and transmit scientific knowledge. In this way, it is the source of explanation of the structures and dynamics of reality and has been socially established as the producer of prime knowledge (Colish, 1999).

The role of HEIs for regional development has been widely discussed. Nowadays, complexity, speed of social change, and environmental crisis are crucial elements to help understand society, and for insight into the social role of knowledge and HEIs. Complexity is a common argument to justify the difficulty of explaining and understanding contemporary reality. In recent years, the growing demand for knowledge followed by the acceleration of social, economic, cultural, and political change, institutional self-referentiality, and the internal difficulty of the HEIs to respond effectively to these demands have given rise to the emergence of new knowledge producers. These producers are often linked to private companies that make the production of knowledge and innovation their corporate purpose, or to specific departments within the organizational structure that meet the needs of the firm, and public institutions that maintain their services, departments, or agencies with similar objectives (Domínguez-Gómez et al., 2019). Uyarra et al., 2017 note that, currently, universities are far from playing an exclusive role in education and knowledge production and are increasingly seen as a central actor in the development of regions and territories. According to the authors, the mission of universities can be divided into three main dimensions: as agents of knowledge, as drivers of regional development, and as civic agents from a social perspective. While the literature decreeing HEIs as knowledge agents is consolidated, their role in regional development and their social role are fields that have emerged more recently (*Ibid.*, 2017).

This growing interaction, connectivity, and interdependence, characteristic of complex societies, has brought the fields of science, technology, and innovation closer together to the point where it has become extremely difficult to distinguish them. Innovation systems are designed through networks of actors that interact in the usual development of their social object, within the framework of a common environment, and whose key element for their function is the production or use of innovation (*Ibid.*, 2021). In addition to universities and other public research entities, innovation is a process that integrates a variety of other actors, such as funding agencies and promoters of knowledge and technology, intermediary agents, and the companies themselves that disseminate knowledge and technology. Universities always hold considerable positions in these networks, due to their recognition, legitimacy, and prestige given by other actors and the diverse roles they are currently expected to perform. HEIs and public research organisations are the drivers that enable the development of new or updated technologies and knowledge applicable to specific areas of social life (economic, cultural, political, and environmental) (Domínguez-Gómez et al., 2019).

Note that, the constant social change interacts with complexity since it increases analytical difficulties and, therefore, the difficulty of understanding the social dimensions and their interactions (Giddens, 2000, cited by Domínguez-Gómez et al., 2019).

Local innovation systems recognize HE as a leader in adapting to high-speed changes and as an active producer of knowledge and innovation. Therefore, society expects universities to be at the forefront of addressing change using knowledge as the main tool. As a result of this demand, HEIs should make the necessary effort to understand it adequately and provide an appropriate and agile response. To fulfill this requirement, universities must focus on the local context by making it the raw material and reference for generating and transferring knowledge through the channels that the administrators must adapt, maintain, and, if necessary, create (*Ibid*., 2019).

There is a demand for teaching and research staff to externalize more of their production towards the social demands of knowledge and innovation, and less towards production for 'own consumption' (academic). Local business needs the competitiveness of knowledge and innovation, and therefore demands the support of the University, which has these key values and capabilities (*Ibid*., 2019, p.12).

HEIs have a crucial role to play in shaping the societal transitions necessary to adjust to the fourth industrial revolution (Gleason, 2018), given that many of the references of current HEIs are still designed to meet the needs of past industrial revolutions with old mass production.

The traditional role of universities in the training and qualification of individuals, despite being the dominant paradigm even nowadays, is becoming obsolete with the subsequent addition of 'home' par excellence of scientific research (Domínguez-Gómez et al., 2019).

The economic success in recent decades of some regions of the world (i.e., North America or South Korea), with an interesting prominence on university-industry interaction, has led public policies to give increasing importance to the role of HE in tackling social problems and, in general, to the production of innovation (Domínguez-Gómez et al., 2019; Pinto et al., 2021).

The change in the role of universities is related to the change in the mode of knowledge production, being more transdisciplinary and applied, and also to the progressive realization of the triple helix model (quadruple, quintuple) in the search for solutions, generation of resilience and adoption of technological innovation and knowledge. The third mission of the university is a complex role, and therefore is not limited to a strict notion of knowledge transfer (Molas-Gallart et al., 2002). Uyarra et al. (2017), abridging the increasing complexity of the role of the university, proposed that HE grew from simple fabrics of knowledge, whose impact was largely determined by knowledge repercussions to institutions with a relational understanding, where HEIs were seen as privileged partners for large companies, embedding a technologic strategy into their action. HEIs were later converted into business universities, therefore emerging as a corollary of the view of the ´triple helix`, a factor that emphasized the need for commercial exploitation of scientific knowledge (Etzkowitz & Klofsten, 2005, p.245). This viewpoint is still widely present today and it is associated with knowledge transfer and valorization, through academic entrepreneurship, while being connected, among other aspects, to the emergence of a variety of intermediary actors, such as technology transfer offices (Pinto et al., 2021).

It is important to consider that society's lack of knowledge about university action, especially in the field of applied research, the lack of proactivity in knowledge transfer tasks on the part of universities, and the cultural stereotypes that label the university as a solemn, brainy institution that does "important things" "but it is not clear what" (Domínguez-Gómez et al., 2019, p.11). These underline the need for translational knowledge between the different theoretical-practical spheres at stake, to take gain relational synergies and boost the achievement of institutional objectives, meaning to improve the levels of social and technological innovation and social functionality of the University (*Ibid*., 2019).

The ability to learn new skills, accept new approaches, and cope with continual social change will be essential in the fourth industrial revolution (Gleason, 2018). To develop these skills, learning must go way beyond information transfer where high education needs to emphasize pedagogy that is student-centered and individualized. Assessments are most effective when they are grounded in project-based learning and authentic experiences, where teamwork also goes a long way in developing the emotional skills necessary for twenty-first-century success.

There is a multiplicity of roles that HEIs can play to contribute to regional knowledge, from contributing to the evaluation of regional knowledge assets, capabilities, and competencies, to providing specialist knowledge and links to national and international innovation networks of knowledge, to being considered a key factor in building dynamic innovation ecosystems. This situates HEIs as entrepreneurial actors (or entrepreneurial universities) which is embodied in the idea of the triple helix, and which refers to the need for adaptation between the knowledge produced and the needs of the business fabric (Uyarra, 2010).

Their social role or civic universities (Goddard, 2009) recognizes the importance of building networks with existing local companies and territorial clusters, that are connected with national and international actors for the updating of knowledge. This implies that these institutions seek to dissolve boundaries, particularly between the public and private spheres, by recruiting individuals capable of translating interests and building bridges between different types of actors (Dominguez-Gómez et al., 2021). This entrepreneurial and civic role is even more important in contexts where governments tend to be fragmented and unable to act beyond their boundaries. In this case, HEIs can assume governance and leadership responsibilities (Pinto et al., 2021). All these functions end up being a heavy burden for HEIs, especially in weaker and poorly consolidated territorial and institutional contexts. In situations where lock-ins and path dependencies exist, transferring this role to HEIs is a multidimensional and complex task.

The literature on this topic demonstrates that through a civic commitment, the university engages with society, at local, national, and global levels, linking social and economic development to sustainability and promoting local development and local grassroots leadership. Locally, the university strengthens civic innovation in firms and the qualification of human resources and contributes to the integration of a more inclusive society and the expansion of cultural and creative activities. At a national level, it supports agenda-setting on social problems and allows for the successful connection of national actors and a localized innovation system. Despite being locally embedded, the civic university should also be globally competitive, encouraging investment and funding, attracting and retaining talent, and the possibilities for connecting local actors to

transnational networks. It is worth mentioning that this vision is particularly relevant for the global understanding of regional innovation systems (Domínguez-Gómez et al., 2019; Pinto et al., 2021).

In the case of the African HEIs under analysis, it is not possible to understand the role they play, their potential, and challenges, ignoring their colonial past since it has a strong influence on them (Darley & Luethge, 2016). The 1960s to 1970s was considered a "golden age" for African higher education institutions (Cardoso, 2020, p.303), with many of its universities emerging in the post-colonial period, having been founded on the notion of "university for development", despite the lack of a culture supporting research system (Assie-Lumumba, 1996; Harle, 2013; Muriisa, 2014; Darley & Luethge, 2016; Mccowan, 2018; Jamison & Madden, 2021). Since education is essential for increasing human capital and promoting human resource development, some of its specific goals focused mainly on increasing the number of university students and graduates, which was at least partially achieved as enrollments increased radically. It was expected that education would reflect and support the national priorities, goals, and aspirations of many African countries (Assie-Lumumba, 1996).

However, this "golden age" lasted a short time. From the 1970s to the 1990s, the African university system struggled with a great deal of instability, many lost years, strikes, and clashes among students, faculty, administrators, and ministries, followed by sporadic and sometimes long periods of stagnation. As a result, a decrease was observed in specialized human resources seeking stability in teaching and research, followed by a period of financial restriction, caused mainly by structural adjustment measures (Cardoso, 2020). This author notes that this crisis is multifaceted, and multidimensional, and poses a variety of uncertainties and challenges, resulting in the idea that HE in Africa differs widely from one country to another and from one university to another, and generalizations are not appropriate.

2.3. Current situation of African universities

2.3.1. *Role and mission of African universities*

Globalization and knowledge network generation have already profoundly influenced HE, where the reality was shaped by an increasingly integrated world economy, new information and communications technology (ICT), the emergence of an international knowledge network, the role of the English language, and other forces beyond the control of academic institutions. Increasingly, national, and regional policies try to implement development programs and projects for universities to respond to global challenges (Altbach et al., 2019).

Despite these trends, African universities are, like other HEIs, regarded as engines of development that contribute to scientific research, training, and meeting social needs (Cloete et al., 2011; Muriisa, 2014; Mccowan, 2018; Cardoso, 2020). As a result, the university operates on three pillars in which knowledge is the basis, namely research, teaching, and extension, which provide a variety of services to society. Research is indispensable for developing higher education, universities, and any scientific field. A successful higher education sector requires an efficient commitment to knowledge transfer but also the development of a high-quality research system. Faculty in African universities need to invest in research to strengthen its role in two main dimensions: their importance and credibility for decision-making, and to the knowledge to be relevant to the

African economy and ensure that students are educated through the proper use of theoretical and empirical research on local and national management issues (Sigué, 2012).

In the 1970s, the consistency of the university's objectives was affected due to the pressures and transformations felt by it. According to Sousa Santos (1999, p. 165, 166), universities have faced three types of crises that persist in current times, especially in developing countries. The first refers to a "crisis of hegemony", resulting from the contradictions that set the traditional function of universities against those associated with them throughout the 20th century. The autonomy of the public university (scientific and didactic) is called into question, due to its clear financial dependence on the State and, recently, on capitalist enterprises. The second concerns the "crisis of legitimacy", to the extent that the collapse of the collectively announced objectives is socially visible, of which knowledge is produced to respond to the interests of the richest, leading to the university molding itself as a class society and acting as a domain of the reproduction of class society. Finally, Sousa Santos (1999, p.166) also mentioned the "institutional crisis" which concerns the organizational specificity of the university, leading to the imposition of administrative models of other types of layouts considered more efficient.

Fowler (2015) recognizes that universities are complex institutions that have a considerable array of stakeholders to satisfy, but believes that partnerships between academia and administration have the potential to enhance the student experience through improved overall service. African universities are under pressure from various entities and society, such as the government, industry, parents, and students. More specifically, governments demand that they produce the human resources that are necessary for economic development; students and parents expect the courses to guarantee employment after graduation; and businesses demand that universities produce graduates who solve their problems without continuing education, not so much concerned with general skills, but with professional skills as the basis for employment (Zeelen, 2012; Muriisa, 2014). Nevertheless, to respond to this multifaceted demand, African universities have been avoiding their primary objective in developing research and research-based training of researchers (Mamdani, 2012).

The Mozambican case suggests a reactive growth since the expansion of HE is largely driven by the demand for credentials to obtain better salaries, especially in the State, rather than by the demand for knowledge through industry and society. In this way, a paradoxical phenomenon is evident in Mozambique and Sub-Saharan Africa, with “low participation rates, low production and dissemination of knowledge, but a potential saturation of the labor market” (Zavale, 2018, p.658).

2.3.2. *Challenges in education and human capital*

For about forty years, the number of enrolments in universities in sub-Saharan Africa has skyrocketed, showing an average increase of 8.6% per year in both undergraduate and postgraduate degrees. To meet this growing demand for training, these universities have been facing the challenge of recruiting dedicated and qualified teachers, but also of adapting their teaching system (e.g., for distance learning) (Bruneforth, 2010, cited by Zeelen, 2012).

To adapt to the lack of teaching space generated by the significant student demand, universities have changed their curriculum, introduced new courses, and initiated parallel programs, such as evening and weekend courses. However, the liberalization of university education, particularly its privatization, was introduced on the recommendation of the World Bank, which

forced the government to reduce investment in this sector (Muriisa, 2014). Another challenge that increases with this constant growth in demand for formation, was in justifying it with some employability since the labor market, in some areas, ends up being pressured by exaggerated graduates not having the capacity or interest in offering employment opportunities to all. Thus, this massification of higher education contributes negatively to these universities' performance in terms of teaching (Zeelen, 2012).

African universities remain in a deep crisis characterized by difficulty in accessing funding, lack of adequate facilities and equipment, as well a lack/loss of qualified and specialized human resources to conduct quality training, especially postgraduate training (Cloete et al., 2011; Bates et al., 2011; Zeelen, 2012; Wambalaba, 2014, cited by Darley & Luethge, 2016; Muriisa, 2014; Zavale, 2018; Cardoso, 2020). Due to a lack of material resources, institutions have difficulty graduating students with the skills desired by the labor market, leading the latter to complain about the inability of graduates to keep up with what is required (Zeelen, 2012; Mohlala & Msimango-Galawe, 2021).

The education system in Africa is deeply problematic, mainly in terms of wasted human capital and financial resources. There is an urgent need to prioritize the responsibilities of a university in creating relevant new knowledge, adequately training students as active citizens for the challenges in the labor market, contributing to the development of communities, and stimulating critical thinking (Zeelen, 2012).

2.3.3. *Challenges in research: production and transfer of knowledge*

The recent existence of wide recognition of the essential contribution of knowledge to economic competitiveness and social welfare has increased attention to the role of universities in producing and disseminating knowledge. The activities performed at universities can generate knowledge that contributes to the improvement of production processes, and to technological advances, which companies can mobilize as a mechanism to enhance their capabilities and create new processes and products. Thus, in addition to contributing to solving national problems by supporting the development process, universities can also make relevant contributions to increasing the competitiveness of companies (Vera-Cruz, 2014). However, the production of new knowledge should not only depend on HEIs. Universities located in developing provinces need to be transformed into "development universities[1]," and for this idealization to materialize there is a strong need for other actors, such as business and government, who must also be prepared to take on new responsibilities (Ondari-Okemwa, 2011).

In the present day, African HEIs, particularly in sub-Saharan Africa, still face several challenges in knowledge production, such as inadequate infrastructure as a result of the continuous decline in public spending; brain-drain of qualified and specialized individuals to other more competitive countries, as well as competition in knowledge production (Ondari-Okemwa, 2011). In addition

[1] Mccowan (2018, p.104) identifies two types of universities, the developmental and the entrepreneurial university. In both, the interest is external but takes different forms. The first focuses on responding to the needs of society, and therefore on solving the various problems in which it finds itself, referring to aspirations for positive change, while the second is sought by consumers/students, in obtaining courses, and by external bodies (e.g., government and business) looking for research and consulting. In the development model, existing courses are established based on need, not on the ability to recruit students, and research is designed based on social benefit rather than commercial demand.

to funding cuts, research has also suffered from the exacerbated increase in the number of students (Harle, 2013). Being part of a developing country, such as South Africa, can lead to faculty members being faced with a greater teaching burden and a lack of guidance on publication techniques (Gerber, 2009). Furthermore, most faculty members, due to the low salaries, characteristic in African universities, are forced to take on a second job to support themselves, which ultimately takes away their time and incentive to focus on research activities, as well as undermining teaching and program quality (Darley & Luethge, 2016). Muriisa (2014) argues that external and internal pressures strongly influence the performance of a university. However, leadership plays a crucial role in balancing these pressures and correctly guiding the university.

Research capacity building is a long-term process that depends critically on relationships and trust between individuals, and is also shaped by cultural values and political processes. Partnerships play a fundamental role in universities (in technical and intellectual support) through the training and development of technical staff; the provision of facilities, resources, management, and leadership necessary to develop research; the existence of funding policies at the national level, supporting and enabling organizations to thrive and individuals to advance their careers (Harle, 2013). Thus, research developed in African universities depends on some support that must consider specific internal needs, such as more qualified staff to teach, supervise PhDs and develop research; better material resources; the institutional environments in which academics work; and broader policy currents, national and international, that advance or hinder scholarship and determine opportunities for national/ international collaboration (Harle, 2013). However, while international support and collaboration are core dimensions, African universities need to be able to define and pursue their ambitions (Harle, 2013; Muriisa, 2014). As Harle (2013) points out, the literature indicates that while new funding is essential, more attention should be paid to the human, relational, cultural, and political dimensions of capacity building and everyday life within African or partner institutions.

To survive, any organization depends on the environment for the supply of resources. Nevertheless, it must interact with the resource controllers who, due to their ownership, exercise power over it. In this sense, organizations are faced with the need to find ways to regulate the behavior of their members, so that they contribute effectively and efficiently in the pursuit of their goals (Muriisa, 2014).

The scholarly publication also assumes an important position in the performance of universities, as these research outputs, by country or region, provide not only an indication of the production of new knowledge but also of its research capacity. A low academic publication rate suggests a region knowledge diffusion problem and possibly low new knowledge production rates (Ondari-Okemwa, 2011). In addition, many of the academic publications in Africa tend not to be highly internationally illustrated, leading to these being less recognized and credible for influencing decision-making (Ondari-Okemwa, 2011; Zeelen, 2012; Darley & Luethge, 2016). In this way, African universities have experienced a decline in research and research-based training. According to Muriisa (2010), current indicators show that African universities' contribution to international journals has been recorded at less than 2% and most of which are from Egypt and South Africa. The decline in university research output is particularly due to poor public funding and financial governance. As academic research in Africa becomes more developed, despite the various challenges it faces, and more emphasis is placed on research productivity due to the need

for international validation and accreditation, there should be a significant increase in the publication of articles in refereed journals (Darley & Luethge, 2016).

Growth and renewal of African HE are closely related to two sets of concerns, that are putting pressure on universities to meet these competing demands: relevance, development (1), and excellence and international standing (2). The former requires them to demonstrate their relevance as institutions by demonstrating how they respond to the needs of national development, while the latter requires them to build robust research systems to claim a position in wider networks. As Harle (2013, p.89) mentioned, "(…) attempts to characterize what a 'world class' institution looks like tend to emphasize high concentrations of talented academics: mobile, connected to international networks, with strong publication records, significant budgets, and strong strategic vision and leadership".

2.3.4. *Challenges regarding linkages with firms*

The existing literature on National Systems of Innovation (NSI) has shown that the interactions between the academy, economy, and policy, in the production, transfer, and use of knowledge, can promote socioeconomic development. This idea has stimulated research on the existing modes of collaboration between HEIs and Industry known as "University-Industry Linkages" (UILs) (Zavale, 2018, p. 645). However, most of the research developed on UILs has mostly focused on developed countries (Teixeira & Mota 2012; Vera-Cruz 2014), giving little attention to existing collaborations between companies and immature HEIs (Zavale, 2018; Vera-Cruz 2014).

Despite this, some of the literature has shown that in most developing countries, university-business collaboration falls more through "traditional channels" (e.g., holding conferences, hiring graduates) and "service channels" (such as consultancies) than through "commercial channels" (Kruss, 2012, p. 213; Vera-Cruz 2014). In some specific countries and universities (such as, in South Africa) commercial channels may also exist. These channels are crucial, as they enable innovation for firms and financial and/or intellectual benefits for universities. The lack of the latter channels can negatively impact the scientific performance and reputation of universities (Kruss, 2012). According to Kruss (2012, p.207) "commercial forms of interaction are driven by the economic strategies of universities and the proactive strategies of firms, taking the form of spin-off companies or incubators that, like the bi-directional channels, require direct personal interaction, at a critical stage".

Furthermore, Arza (2010) argues that there are two categories of benefits of cooperation between universities and industry: economic benefits, which usually refer to financial support in universities, as well as short-term production in companies, and intellectual benefits (e.g., new ideas for research in universities and long-term innovations for firms). Regarding the main benefits of the cooperation between African universities and industry, Kruss & Petersen (2009) revealed that for enterprises these consist more of short-term production rather than long-term innovation, while for universities these are more of an intellectual rather than financial nature. However, the benefits of this type of relationship may vary according to each university's maturity level (Kruss & Visser, 2017). This level of maturity shapes the patterns of linkages between HEIs and businesses and depends on four factors: the level of academic capacity of universities, concerning their size, mission, quality, and academic productivity, absorptive capacity (1), as well as the technological capacity of companies (2); external conditions in which universities and firms operate, including the socio-

political context, the overall economic structure and the historical trajectory of the country (3), and, finally, the dynamics of the global economic and technological landscape (4) (Kruss, 2012).

The results of a study conducted by Zavale (2018) indicate the main barriers that can hinder UIL, namely, differences in mission (academic mission/economic mission) and organization between universities and companies; internal capabilities of universities and companies, as well as external conditions. Through his study, the author showed that companies prioritize the Internet as the main source of innovation, followed by customers, sectors within companies, other companies, government, specialized literature, and professional conferences, respectively. Although these companies recognize some importance of universities, as well as research institutes, a weaker collaboration is assumed. Note that, this fragile relationship is more evident in African universities (Zavale, 2018).

The relationship between educational institutions and companies is increasingly marked by disagreements and tensions, including conflicts about the kind of knowledge and skills students bring to the labor market (Ruben, 2018). Of note, Windeløv-Lidzélius (2018) points out that it is not just about the adoption of new technologies, but about reconsidering the role that the Professor assumes, as well as what happens in the classroom, and the appropriate teaching methods.

2.3.5. *Challenges in contributing to sustainability*

Universities assume a social responsibility, in the production and transfer of knowledge, through scientific research, which can be used by other actors from all sectors, as well as by policymakers and communities, in informing mitigation and adaptation practices; in providing training and capacity development in various scientific fields, and can therefore produce well-informed and competent graduates, in raising awareness, as well as providing guidance to communities and policymakers (Sousa Santos, 1999; Muriisa, 2014; Darley & Luethge, 2016; Kasozi, 2017; Cardoso, 2020; Ssekamatte, 2022).

Virtenen (2010, p.232) stated that higher education institutions can choose between two roles: as simple 'indicators of changes in attitudes, knowledge, and practices within a society, but not themselves providing the inputs for change', or as 'proactive leaders in promoting social change'. Adesina (2006), however, suggests that universities differ from research centers in that they function on two distinct levels, namely, by training successive generations of young people required by the economy, as well as, reproducing, through academia, a widespread of knowledge produced. Recently, universities have been providing strategies to promote sustainability and the implementation of sustainable development goals (SDGs) and many have already integrated them into their curriculum. They are trying to attract policymakers and individuals from various sectors through their political engagement to drive their implementation. Regarding climate change, some HEIs have already initiated education programs, including courses, programs and activities, research and innovation interventions, and community engagement interventions (Filho, 2015, Filho et al., 2019). African universities have also been developing educational programs related to climate change (Ssekamatte, 2022).

The SDGs recognize the importance of higher education institutions and lifelong learning opportunities in providing relevant skills to develop the complex, sustainable and integrated solutions

they require. While six of the seven sub-goals of SDG 4 focus on improving access to education, SDG 4.7 promotes knowledge for sustainable development, which includes a dual focus on training the individual and developing knowledge for society. Note that, knowledge for sustainable development not only refers to economic gains but also to acquiring knowledge and skills that enable individuals to contribute to the common good, eventually leading to progress on other SDGs. In turn, SDG 4. b aims to increase educational opportunities for individuals, calling for the provision of scholarships for students, particularly from Africa, to pursue higher education as well as lifelong learning (Jamison & Madden, 2021). However, this mission can be compromised since many public HEIs in Africa lack autonomy, and sub-Saharan Africa is no exception. Decisions on recruiting technical staff depend on university administrations and politicians who do not know the intricacies of managing a university or higher education institution. Some institutions have an excessive number of higher administrative staff who are not involved in teaching, research, and/or knowledge production. This unbalance compromises teaching, research, and the production and distribution of knowledge in HEIs, particularly in sub-Saharan Africa (Ondari-Okemwa, 2011).

Higher education institutions, in general, are under pressure to change many, if not all, of their traditional ways of conduct. However, responses to such pressures differ in developing regions such as sub-Saharan Africa, with its universities having to find their answers to the challenges of their role in producing and transferring knowledge relevant to local and national development. Meanwhile, that access to advanced research and the ability to absorb and preserve human capital in universities can contribute to their greater involvement in regional economic growth (Ondari-Okemwa, 2011).

With the drain of qualified labor, and therefore, sufficiently specialized expertise faculty and researchers, HE from Africa do not possess enough skilled workforce to combat the ongoing challenges they face (Ondari-Okemwa, 2011; Bates et al., 2011; Harle, 2013; Muriisa, 2014; Cardoso, 2020). Leadership in the university sector, faced with increased internal and external pressure, has placed more emphasis on the knowledge economy than on supporting research, quality teaching, and community service. Both the government and industry have given up their role and started looking only for graduate human resources to contribute to the country's economic development (Muriisa, 2014).

The importance of higher education institutions lies in their ability to contribute to the socioeconomic development of their countries. Nevertheless, there is an inconsistency between needs and competencies, with inadequate funding and poor availability of qualified faculty alone hindering universities' capacity to act and extend (Alabi & Mba 2012). Gaps in governance and leadership are highlighted in a long list of causes of disconnects that replicate the challenges experienced in African higher education institutions (Zhou, 2020). Although the university is essential to contribute to responding to the contemporary worldwide challenges, such as prolonged conflicts, refugee crises, poverty, climate change, and socioeconomic inequalities, its contribution is limited and does not exclusively depend on it (North et al., 2011; Muriisa, 2014; Mccowan, 2018; Ssekamatte, 2022). While it can adapt, the university has specific characteristics, which bring opportunities, particularities, and limitations (Mccowan, 2018).

The lack of resources and the weak academic capacity of universities force them to spread existing knowledge instead of producing new knowledge (Liefner & Schiller 2008; Kasozi, 2017).

Innovation is, in most developing countries, limited by the surrounding structural conditions, not only by inadequate infrastructure and limited financial resources, but also by weak political systems, corruption, partially closed economies, fragile legal system, and weak educational systems (Altenburg, 2009; Zanello et al., 2016). According to Zavale (2018), countries with low scientific production tend to have low technological production and low GDP[2] per capita, thus being seen as low-income countries. Countries with medium scientific production tend to have medium technological production and medium GDP per capita, being considered as middle-income countries, and countries with a high level of publications tend to have a high level of patents and a high level of GDP per capita, being situated as high-income countries (*Ibid.,* 2018). Thus, there is a clear dependency between scientific production and the socioeconomic development of a country.

2.4. Learning from the literature review

Through the literature reviewed, it was possible to verify that African universities have interconnected weaknesses in their three bases of action - education, research, and the provision of several services to the community, that hamper their performance and extension.

In this regard, it is pertinent to mention some recommendations presented by Assie-Lumumba (1996), of which applicability may vary according to national and institutional contexts, these being:

1. the importance of the State to remain linked to higher education, providing solutions for social serenity/harmony and socio-economic progress;
2. the need for a solid policy to respond to the urgent needs of society in the medium and long term;
3. the existence of short-flow programs within universities, which will contribute to the ease of responding to the diverse and growing demand for training.

In addition, the above-mentioned author also pointed out the need to take some of the pressure off universities by strengthening longer-lasting programs that will have the opportunity to improve quality and efficiency internally and externally but must continue to perform their roles of teaching, research, and community service (4), and finally, the need to revitalize the research mission of African universities by investing in better research facilities and increasing human capital through collaborations and partnerships between African and international institutions (5).

[2] Gross Domestic Product (GDP) is a macroeconomic indicator that measures the degree of economic development of a country or region.

3. Research methodology

3.1. Desk research

The first phase of the research process began with the application of desk-research techniques. The main objective of this phase was to analyze and summarize the existing scientific activities on African HEIs, particularly on the role and mission of African universities, and the challenges faced by them. This was done by identifying and selecting key scientific outputs, namely peer-reviewed indexed articles on the main scientific repositories and databases, that directly contributed to the following research questions: What are the characteristics of Africa's Higher Education Institutions? What are the most relevant contextual and institutional dimensions for understanding these HEIs? What role do they play in their territories? What are the main challenges they face?

The following keywords were used as research topics: Africa; sustainable development; higher education; innovation; challenges, and cooperation. This collection of information was essential since it allowed a contextualization of both historical and up to date of African universities, which made it possible to identify the main dimensions of analysis and subsequently to create the data collection instruments.

3.2. Interviews

After identifying the crucial dimensions of analysis, a semi-structured interview script was constructed. The main purpose of a semi-structured interview is to allow the interviewer to understand how their interlocutors perceive certain dimensions of the research, and also flexibility in conducting the conversation (Nunan, 1992; Bryman, 2016). This flexibility is achieved through the way questions are constructed. The formulation of the questions should consider the possibility of leaving open alternative avenues of inquiry that may arise during data collection - this is precisely one of the assumptions of qualitative research.

The interviews were held in June 2022, via zoom. The option for conducting interviews online was related to the geographical distance since during the project there is a concern to minimize the environmental impact of its activities. Bryman (2016) identifies this factor as one of the main advantages of conducting interviews online. Added to this is the greater ease in scheduling the interviews with less constraint on the participants' schedules.

In total, nine semi-structured interviews were carried out, one for each university partner in the project. Since the main objective of this WP9 activity was to obtain a critical view of the current situation of the universities belonging to the partnership, each one was given the possibility to choose a representative to be interviewed. The participants[3] were selected based on their knowledge and experience within the higher education institution where they work. In this way, permanent professors, department directors, general directors of the institution, as well as division heads, were

[3] Cf. Annex 2 – Interviews Participants.

selected to participate (seven have completed their Ph.D., one is in the process of completing his Ph.D., and another one has only completed his master's degree).

Based on the objectives of the current study and the bibliographical analysis, the interview script[4] addressed issues such as the role and contribution of the university to national and regional development, as well as to the community in general, the characterization of the university, the identification of their strengths, weaknesses, threats, and opportunities, its articulation with the geological sector and their training, production, and knowledge transfer capabilities. It also addressed the resources and other forms of institutional support provided by the university management to the academic community, its integration in the dynamics and strategies of sustainable development, the constraints that hinder cooperation between African universities and European universities and other public research entities, as well as cooperation between African universities and the business and social fabric, among others. Each interview was audio recorded to retain the data, which was later organized and summarized for analysis.

Official websites of the universities were also used to complement the information collected through the interviews, as it was considered interesting and relevant to mention certain aspects related to the characterization of universities that were not mentioned or expanded upon by the interviewees. These aspects include the historical background of the universities, the main areas of training and research, and the type of existing programs and/or research centers.

3.2.1. *Institutional presentation and brief characterization of the interviewees*

UNIVERSIDADE EDUARDO MONDLANE (UEM)

With its rectory located in Maputo, Mozambique, it was founded in 1962 and has around 20 thousand students. It is the oldest public institution of higher education in the country and covers all areas of knowledge, from veterinary sciences to biological sciences, social sciences, law, and mathematics, among others. It aims to become a research university, to solve the various problems that society faces, and is concerned with the university's position in the world ranking. Regarding sustainability, this HEI has a sustainable development strategy, which is regularly reviewed and contributes to the water supply and the combat against hunger.

The representative selected to be interviewed is a professor of Economic Geology, Director of Graduate Studies in the Department of Geology, and Coordinator of a master's degree and Ph.D. in Mineral Resources Management. In 1992, got his master's degree in England and returned to Netherlands and completed his Ph.D. in 2005. As they were short of teachers, he was "enticed" to stay at the university where he had done his internship after finishing his degree.

INSTITUTO SUPERIOR POLITÉCNICO TUNDAVALA (ISPT)

Located in the city of Humpata, in Angola, is a private institution, created in 2005, a product of the evolution of the Private University of Angola (UPRA) – Lubango Campus. It initially emerged as a campus mostly dedicated to the areas of Environment and Agronomy. Currently, it has 4 departments, such as Health, Engineering, Social Sciences and Humanities, and Arts, with

[4] Cf. Annex 1.

13 degrees' programs in operation, and about 2,000 students, 118 professors (only 7 holding a Ph.D.), 34 classrooms, 4 laboratories, and two preparation rooms, three computer rooms, two auditoriums, a museum, a reprographic office, a canteen, a health service area, a sports area, an experimental farm, and an area of native flora. Its main role is teaching; however, research has been gaining some relevance. This institute has an annual magazine (Tundavala – Angolan Journal of Science), which started in 2013. It should be noted that this institution offers undergraduate courses that do not exist in the province and others that are unique at the regional level. The ISPT recruits teachers among its best graduates, to give them access to post-graduate programs (masters and doctorates) and aims to implement doctoral courses in the main areas of interest taught at ISP Tundavala. It has been developing a project on changing the agricultural practices of rural communities to be more resilient and working drought in southern Angola, with the contribution of different areas of knowledge such as social and natural sciences.

This institution was represented by one of the founders of its institution − an associate and deputy director in the scientific area specialized in Environmental Engineering.

UNIVERSIDADE AGOSTINHO NETO (UAN)

Situated in the city of Talatona, Angola, it was created in 1968, initially called the "University of Luanda". It is a public institution that has courses such as geology, biology, geographic engineering, computer science (with more students), meteorology, mathematics, physics, chemistry, and geophysics. It consists of 7 faculties: faculty of natural sciences, faculty of economics, faculty of humanities; medicine; letters and law), all of which have bachelor's and master's degrees and four of which also have doctorates (faculty of natural sciences; economics; humanities and medicine). It has around 25,000 students, with between 200 and 600 students in each course. There is more research in the courses of geology, engineering, and medicine, with projects more oriented towards the technical component and with easier access to some funding. Despite attaching great importance to research, there are many constraints.

The interviewee selected is an associate professor in the Department of Geology, coordinator of the master's degree in mineral and environmental resources who collaborates in one of the doctoral programs (responsible for the gas and oil area). In 2003, they needed professors and invited her to be a lecturer at the university, which she eventually accepted starting only as a master's professor.

UNIVERSIDADE DE CABO VERDE (UniCV)

Its rectory is in the city of Praia. It is a public institution that initially emerged in 1979 as the "Teacher Training School". It is considered the largest university in the country. It inherited several structures that belonged to Cape Verde's higher education system. In 2006, it became the University of Cape Verde and started a plan to train its teachers at the Ph.D. level. It focuses on teacher training in Portuguese language and Lusophone languages. More than half of the staff has completed or is in the process of writing their doctoral thesis. It has 5,500 students, 280 teachers, and 186 employees. It works with full-time teachers, teachers with indefinite contracts, and part-time teachers. It has been increasing its offer of higher education courses. It consists of 5 organic units, such as the faculty of science and technology; the faculty of social sciences and humanities; the school of business and governance; the faculty of education and

sports; and the school of agricultural and environmental sciences. In 2015, it started medical school and last year it started law school. It is located on a new campus, which was built from scratch to meet the needs of the University of Cape Verde (it includes all the organic units, an excellent media library, cafeterias, residence halls, laboratories, and a convention center with a capacity for 650 people). The areas of greatest demand are in the faculty of science and technology (medicine, nursing, engineering, biology, chemistry, and electrical engineering) and the faculty of social sciences and humanities (international relations and diplomacy, which, according to the interviewee, promotes the university a lot) and political philosophy. It has already signed, on average, 300 protocols with foreign universities that have helped in the development of increasingly current lines of research and investigation.

The interviewee selected, has been working in this university for 27 years, entered as a guest, and is currently a permanent member of the staff of the University of Cape Verde. She is an assistant professor in the Languages, Literatures and Cultures course with disciplines related to the teaching of Lusophone literatures, Portuguese literature, African literature, Brazilian literature, and Cape Verdean literature, and advises students in the fields of Children's and Youth Literature and literary reading. She is a member of the Eugénio Tavares Chair of Portuguese Language, where she coordinates research projects related to literacy and the promotion of literature in the Portuguese language. Since March 2022, she has served as pro-rector and lecturer and is also responsible for all student policy. She completed her Ph.D. in 2013 in comparative studies of Portuguese language literature at the University of São Paulo, Brazil.

INSTITUTO SUPERIOR DE CIÊNCIAS E TECNOLOGIA DE MOÇAMBIQUE (ISCTEM)

Located in Maputo City, Mozambique is a private institution, founded in 1996 and inspired by the standards and experiences in Portugal. It has 4,000 students and is in the process of becoming a Higher University. It focuses more on teaching, especially at the undergraduate level, however, it aims to become a national reference institution in the business, professional, labor, and scientific/academic markets in the fields of Advisory Services, Consulting, Scientific Research, and Outreach to communities. It lives on tuition fees and sources of income (partnerships). Many of the institution's staff have taken their post-graduate degrees in Portuguese universities. There is an effort on improving the research outputs, especially in pharmacy and dentistry, with published reports, articles, and participation in conferences, which is already motivating colleagues from other areas to invest more in research. It assumes a privileged position in the higher education market. It has around 16 full-time professors and between 350 and 370 part-time professors per year. It is divided into four schools, namely, the school of health; the school of economics and business management; the school of engineering and technology, and the school of law and arts. In 2023, it will also open a course in physical therapy. Its main areas of training are Management; Economics and General Medicine, and its main areas of research and performance are Engineering and Informatics; Health and Population; Economics; Finance and Business; Architecture, and Urbanism.

This HEI was represented by the director general of ISCTEM. In 1996, completed his Ph.D. in Thermodynamics of Inorganic Materials (Germany). He was a lecturer at Eduardo Mondlane University. In 2019, he retired from years of service and started working as a full-time professor

and in the direction of research and extension (for 8/9 months) at ISCTEM. In 2020, he was invited to take up the position of Director General.

UNIVERSIDADE DE SANTIAGO (US)

Located in the city of Assomada, in Cape Verde, this university was created in 2008, having emerged from the perspective of expanding higher education (science, culture, and education), at a higher level, and reorganizing the entire market of scientific and cultural production. It is a private institution, though it operates as if it were a public one, concerning the dimension of citizenship, inclusion, fighting regional asymmetries, and the abandonment of the island's interior. It has around 2,000 students (in person and distance learning), from the PALOP'S, Portugal, and the United States. It has always defended the inseparability between teaching, research, and extension. It has created the US-Communities project, which is seen as a strategic resource to foster and increase the participation of the academic community in Cape Verdean social and cultural life, in which students travel to other islands to interact with communities and institutions. Its main areas of training are nursing, law, and business management. It consists of 4 departments, namely, the Department of Education, Philosophy and Literature; the Department of Health Sciences, Environment and Technology; the Department of Economics and Business Sciences, and the Department of Legal and Social Sciences. It offers about 20 bachelor's degrees and 9 master's degrees, has 3 scientific journals (Lantuna – Capeverdean Journal of Education, Philosophy and Letters; Cape Verdean Journal of Social Sciences and Journal of Law of the University of Santiago), and hopes to implement doctoral courses in the next academic year. In addition, it contains a Language Center of the University of Santiago, which aims to disseminate and stimulate activities that promote the different languages and cultures taught at the institution. Currently offers free courses in English, German, French, and Creole. In 2013, founded the Institute of Research and Studies for Development – IPED, an institutional body created to guide, manage, and encourage the improvement of the quality of research, at the institutional level.

The selected interviewee is the head of the Department of Legal and Social Sciences, professor, and coordinator of the master's degree in public policy and local development and is part of the collegial coordination of the university's institute for research and development studies. He has basic training in sociology, a master's degree in African studies, development, and management, and in 2015, completed his Ph.D. in social sciences and joined this university as a visiting professor.

UNIVERSIDADE DE COIMBRA (UC)

It is located in the city of Coimbra, Portugal, and is a public institution created in 1290 (732 years old). It is divided into 8 faculties and therefore has several teaching areas to offer students, as well as to contribute to research. It has around 26,000 students, 1760 teachers, 279 researchers, 1340 technical staff, and 514 research fellows. All the faculties of this university are committed to research. The Faculty of Science and Technology has a larger dimension and, consequently, more research projects and funding. In the area of medicine, the university has an organic research unit, the Institute of Nuclear Sciences Applied to Health, which ends up having great research potential. This university has 38 research centers, 347 courses (35 bachelor's degrees,

109 master's degrees, 12 integrated master's degrees, 68 doctorates, and 123 non-degree courses), and more than 2,000 cooperation agreements. It also has a college of arts, and an interdisciplinary research institute. With a uniquely tangible and intangible legacy that is fundamental to the history of European and world scientific culture, it has been a UNESCO World Heritage Site since 2013.

The selected interviewee has a master's degree in Economics since 2010, works as head of division in the division of projects and activities that are integrated into the service of promotion and management of research in the administration of the University of Coimbra, and is part of the general council. He entered the University as a management and technology science fellow in the same division (for 3 years), and in 2011 he entered a competition for a higher technician.

UNIVERSIDAD DE SALAMANCA (USAL)

Located in the city of Salamanca, Spain, it emerged from the 'Schools Salamanticae', created in 1218, by the desire of Alfonso IX of Leon to have higher education in his kingdom, having more than 800 years of uninterrupted history, creating, promoting, and disseminating knowledge. It is a public institution, divided into 9 university campuses, 26 faculties and higher colleges, 13 research institutes, and has 30,000 students. It is considered to be generalist, very connected with the region and the area with the Portuguese border, and has a typical structure of Spanish universities. The main areas of training and research are philology, law, and medicine.

USAL was represented by the director of the Department of Modern Philology in the Faculty of Arts and delegate of the rector for International Networks. His scientific area is German Linguistics in the Dutch language. He obtained his Ph.D. in 2003 and joined this university in 2005 as an assistant professor in the field of German philology.

UNIVERSITÀ DEGLI STUDI DI TORINO (UNITO)

Located in the city of Turin, Italy, is a public institution, founded in 1404. It is considered one of Italy's largest universities, with 27 departments, approximately 79,000 students, 4,000 employees, and about 12,000 graduates per year. It is multidisciplinary: Medicine, Mathematics, Law, Economics, Geology, and Social Sciences, among other fields, and an integral part of the community, acting to revitalize urban and suburban areas, promoting cultural interaction, social integration, and development, encouraging dialogue, and understanding of current realities. It is also the leader of the European University Alliance (UNITA), composed of more than 5 universities: Universidade da Beira Interior (UBI) - Portugal, Université de Pau et des Pays de L'Adour (UPPA) - France, Université Savoie Mont-Blanc (USMB) – France, Universitatea de Vest din Timisoara (UVT) – Romania and Universidade de Zaragoza (UNIZAR) – Spain, of which its partners are closely committed to share and implement common values for an innovative, European and future-oriented university.

The selected interviewee is a professor of mineralogy and the head of the Department of Earth Sciences at the University of Turin. He holds a Ph.D. in Mineralogy and Crystallography and joined the University of Turin in 2016 as a professor, after serving as a professor from 2005 to 2016 at the University of Milan.

3.3. Focus group

As an additional method of data collection to validate and deepen the ideas developed in the exploratory interviews, a focus group (FG) was conducted with the participation of some of the project partners[5]. Krueger and Casey (2009) understand the FG as moments of discussion, carefully planned, and designed to obtain insights about a specific area to be analyzed, in which a permissive and enabling environment of discussion and sharing among the group should be built. According to Morgan (1997), the focus group, or focused discussion group interview, is a qualitative technique that consists in controlling the discussion of a small group through non-directive interviews, privileging the observation and the recording of experiences and attitudes of the individuals belonging to the group, which would not be possible to capture by other methods (participant observation, individual interviews and/or questionnaires). Data collection using this technique is carried out through group interaction on a certain topic of interest presented by the researcher, recognizing his active role in facilitating the group discussion for information collection and locating the interaction as a source of data (Morgan, 1996).

The focus group was based on nine questions proposed by the moderator that were divided into two main parts. The first part referred to the potential beneficiaries and their expectations for the SUGERE network, and the second part consisted in sharing significant ideas and suggestions to improve the quality of the project and ensure its continuity.

PART 1. Potential beneficiaries and their expectations

1. For whom can the SUGERE network create value? (Who are the potential beneficiaries?)
2. What value proposition can the SUGERE network offer to its beneficiaries? (Problems that SUGERE can help answer)
3. Which channels can SUGERE use? (How to reach potential beneficiaries and capture their attention)
4. What kind of relationship do potential beneficiaries expect to have with the SUGERE network?

PART 2. Ideas and suggestions to improve the quality of the project and ensure its continuity

5. What resources does the network have? What more resources does it need (non-financial resources)?
6. What activities should be developed by the SUGERE network to realize its value proposition? (Identify crucial activities)
7. Which partners will be essential to the sustainability of the network?
8. What financial resources can the SUGERE Network obtain (projects and services)?
9. What costs might the project activities have?

[5] Cf. Annex 3 – Focus Group Participants.

The FG was held by zoom and aimed to identify key aspects for the future continuity of the SUGERE project. This focused discussion was guided by a moderator, lasted 1h45min and during its course notes were taken on relevant information mentioned by the participants, which were then organized and summarized for analysis.

4. Interviews results

This project involves three European public universities (UC, Portugal; UNITO, Italy and USAL, Spain), as well as six African universities, part of the Portuguese Speaking African Countries (PALOPs), three of which are private institutions (ISPT, Angola; ISCTEM, Mozambique and US, Cape Verde), and three other public institutions (UniCV, Cape Verde; UEM, Mozambique and UAN, Angola).

The main dimensions of the present study were: the role, contribution, and challenges of the universities (assuming an internal and external analysis, following a SWOT[6] analysis approach); their performance capacities (advanced training; production and transfer of knowledge); partnerships and collaborations, particularly about the constraints in the cooperation between African and European universities, but also in the cooperation with the business and social fabric; aspects for improving their performance and finally, expectations for the future of the SUGERE project. During this analysis, a brief comparative analysis was carried out between the current situation of the six African universities and the three European universities.

4.1. Contribution and challenges for African universities

Although some of these universities are in different regions and divided between public and private institutions, it was possible to identify some common aspects between them, regarding their strengths, weaknesses, opportunities, and threats, as well as their performance and extension capacity.

4.1.1. Internal analysis

Weaknesses

It was possible to observe common weak points among the six African universities, such as few effective and qualified lecturers (there are still part-time and contract teachers), reduced provision of support for students' financial needs (which leads many students to drop out of their studies, and consequently to a reduction in the number of graduates), difficulty in developing research autonomously (mainly due to the lack of facilities and limited financial and material resources, which end up hindering the capacity to work effectively). The low percentage of effective and qualified faculty members pointed out by most interviewees, according to them, is mainly due to the low attractiveness of compensations and the loss of faculty members to other more competitive challenges, which leads to a brain drain (i.e., loss of specialized and qualified human capital).

It should be noted that, in post-graduate studies, there is a poor supply of doctoral courses, and of the six African universities that are part of this study, only two offer doctoral courses (UAN – six and UEM – four). Despite this, the offer is quite scarce compared to European universities which offer more than 40 doctoral courses.

[6] Acronym for Strengths, Weaknesses, Opportunities and Threats - S.W.O.T.

It is worth mentioning that these weaknesses were not mentioned by the representatives of the European universities in terms of their institution, with only the difficulty of internal management being emphasized as a common aspect among them.

Table 1. Most highlighted weaknesses per university

UniCV	UEM	ISPT
- Difficulty in meeting the demands for training. - Lack of investment in research. - Limited resources (financial, material, human, scientific, and specialized). - Few effective and qualified faculty members. - Lack of support for students' financial needs. - Difficulty in data compilation. - Lack of Ph.D. courses.	- Few effective teachers in some areas of knowledge. - Lack of support for students' financial needs. - Lack of Ph.D. courses (only 4). - Difficulty in the English language (which hinders access to knowledge at an international level, as well as the inter-relationship between countries).	- Lack of English language skills. - Lack of computer skills. - Lack of teachers developing research. - Difficulty in developing research autonomously. - Lack of Ph.D. courses. - Low local connection.
ISCTEM	**UAN**	**US**
- Few effective and qualified faculty members. - Lack of Ph.D. courses. - Few laboratories resource. - Limited capacity to produce and transfer new scientific knowledge. - Young faculty members (with limited experience).	- Lack of support for students' financial needs. - Unmotivated and inexperienced teachers. - Difficulty in developing research autonomously. - Lack of research grants. - Limited resources (financial and human. - Lack of laboratory and school conditions and resources. - Precarious training and research capacity. - Lack of Ph.D. courses (only 6). - Elitist. - Low salaries.	- Limited resources. - Low scientific production. - Few annual publications. - Little mobilization of funds. - Few qualified faculty members. - Lack of Ph.D. courses.

Strengths

Despite some constraints in these African higher education institutions, they seek to respond to social needs, and, therefore, contribute to human resources training and research, especially in areas of great interest (such as the environment, for example). Although these six universities focus mainly on education, they have been increasingly concerned about investing more in research. A great willingness and ability to adapt to the circumstances they find themselves in is evident, but also a significant commitment to constant improvement in their performance. It was also observed that there is a policy of inclusion in access to education, as a common aspect. Despite having few qualified teachers teaching and developing research, according to the interviewees, they are trained in universities from various parts of the world, which allows a variety of knowledge.

In addition, these universities have managed to offer, as much as possible, some incentives to students for their personal and professional development for greater civic engagement, namely, the case of UniCV, US, and ISCTEM, in offering internships in some areas of knowledge, of which students end up getting employment in the companies where they intern; the case of UEM and ISPT, in the insertion of students in some research projects, and the case of UAN and US, in the support of the payment of tuition fees.

Table 2. Most highlighted strengths per university

UniCV	UEM	ISPT
- Staff trained in different countries. - Offers graduate scholarships. - Large size (the largest university in the country). - Good dynamic with Portuguese universities. - Investment in Portuguese, French, Chinese, Cape Verdean, and English languages. - Investment in research on topics such as climate, tourism, and the sea. - Offers internships in major companies. - Seeks to respond to the needs of society.	- Young, diverse, and specialized team. - Provides the minimum necessary resources. - Insertion of students in some research projects. - Offer of scholarships. - Inclusion policy. - Seeks to respond to the needs of society. - The oldest university in Mozambique. - Sharing knowledge and training of human resources.	- Provides limited necessary resources. - Inserts students in some research projects. - Seeks to respond to the needs of society. - Training of human resources. - Percentage of qualified teachers. - Investment in research. - Inclusion policy. - Collaborates with national and international protocols. - Strong emphasis on the training of specialized technicians. - Conducts research and participates in scientific institutions and events.
ISCTEM	**UAN**	**US**
- Offering internships. - Post-graduation courses (masters). - Ability to adapt to the constraints that arise. - Commitment to distance learning. - Investment in research. - Investment in the training of human resources. - Seeks to respond to the needs of society.	- Capacity to adapt to the constraints that arise. - Great investment in research. - Great investment in the training of human resources. - Strong bet on knowledge sharing. - Supports the payment of tuition fees. - Seeks to respond to the needs of society.	- Advocacy of inseparability between teaching, research, and extension. - Inclusion policy. - Rooting in communities. - Collaboration with Portuguese universities (Coimbra, Lisbon...). - Position in distance education. - Reduction of tuition fees. - Offering internships. - Seeks to respond to the needs of society. - Promotion of the different languages and cultures taught (English, German, French, and Creole). - Incentive in the improvement of research, at the institutional level. - Capacity to adapt to the constraints that arise.

4.1.2. External analysis

Threats

The most mentioned threats were the lack of financial support by the State (low state budget) and the industry. As for the relationship with the companies, in the case of UEM, the university technicians are "eaten" by them; in the case of UAN, US and ISPT, there is a devaluation on the part of the companies for the academic contribution (low solicitation of graduate students for internships, leading to a decrease in their supply and possible jobs, as well as low demand for research); In the case of UniCV, the financial availability of companies/entities to support the university has been decreasing continuously, mainly due to the economic impacts of the pandemic experienced since 2020, which hinders the capacity for training and research. In the case of ISCTEM, it was observed that this institution has a weak relationship with the business community, given the difficulty in responding to the expectations of companies, due to a poor dialogue between the parties, which, in turn, may lead to the loss of confidence in the academic contribution of this institute.

In the African universities under analysis, it was also observed a strong dependence on funding and partnerships. According to most of the interviewees, the lower the funding, the lower the capacity to perform in training (i.e., fewer resources available for teachers and students) and research (i.e., fewer quality laboratories and equipment, less realization or contribution in projects, among others).

In addition, there is a greater attractiveness of other universities that offer the same courses, but with more employability opportunities, better infrastructure, and more available resources needed by students. This situation leads to a loss of students who migrate to other countries (European or international). Another factor influencing the loss or reduction of students refers to the financial needs of students, pointed out by some of the African universities (UniCV, UEM, and UAN,) which can be a major threat to their performance since these students do not have the capacity to continue their studies, which leads them to drop out and the number of enrolments being higher than the number of graduates.

It should be noted, however, that European universities (UC and UNITO), except for the University of Salamanca, reported having a solid relationship with entrepreneurs. Compared to the African universities, USAL also mentioned the lack of relationship between the university and industry and the lack of State support (which hinders funding for the creation of new knowledge), the demographic decline in Salamanca (which leads to a decrease in the number of students); dependence on partnerships and collaborations in research and greater attraction of human resources abroad (which leads to the loss of many competent professionals), as the main external threats to university performance.

Table 3. Most highlighted threats per university

UniCV	UEM	ISPT
- Global crises: making existing cooperation more difficult, and therefore less financial availability, reduction or non-existence of compensating salaries, reduction or non-existence of research projects, reduction in the number of national scholarships, reduction of students, and increase in request for support for students' financial needs.	- Large portion of partner funds can create dependency. - University technicians "eaten by companies". - Students are more interested in acquiring specialized skills than having the diploma/degree itself. - Few funds for research. - Difficulty in accessing financial resources. - Dependence on partnerships for advanced training.	- Political and religious context. - Lack of international funds to support research. - Little dynamic with the African university network. - Few financial resources. - Little demand for academic contribution. - Weak business fabric (most of the work is requested only by the State, and companies have no interest or confidence in university work).
ISCTEM	**UAN**	**US**
- Increased demand for training leading to a need to increase space and infrastructure. - Competition with other institutions offering some of the same courses. - Very expensive quality laboratory equipment.	- Government bureaucracy. - Limited State budget. - Lack of financial availability by companies. - Lack of transportation to take students to classes. - Financial shortage of students (in the payment of tuition fees, access to internet, electricity, and computer). - Wrong dissemination by some companies of the correct use of methodologies and techniques (discredits the teachers). - Dependence on partnerships for research. - Weak collaboration with companies (they devalue universities, not seeing them as an added value); - Precarious labor market which leads people to follow the path of teaching, often without the passion for teaching; - Difficulty in arranging internships; - Difficulty in obtaining financing.	- Migration of students and qualified professionals leading to a loss of students and a brain drain. - Reduced State funding policies. - Low demand for academic contribution. - Small size of the country. - Weak relationship with the business. - Political instability.

Opportunities

The opportunity most mentioned by the six African universities was the existence of partnerships, in financial and material support for training, research and extension. In addition and in a more specific way, common opportunities were also pointed out, such as collaboration in European and international projects; collaboration with both industry and government institutions, where they seek the university's contribution (by graduates or by research in a specific theme), as well as collaboration with other universities, which allows the sharing of knowledge

(*Know-how*) from one university to the other, but also the improvement of staff and the quality of research. Although there is little demand from companies for academic contribution, it still exists and is considered a strong opportunity for the performance of universities, as well as for the academic and professional path of students, and should be recovered and maintained.

Table 4. Most highlighted opportunities per university

UniCV	UEM	ISPT
- Partnerships. - Demand from society. - Training and contact with China have increasingly been an opportunity for research, investigation, and training of its staff. - Permanent invitations to participate in international congresses. - Entry of immigrants to Cape Verde.	- Exploration of north-south and south-south collaboration (opening the lines of knowledge and *know-how*). - Cooperation with industry. - Cooperation with other universities.	- Funding. - Liaison with the Africa-Australia Community (SADC). - Cooperation with government institutions. - Partnerships. - Strong partnership with Portuguese universities (Coimbra, Nova Lisboa...).
ISCTEM	**UAN**	**US**
- Partnerships. - Joint Projects. - Participation in conferences; - Good relationship with external institutions (that want to establish partnerships for extension activities and even training activities in certain fields, which allows a better link between academia and the productive sector). - Strong collaboration with UEM (that makes faculty members available to this institution). - Organizations that offer extracurricular seminars. - Organizations that look for input from students (helping with their training and promoting their relevance).	- Some solicitation of graduates by companies. - Participation in European and international projects. - International protocols. - Strong support in post-graduate education, staff training, and research promotion through the University of Coimbra, Algarve, Porto, and Lisbon.	- Strong partnerships with institutions and universities in Leiria, Aveiro, Brazil, Coimbra, and Lisbon. - Great demand from Portuguese Speaking African Countries (PALOP's). - The pandemic itself allowed the advancement of virtual US. which, in turn, allows for innovation - Participation in European and international projects. - Joint production of knowledge.

It should be noted that these highlighted opportunities were also the ones most referred to by the interviewed European universities as strong contributors to their performance.

Table 5. Summary of common aspects between African universities

Common aspects between African universities			
Weaknesses	**Strengths**	**Threats**	**Opportunities**
- Few effective and qualified teaching staff. - Difficulty in developing research autonomously. - Limitation of resources. - Provision of advanced training. - Capacity to publish articles in leading journals and to the business and social fabric.	- Concern in responding to the needs of society. - Strong adaptation to circumstances. - Inclusion policy. - Members of staff formed in various parts of the world. - Commitment to research.	- Dependence on funding and partnerships. - Little support from the State and industry. - Devaluation by companies of the academic contribution. - Increased attractiveness of other universities (loss of students and human capital).	- Partnerships. - Financing. - Collaborations between universities. - Collaborations with industry and the State. - Participation in international and European projects.

4.1.3. *Articulation of African universities with the geological sector*

All the African universities that are partners in this project, apart from the University of Santiago (US), are directly linked to the geological sector, through the provision of undergraduate and master's degree courses, as well as research. In this way, they have contributed to the training of human resources in this scientific area – to the transfer of knowledge of the country itself in geological terms, but also, to its sustainable development. However, it was evident that none of these universities offers advanced training, more precisely doctorates, in this scientific area.

ISPT

At the level of training, ISPT has a geology course (articulated with the University of Coimbra) which, according to the interviewee, is not equal to the traditional geology courses, it only serves as a complement to these courses. In terms of research, this university has worked with CARITAS and the World Bank in the search for alternative solutions for water growth and has been developing a project on changing the agricultural practices of rural communities to be more resilient and work on drought in southern Angola, with the contribution of different areas of knowledge such as social and natural sciences.

UAN

It offers undergraduate and graduate programs in Geology, and Mineral Resources and Environment, respectively. This university has had a strong contribution to the training of human resources for the petroleum area. At the research level, it has contributed to enhancing the country's scientific knowledge in geological terms. Recently, its geologists discovered a microfossil for the first time in Angola. In terms of knowledge transfer, the Department of Geology of the

Faculty of Natural Sciences, publishes around 6/7 articles per year in reference journals. They are currently implementing a Ph.D. in Geology, one of the objectives of SUGERE.

UEM

It has a Geology Department, with two undergraduate degrees (Applied Geology; Cartography and Geological Survey) and two master's degrees (Management of Mineral Resources, and Geohydrology and Aquatic Resources). Besides contributing to the training of human resources for this area, it also contributes to the search for ways of studying and sharing the cumulative impacts of mining; in the investigation of renewable energies, in the process of decarbonization of the world; investigation of hydrogen as a non-polluting option, in the process of energetic transition, focusing on the sustainability of the human ecosystem.

ISCTEM

This institute has a course in Geological and Mining Engineering (EGM), in the School of Engineering and Technology, which aims to respond essentially to the needs of qualified human resources to develop a sustainable management of mineral resources, trying to take students on fieldwork to become familiar with the "world of geology" as a stimulating factor for the integrated and sustainable development of the country. Its graduates will be able to contribute to Mozambique's development and boost the economic development strategy in the southern region of Africa.

UNICV

The university has training in the area of geology, and promotes research projects in the sector of volcanology, in the climate sector linked to the archaeological volcanological configuration and extension activities that are being installed in the islands (e.g., fire island, of an active volcano). UNICV is the main entity that dominates/guides the geological sector, both in terms of training, research, and extension (3 specialists in geology, which is one of the oldest areas of the university, developed with the University of Lisbon and the University of the Azores). This work is developed with the Ministry of Environment. They are currently implementing the Master in Geological and Environmental Resources, supported by the SUGERE network.

4.2. Performance capabilities

4.2.1. *Advanced training capacity*

The capacity of African universities to provide advanced training and, therefore, postgraduate courses, is much lower when compared with European universities, which have a significant supply of postgraduate courses, both master's degrees, and doctorates. This evidence results from the limited resources available, as African universities have fewer qualified scientific and specialized human resources, and reduced material and laboratory resources. In turn, this difficulty in offering advanced training, especially doctorates, and this scarcity of resources is due to the difficulty in obtaining financing.

4.2.2. *Knowledge production and transfer capacity*

It was noted that these African higher education institutions have a weak capacity to publish articles in leading journals and to share knowledge to the business and social fabric, because of the limited resources available (financial, laboratory, material, human, scientific, and specialized). Despite these constraints, African universities continue to invest in improving their capacity to produce and transfer knowledge and have been contributing, as much as possible, to the development of their country.

However, it should be emphasized that the capacity to transfer knowledge cannot be discussed without mentioning the capacity to create knowledge. If there is difficulty in developing research autonomously, and if there are no laboratory conditions and access to functional and quality equipment, there will be, from the outset, difficulty in creating new knowledge, and in turn, difficulty in transferring scientific knowledge, which is scarce or null. To the extent that research capacity is minimal, knowledge transfer is expected to be equally limited. Many of the few articles published by these universities in leading scientific journals are in articulation with partnerships.

In turn, the weak capacity for advanced training and knowledge production and transfer mentioned above is not evidenced in the current situation of the three European universities that are part of this project. It is believed that this difference in capacity for action and extension, as well as for obtaining financing is linked to their time of existence, given that the six African universities are relatively recent, having emerged between the end of the 20th century and the beginning of the 21st century (whilst the three European universities emerged between the 13th century and the beginning of the 14th century).

4.3. Partnerships and collaboration

The six African universities have a strong dynamic with Portuguese universities (the University of Coimbra, New Lisbon University, University of Porto, as well as the Polytechnic Institute of Leiria and/or the Polytechnic Institute of Santarem). Some of these also establish partnerships with other European and international universities or institutions in countries such as France, Germany, Spain, Brazil, Italy, China, and/or Japan. However, it should be noted that some constraints hinder this cooperation.

4.3.1 Constraints on cooperation with European universities

Regarding the constraints in the cooperation with European universities, through the majority of the interviewees, it is possible to highlight some aspects, such as the bureaucracy – the processes are very bureaucratic in the granting of visas and low efficiency of cooperation agreements which complicates obtaining a visa by the superior staff, since, it takes a long time and is very expensive; geographical distance and difficulty in transporting materials to European universities or vice-versa (time and high prices); and different levels of work, development and laboratory conditions, which makes it difficult to follow up on given offers or proposals.

Nevertheless, cooperation is seen as a strong opportunity for knowledge sharing, with respect not only to the exchange of *know-how* but also to the production of articles or joint projects and the provision of qualified teachers from European universities to African universities, especially in postgraduate courses. In this way, collaboration with European universities assumes a strong contribution to the performance and recognition of African universities.

According to the interviewee from the University of Salamanca, the students are not interested in going to African universities, preferring to go to European universities. This lack of interest hinders the exchange between African universities and the University of Salamanca. Although it accepts students from Africa, they are only exempted from paying administrative/university fees if there are also students from the university itself going to African universities.

4.3.2 Constraints in the cooperation with the business and social fabric

Throughout the analysis of the information retained through the interviews, it became clear that the relationship between African universities and the business world is very tenuous, in the sense that there is poor cooperation between them. According to the interviewees, this weak relationship is mainly due to the lack of interest and trust that companies have in academic contribution ("academic fabric in discredit", UAN).

In addition, some of the universities also mentioned constraints such as: the difficulty in responding to the demands of the entrepreneurial fabric; difficulty in dialoguing expectations; difficulty in organization and preparation; responsibility/preoccupation in meeting the companies' requirements (sometimes less experienced senior technicians end up staining the university's image). The bureaucracy, geographical dispersion, and the financial availability of the companies were also mentioned as influential factors in the fragile relationship between African universities and the business community. There are also limitations in terms of transport at the financial level, since the further the distance, the more expensive it is. This limitation leads to the difficulty of expansion at the social level, and the return is not the one expected (i.e., it is easier to develop the projects internally and receive the entity that will benefit, than the other way around - UniCV).

4.4. Aspects to be improved for the performance of African universities

The most highlighted aspects to be improved for the performance of African universities were: the need for more research projects, more financial support, more donations or acquisition of up-to-date and quality equipment, and more scientific production.

Although not mentioned by all the African universities participating in this study, it is relevant to emphasize that the development of medium and long-term thinking (US and ISPT) and the justification of training with some employability from society's point of view (UniCV) were also mentioned as aspects to be improved.

4.5. Expectations for the future of SUGERE

As far as the interviewees' expectations regarding the future of the SUGERE project are concerned, both the interviewees from the African and the European universities expect that the

proposed goals are reached and that there will be a continuation of the project for a 2nd phase, more dynamic and participative.

5. Focus group results

Following the organization and review of the data collected through the focus group conducted, it was possible to observe a strong consensus among the stakeholders on all the dimensions proposed by the moderator.

Part 1. Potential beneficiaries and main expectations

a) *Potential beneficiaries*

Regarding the potential beneficiaries, the participants mentioned the academic community (teachers, researchers, and students) as the main beneficiary. Moreover, UniCV also highlighted as some of the potential beneficiaries, the National Laboratory of Civil Engineering, the General Direction of Energy and the National Direction of Environment, the quarry owners and/or public and private companies that own this exploitation business, as well as the society in general.

b) *Contribution of SUGERE*

According to the participant mentioned above, through the characterization of geological materials, the SUGERE project can provide scientific knowledge to companies, partner institutions, and society about the value of these materials, as well as what they are useful for and how they can be used. Furthermore, it can emphasize the geosciences at the secondary school level (e.g., through lectures), contributing to the increased interest of young people to specialize in this area in higher education. In the case of UAN, the following were mentioned as possible contributions of the SUGERE network: encouraging and promoting partnerships between universities and industry; promoting the credibility of higher education institutions to attract these partnerships; promoting internships; improving the quality of teachers and researchers, and consulting to companies. In the case of the US the contributions mentioned were awareness and sharing of information for society in general, but also for policymakers (e.g., legislative proposals); bringing companies closer to the academic community, since there is little dialogue and investment in academia, and finally, the promotion of geological themes in secondary education.

During the focused discussion, the participants referred that there is scarce attention from the political decision-makers in the geological area, thus being pertinent to highlight its relevance. The representative of UAN emphasized that geology is key to the energy transition (considered the great motivator in the attempt to eliminate fossil fuels - a gradual process).

c) *Attractiveness of potential beneficiaries and expectations of the types of relationships to be established*

Regarding the type of channels that the network can mobilize to attract potential beneficiaries and the expectations for the continuity of the project, one of the participants (US) pointed out the origin of a common master's degree that would allow the exchange of students between African universities (in Angola, Cape Verde and/or Mozambique); a relational infrastructure; promotion of partnerships with journalists, so that, in turn, they can promote and facilitate the transmission of the geological area and the importance of these projects networks for sustainability; curricular

adaptation (revision of the curricular proposals), and a more transnational and practical project. The existence of a networked master, with the interaction of several professors and students from different countries, that would create a strong dynamic of internalization, was a point quite mentioned by most of the participants.

In the case of UEM, it was alluded the expectation that the training actions may enable networking with other colleagues from other European universities and the promotion of collaborative partnerships; internalization of academia; the development and boosting of master's and doctoral programs; teacher training, as well as the existence of an international platform with other Portuguese-speaking countries. The participants representing UniCV also highlighted the expansion through SUGERE to other networks, allowing a wider involvement of other countries.

Part 2. Ideas and suggestions to improve the quality of the project and ensure its continuity

a) *Existing network resources*

The existing resources in the network most mentioned by the majority of the participants were the Portuguese language, diversified human resources (intellectual and analytical), laboratory resources, and also the natural resources themselves that can play a key role in the development of countries in the process of energy transition and climate change.

b) *Relevant activities to be developed*

Throughout the focus group, several activities were outlined by the participants as being relevant to be developed, such as: the increase of training, especially in partner universities that do not have teaching areas in the field of geology; an increase of meetings that allow partners to be aware of the strategies and intentions of the project; holding lectures in secondary schools, companies, and public spaces, to demonstrate the relevance of the geological area for sustainable development, but also in an attempt to create a strategy that involves more of the contributors and beneficiaries; increased sharing of the relevance of the present project in local production and academia as a privileged interlocutor that can provide a "voice" to the communities.

Also mentioned were the development of information tools; the promotion of a guide for society and journalists; investment in rotating transdisciplinary congresses (annually or every two years) that bring the SUGERE agenda to create a dynamic in the search for solutions and innovation for the problems (social, environmental and sustainability) faced by societies, with the participation of academia, policymakers, and civil society; promotion of a master's degree in mineral resource economics (engaging political and environmental issues), and a digital master's degree (involving civil servants from ministries and professors in the management of these processes), supervised by professors from other universities. According to the UEM representative: "it is necessary to train geologists, but also for public managers to be prepared for the issue of harnessing and transforming natural resources into wealth".

In the case of the UAN, it was also highlighted the need to create activities that showcase the potentiality of natural resources and the scheduling of cross-border field trips (with the involvement of academia and companies) which is believed that will contribute to the stimulation

of young people. The UniCV representative noted the interest in conducting intensive summer courses, in the case of Cape Verde, a one-week stay on an island to learn about geology and natural resources (punctual works). Meanwhile, a US representative highlighted the importance of the SUGERE network in connecting with the issues of climate change, oceans, and among other related topics. Many of the participants believe that this connection with current problems may make it easier to raise more financial resources.

c) *Partners and funding*

The involvement of private and State-owned companies related to the geological field, through excursions, as well as international organizations (e.g., World Bank) were considered as strong influencing factors for the financial contribution to the continuity of the SUGERE network, by most participants. However, the project partners that participated in the focus group noted that there is difficulty in obtaining funding for geology-related projects, as it is considered an unattractive area, and that this difficulty may be the main barrier to the continuity of the SUGERE project.

d) *Network organization*

This section was used as a reflexive and conclusive moment of the discussion. The participants emphasized that in the SUGERE ecosystem there should be student circulation; a new conceptual framework in the geological area; a rotation of the person in charge (of experts in the geological area) that would allow all partners to be protagonists (promoting the countries, as well as the institutions that are coordinating the project); visibility on national and/or international current affairs, and a larger interaction with other African colleagues (e.g., from São Tomé, Guinea-Bissau and Timor-Leste), but also colleagues from other European and international countries.

On an isolated note, it is believed that the focus group would have been more dynamic if all project partners had been able to attend and if it had been carried out in person.

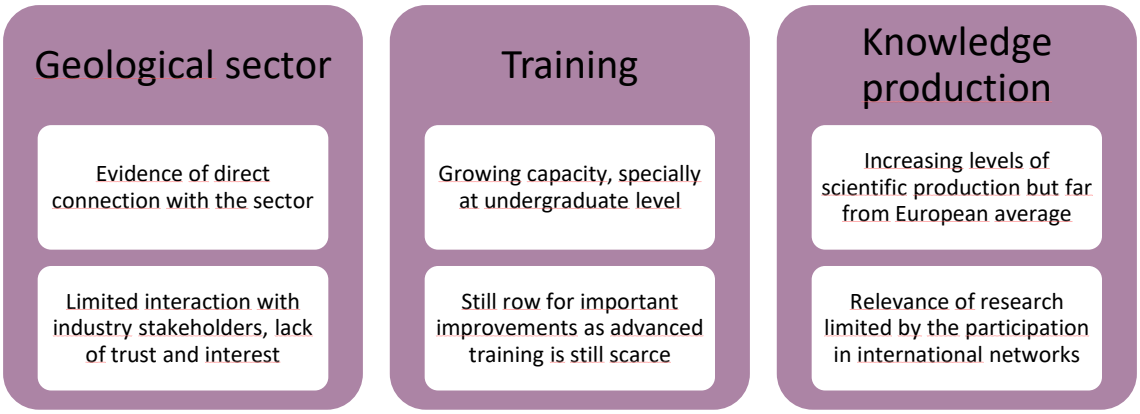
6. Discussion of key findings

In summary, according to the perceptions of the interviewees, the HEIs under analysis are, in general, structurally involved in the geological sector. However, the impact they can have in strengthening the sector, both at the academic and business level, and even the possible contribution to the SDGs is limited by a set of circumstances.

The data revealed, as summarized in figure 1, that the capacity for training and advanced qualification, namely, at the level of masters, doctorates, and post-doctorates, is still low when compared to the European HEIs under analysis. This difficulty in training and attracting qualified human resources conditions the production of knowledge and its transfer. In this dimension, there are also low rates of scientific production when compared to the European HEIs under study. This is related not only to human resources but also to gaps at the level of knowledge infrastructures, such as laboratories.

One way to bridge this gap is through partnerships and collaboration. In this dimension, African HEIs report a strong relationship with Portuguese universities. However, several barriers have limited their partnerships with other European universities, mainly the bureaucracy associated with the processes, the geographical distance, and the different levels of development of the infrastructures. Collaboration with the business sector is one of the main difficulties of the African HEIs under analysis, mainly because they report a feeling of little confidence in the benefits that companies can obtain through their relationship with the university.

Figure 1 – Key aspects of interview results



Source: Own Elaboration

These results are complemented with the analysis of the main problems and opportunities these HEIs face. The most notable problems faced by African Universities were found to be the dearth of research facilities (laboratories) and quality laboratory equipment, the lack of financial and material resources to meet the training needs of students and to enhance quality research, the lack of research funds, and the low number of effective and qualified faculty members (both teaching and research), as a result of low wages and the loss of faculty members to other more competitive challenges, which leads to a brain drain (i.e. a loss of specialized and qualified human capital). The findings are consistent with the literature that state that African universities remain

in a deep crisis characterized by difficulty in accessing funding, lack of adequate facilities and equipment, as well as lack/loss of qualified and specialized human resources to conduct quality training (especially in advanced training) and quality research, in production and transfer of knowledge (Cloete et al., 2011; Bates et al., 2011; Zeelen, 2012; Muriisa, 2014; Darley & Luethge, 2016; Zavale, 2018; Cardoso, 2020). African HEIs, particularly in sub-Saharan Africa, according to Ondari-Okemwa (2011) still face several challenges in knowledge production, such as inadequate infrastructure resulting from the continuous decline in public spending, brain-drain of qualified and specialized individuals to other more competitive countries, as well as competition in knowledge production.

Some of the authors reviewed also referred that many of the academic publications in Africa tend not to be highly internationally illustrated, leading to them being less recognized and credible to influence decision-making and that the decline in university research output is particularly due to public funding and poor financial governance (Ondari-Okemwa, 2011; Zeelen, 2012; Darley & Luethge, 2016), which is in line with the weak capacity to publish in reference journals pointed by some of the interviewees.

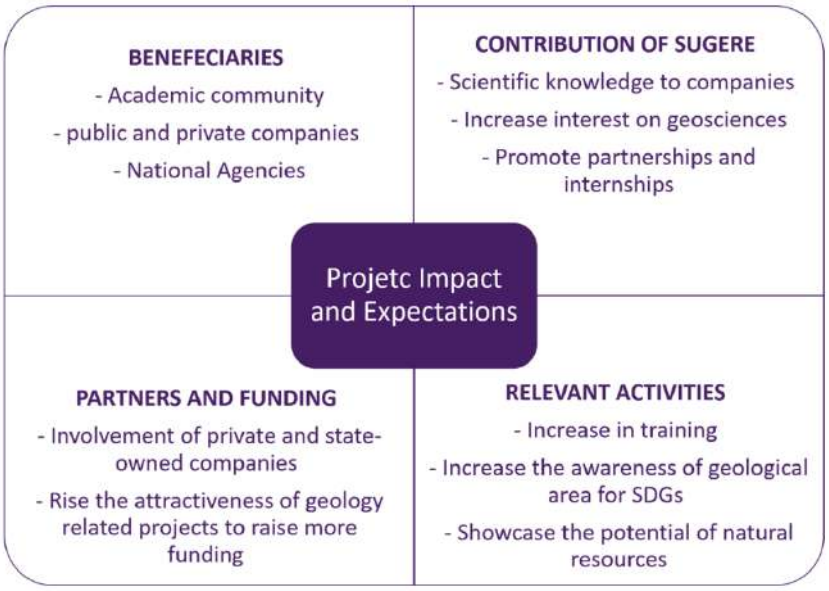
Regarding the opportunities for the universities, Harle (2013) also emphasizes that partnerships play a fundamental role in universities, regarding technical and intellectual support, through training and development of technical staff, provision of facilities, resources, management, and leadership necessary to develop research. The existence of funding policies at the national level supports and enables organizations to thrive and allows individuals career progress. Several of these results support the findings of Zavale (2018), who concluded that despite companies' recognition of universities/research institutes' value, their collaboration is weak, with this relationship being especially prevalent at African universities.

The summary of the results of the focus group allows us to trace some general lines of the perceptions about the impacts and expectations in relation to the project (figure 2). Firstly, and given the difficulties previously mentioned, the participants consider that the main beneficiary (although not unique) is the academic community. The major contribution that the project can make to its beneficiaries is to increase the capacity to transfer the knowledge produced to companies while promoting partnerships to serve as dissemination channels. The participants also expect the project to contribute to increasing interest in geosciences and promote internships.

In this way, the activities considered most relevant to the participants can be categorized as an increase in human resource training and education. This is directly related to the lower rates of advanced training capacity of African HEIs compared to European HEIs and therefore a key dimension of the whole project. Other suggested activities are related to the dissemination of the geological field, namely through participation in congresses, showcasing the potential of natural resources, and increasing the recognition of the geological field for sustainable development.

It is also expected that the project will contribute to strengthening the capacity to establish partnerships, mainly through the involvement of private and State-owned companies. Another dimension to which the project should pay attention is to develop strategies to increase the attractiveness of geology-related projects so that they can channel more funding.

Figure 2 - Summary of focus group results



Source: Own Elaboration

Table 6. Limitations and proposed activities to leverage HEIs in Africa

LIMITATIONS	PROPOSED ACTIVITIES TO BE DEVELOPED
Education System	Increased teacher training Meetings with other European and international universities to share teaching techniques Holding lectures in higher education to attract students, especially in the field of Geology Summer courses Networked Master's Degrees Online Master's Degrees Master's degree in natural resources economics Cross- field trips (with the involvement of academia and companies)
University-Industry	Holding lectures in companies and public spaces, to demonstrate the relevance of universities, and what they have been doing and expect to do
Knowledge Production and Transfer	Cross-borderer field trips (with the involvement of academia and companies) Meetings between universities in the sharing of information techniques Connecting with current issues (e.g., climate change, oceans) Promotion of a guide for society and journalists Investment in rotating transdisciplinary congresses (annually or every two years) that bring the SUGERE agenda to create a dynamic in the search for solutions and innovation for the current problems (social, environmental, and sustainability) with the participation of academia, policymakers, and civil society

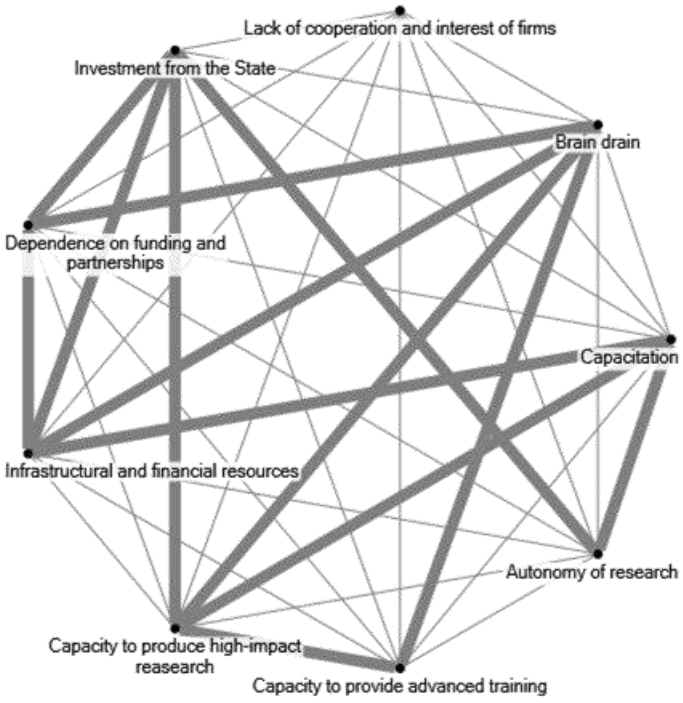
Inspired by the Complexity Theory and particularly the SWOT analysis, which allows the identification of strengths, opportunities, threats, and weaknesses within African universities, concerning their role, to understand the current situation in which they find themselves, and to then anticipate a diagnosis and factors that may condition the situation of the context, we were able to define critical dimensions – seen in the figure below.

We defined the following critical dimensions:

- Brain drain to Global North universities
- Dependence on funding and partnerships
- Difficulty in developing research autonomously
- Lack of capacitation of research support staff
- Lack of capacity to produce high-impact research
- Lack of cooperation and interest of companies in academic research
- Lack of infrastructural and financial resources
- Limited capacity to provide advanced training
- Limited investment from the State

Then, using a network analysis software (Smith et al., 2010) inspired by the interviews and focus groups, we defined the connections between the dimensions and relative weight (based on co-mentions). Note that, the circle of connections, based on two fundamental elements: a problem behavior pattern and the causal loops (known as feedback loops) driving it (Quaden et al., 2006), allows the delimitation of causal links that result in the problem in question.

Figure 3 – A Connection Circle of Problems in African Partners



Source: Own Elaboration

The circle of connections obtained confirms that the majority of dimensions found in the SWOT analysis are interconnected, and that, apart from the dimension "Lack of cooperation and interest of firms", they present strong linkages. As seen in figure 3, four dimensions stand out more, since they are the ones that present a larger number of stronger connections, being the cause as well as the effect of others, namely "State investment"; "brain drain"; "infrastructural and financial resources" and "capacity to produce high impact research". Note that, "State investment" seems to be only the cause of the origin of other dimensions (i.e., Dependence on funding and partnerships; Difficulty in developing research autonomously; Lack of capacity to produce high-impact research; Lack of infrastructural and financial resources) which, in turn, are the cause of other challenges experienced and mentioned by African universities under analysis (e.g. brain drain; limited capacity to provide advanced training, and capacitation).

7. Conclusion

African universities are still facing multiple challenges that hinder their performance. This case study reinforces the arguments carried out by the literature and data collection provides insights into the constraints that undermine the performance of the three pillars of African higher education: teaching, research, and extension. These difficulties are barriers to the relevance of HE in Africa for local sustainable development. The lack of research facilities, lack of financial and material resources, weak relationship with industry, and low percentage of effective and qualified faculty members, were referred by the interviewees as being the more significant challenges that African universities face in current days. These are crucial factors for HEIs to play their role as catalysts for regional development (Uyarra, 2010). As long as these structural conditions are not assured, it becomes difficult to demand that African HEIs can contribute to the development of the territory.

Thus, there is a growing need to create meaningful strategies to enhance HEIs in Africa and their relevance to the local socio-economic context, to make them more attractive to businesses and policymakers, and in turn, allow them easier access to financing. In complex contexts with multiple challenges, HEIs must be supported by a set of public policies, and a greater connection with governance bodies, so that the existence of short-cycle institutions or short-flow programs within universities contributes to the ease of responding to the diverse and growing demand for training (Assie-Lumumba, 1996).

This implies taking some of the pressure off universities by strengthening longer-lasting programs that will have the opportunity to improve quality and efficiency internally and externally and the need to revitalize the research mission of African universities by investing in better research facilities and increasing human capital. HEIs are thus faced with a double paradox as, on the one hand, it is in these contexts that they must assume a more structural role to better respond to regional challenges (Pinto et al., 2021). On the other hand, in these cases, HEIs, often undercapitalized with gaps in infrastructure and human resources, find it more difficult to assume this role. This paradox, if not addressed, can create a kind of trap that does not allow changing this trajectory. There is a need for approaches that understand this complexity and seek to strengthen the symbiosis between public policy and the needs of HEIs so that they can later develop a more structural role.

In this report, despite facing these previously mentioned “bottlenecks”, African universities, especially those involved in this project, seek to respond to the needs of society, and, therefore, to contribute to the training of human resources and to research, especially in areas of great interest (i.e., environment). There is a great ability and willingness to adapt to the circumstances in which they find themselves but also a great commitment to constant improvement in their performance. In addition, although it has few qualified professors teaching and conducting research, its human resources are trained in universities around the world, which provides a variety of expertise, according to some interviewees. These HEIs have potential and a will that can place them in the position of civic universities. While there are challenges - identified in this analysis - the commitment to this role is a crucial driver of performance. The contextualization of this civic University in its closest territorial scope grants the role of leadership based on the place, stimulating, together with several relevant actors, internal and external to the region, a transformative vision of the territory (Dominguez-

Gómez et al., 2021). The University can facilitate this process, ensuring the improvement of skills and connections within the system.

Universities can be the key drivers of a country's economy by excelling in research and increasing human resources. The HEIs under analysis, particularly the African ones, face cross-cutting challenges in multiple dimensions. On the one hand, there is a set of internal challenges related to the attractiveness of their academic curricula and the gap in qualified human capital and consequent scientific production. This affects a meso-level dimension that refers to collaboration networks. Poorly structured collaboration networks compromise the dissemination of knowledge produced and the international competitiveness of these institutions. Subsequently, there is a set of constraints at the macro, political and institutional levels that compromise the resolution of micro and meso problems. Public policies play a key role here by developing a set of incentives to attract and retain critical mass in these HEIs and their territories and simultaneously help in their capitalization so that they have the autonomy to fill some of these gaps.

Although financial resources should not be the main factor to drive individual and collective intentions, they are important not only to motivate specific contributions and also to guarantee real capacity to succeed. Without financial resources available, HEIs find quite hard to develop the myriad of activities they are supposed today. Assuming an important role in regional and national development, governments and enterprises should reflect about their understandings on universities, especially in Africa, and begin investing in what gives them real wealth, not only in monetary terms but also intellectually. Increased funding in African higher education will most likely allow a boost in the quality of teaching and research, by enabling the adjustment of facilities and teaching methods, the increased supply of stimuli for students to progress in their professional careers (e.g. scholarships, internships, research grants), greater ease in attracting and containing specialized and qualified teachers/researchers (through salary compliance and increase, reduced workload, and other incentives/compensations) and, consequently, in the quality of response to the needs and demands of society.

The continuity of the SUGERE project or other similar initiatives attains a strong interest from all those involved. It is crucial the development of activities that integrate more African, European, and international universities, more professors, researchers, and students from the various universities, but also a stronger linkage with the governance dimension and with the economic fabric.

References

Adesina, Jimi. (2006). Global Trends in Higher Education Reform: What Lessons for Nigeria, *Journal of Higher Education in Africa* / Revue de l'enseignement supérieur en Afrique, Vol. 4 (1), pp. 1–23. Retrieved from: https://www.jstor.org/stable/43658256

Alabi, G. B., & Mba, J. C., eds. (2012). The Quality Assurance and Capacity Building Needs of Higher Education in Africa, Accra: Association of African Universities.

Altbach, P. G., Reisberg, L., & Rumbley, L. E. (2019). Trends in global higher education: Tracking an academic revolution, Brill.

Altenburg, Tilman (2009). Building Inclusive Innovation Systems in Developing Countries: Challenges for IS Research, Chapter 2, In: B.-A Lundvall, K. J. Joseph., Chaminade, C., & Vang, J. (eds) Handbook of Innovation Systems and Developing Countries, pp. 33–56. Cheltenham: Edward Elgar Publishing.

Arza, Valeria (2010) Channels, benefits, and risks of public-private interactions for knowledge transfer: conceptual framework inspired by Latin America, *Science and Public Policy*, 37(7), pp. 473–484. Retrieved from: https://doi.org/10.3152/030234210X511990

Assie-Lumumba, N'Dri T. (1996). The role and mission of African higher education: preparing for the 21st century and beyond, *South African Journal of Higher Education* - SAJHE Vol 10 (21), pp. 5-12. Retrieved from: https://journals.co.za/doi/pdf/10.10520/AJA10113487_1304

Bates, I., Phillips, R., Martin-Peprah, R., Kibiki, G., Gaye, O., Phiri, K., Tagbor, H., & Purnell, S. (2011). Assessing and Strengthening African Universities' Capacity for Doctoral Programmes, *PLoS Medicine*, Vol.8, (9): e1001068. Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3172246

Bloom, D. E., Canning, D., & Chan, K. (2006). Higher education and economic development in Africa (No. 102), Washington, DC: World Bank.

Bryman, A. (2016) *Social Research Methods* (5th ed.). Oxford: Oxford University Press.

Byrne, D., & Callaghan, G. (2014). Complexity theory and the social sciences: The state of the art. New York, NY: Routledge.

Burman, C., Aphane, M., & Mollel, N. (2016). Knowledge as Enablement: Additional Perspectives Influenced by Complexity, Educational Research for Social Change (ERSC) Vol. 5 (2), pp. 1-17. Retrieved from: http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S2221-40702016000200002

Cardoso, Carlos. (2020). The Challenges Facing African Universities*, Journal of African Cultural Studies*, Vol. 32 (3), pp. 302–315. Retrieved from: https://doi.org/10.1080/13696815.2019.1671812

Cloete, N., Bailey, T., Pillay, P., Bunting. I., & Maassen, P. (2011). *Universities and Economic Development in Africa*, Centre for Higher Education Transformation (CHET), pp.1-188. Retrieved from: https://www.researchgate.net/publication/313051319_Universities_and_Economic_Development_in_Africa

Colish, Marcia L. (1999). Medieval Foundations of the Western Intellectual Tradition, New Haven/London: Yale University Press. Retrieved from: https://archive.org/details/medievalfoundati0000coli

Darley, W.K. & Luethge, D.J. (2016). The Role of Faculty Research in the Development of a Management Research and Knowledge Culture in African Educational Institutions, *Academy of Management Learning & Education*, Vol. 15 (2), pp. 325-344. Retrieved from: https://journals.aom.org/doi/10.5465/amle.2013.0337

Dominguez-Gómez, A.; Pinto, H. & González-Gómez, T. (2021). The Social Role of the University Today: From Institutional Prestige to Ethical Positioning, In Universities and Entrepreneurship: Meeting the

Educational and Social Challenges, Emerald Publishing Limited. Retrieved from: https://doi.org/10.1108/S2040-724620210000011011

Drape, T. A., Rudd, R. D., Lopez, M., & Radford, D. (2016). Challenges and solutions to higher education institutions in Africa, *International Journal of Education*, 2016, Vol. 8 (1), pp. 43-58. Retrieved from: https://doi.org/10.5296/ije.v8i1.8742

Etzkowitz, H., & Klofsten, M. (2005). The Innovating Region: Toward a Theory of Knowledge-Based Regional Development, *R&D Management*, Vol. 35(3), pp. 243-255. Retrieved from: https://doi.org/10.1111/j.1467-9310.2005.00387.x

Filho, W. L. (Ed.). (2015). Handbook of climate change adaptation (2015th ed.). Springer.

Filho, W. L., Emblen-Perry, K., Hill, P. M., Mifsud, M., Verhoef, L., Azeiteiro, U. M., Nicolau-Bacelar, P., de Sousa, L.O., Castro, P., Beynaghi, A., Boddy, J., Salvia, A.L., Frankenberger, F., & Price, E., (2019). Implementing innovation on environmental sustainability at universities around the world, *Sustainability*, Vol. 11(14), 3807. Retrieved from: https://doi.org/10.3390/su11143807

Fowler, Kathryn (2015). There Is No Contest Between Academic and Administrative Staff, *Times Higher Education*. Retrieved from: https://www.timeshighereducation.com/blog/there-no-contest-between-academic-and-administrative-staff (Accessed 25 august 2022).

Gare, A. (2000). Systems theory and complexity introduction, *Democracy and Nature*, 6(3), 327–339. Retrieved from: https://doi.org/10.1080/10855660020020221

Gerber, H. (2009). Research success and structured support: Developing early career academics in higher education, *South African Journal of Higher Education*, Vol. 23(4), pp. 674–668. Retrieved from: https://journals.co.za/doi/pdf/10.10520/EJC37555

Gleason, N. W. (2018). *Higher education in the era of the fourth industrial revolution* (p. 229), Springer Nature. Retrieved from: https://link.springer.com/book/10.1007/978-981-13-0194-0

Goldstein, J. (1999). Emergence as a construct: History and issues, *Emergence*, 1(1), 49–72. Retrieved from https://www.researchgate.net/publication/243786253_Emergence_as_a_Construct_History_and_Issues

Harle, Jonathan. (2013). Strengthening Research in African Universities: Reflections on Policy, Partnerships and Politics, A Critical Analysis of North-South Educational Partnerships in Development Contexts, *Policy & Practice- A Development Education Review*, Centre for Global Education, issue 16, pp. 1-9. Retrieved from: Issue 16.pdf (developmenteducationreview.com)

Heylighen, F., and C. Joslyn. (2001). Cybernetics and Second-Order Cybernetics. In Encyclopedia of Physical Science and Technology, Eighteen-Volume Set, ed. Robert A. Meyers, 3rd ed. Waltham, MA: Academic. Retrieved from: https://www.researchgate.net/publication/2354032_Cybernetics_and_Second-Order_Cybernetics

Jamison, A., & Madden, M. (2021). Developing capacities for meeting the SDGs: exploring the role of a public land-grant institution in the civic engagement of its African alumni, *Higher Education,* Vol. 81, pp.145–162. Retrieved from: https://doi.org/10.1007/s10734-020-00638-8

Kallemeyn, L.M., Hall, J.N., & Gates, E. (2019) Exploring the Relevance of Complexity Theory for Mixed Methods Research, *Journal of Mixed Methods Research*, Vol. 14 (3), pp. 1–17. Retrieved from: https://doi.org/10.1177/1558689819872423

Kasozi, A. B. K. (2017). Innovating University Education: Issues in Contemporary African Higher Education (J. Ssempebwa, P. Neema-Abooki, & J. C. S. Musaazi, Eds.), *Fountain Publishers*, pp. 1-208. Retrieved from: https://doi.org/10.2307/j.ctvgc60c1

Krueger, R.A., & Casey, M.A. (2009). Focus groups: A practical guide for applied research (4th Ed.). Thousand Oaks, CA: Sage Publications.

Kruss, G., & Petersen, Il-haam. (2009). University-Firm Interaction in the Region, Chapter 5, in P., Kotecha (ed.) *Towards a Common Future: Higher Education in the SADC Region,* pp. 303–394. Johannesburg: SARUA. Retrieved from: https://hedbib.iau-aiu.net/pdf/Towards%20a%20Common%20Future%20SARUA_Chapter5.pdf

Kruss, Glenda. (2012). Channels of interaction in health biotechnology networks in South Africa: who benefits and how? *International Journal of Technological Learning, Innovation and Development*, Vol. 5 (1/2). Retrieved from: https://doi.org/10.1504/IJTLID.2012.044883

Kruss, G., McGrath, S., Petersen, I. H., & Gastrow, M. (2015). Higher education and economic development: The importance of building technological capabilities, *International Journal of Educational Development,* Vol. 43, pp. 22-31. Retrieved from: https://doi.org/10.1016/j.ijedudev.2015.04.011

Kruss, G., & Visser, M. (2017). Putting university–industry interaction into perspective: a differentiated view from inside South African universities, *Journal of Technology Transfer*, Vol. 42(4), pp. 804-908. Retrieved from: https://doi.org/10.1007/s10961-016-9548-6

Laranja, M., Edwards, J., & Pinto, H. (2019) Smart specialisation and the complex nature of governance: Perspectives from Portuguese regions for the Post-2020 Period, Regional insights: a selection of articles providing a fresh take on regional studies, Regional Studies Association (RSA). Retrieved from: https://regions.regionalstudies.org/ezine/article/smart-specialisation-and-the-complex-nature-of-governance-perspectives-from-portuguese-regions-for-the-post-2020-period/?doi=10.1080/13673882.2018.00001036

Liefner, I., & Schiller, D. (2008). Academic Capabilities in Developing Countries—A Conceptual Framework with Empirical Illustrations from Thailand, *Research Policy*, Vol. 37 (2), pp. 276–93. Retrieved from: https://doi.org/10.1016/j.respol.2007.08.007

Lynam, T., & Fletcher, C. (2015). Sensemaking: A complexity perspective. *Ecology and Society*, Vol. 20 (1). Retrieved from http://www.ecologyandsociety.org/vol20/iss1/art65

Mamdani (2012). Mamdani, Mahmood (2012). Uganda: Beyond the Colonized, Neoliberal University, *The Independent- News Analysis*. Retrieved from: https://www.independent.co.ug/beyond-colonised-neoliberal-university/

Mccowan, Tristan. (2018). The University as Engine of Development, *Philosophical Inquiry in Education*, Vol. 25 (2), pp. 188–204. Retrieved from: https://journals.sfu.ca/pie/index.php/pie/article/view/1057

Mohlala P. J., & Msimango-Galawe, J. (2021). Social Innovation in the Academic Curricula of Chemical Science Degrees in South Africa, *International Journal of African Higher Education*, Vol. 8(3), pp.46-72. Retrieved from: https://doi.org/10.6017/ijahe.v8i3.14161

Molas-Gallart, J., Salter, A., Patel, P., Scott, A., & Duran, X. (2002). Measuring Third Stream Activities, Final Report to the Russell Group of Universities, Brighton: University of Sussex, Science Policy Research Unit. Retrieved from: https://www.academia.edu/532097/Measuring_third_stream_activities

Morgan, D.L. (1996) Focus Group, Annual Review of Sociology, Annual Review, Vol.22, Institute of Aging, School of Urban and Public Affairs, Portland State University, Oregon 9701, pp. 129-149. Retrieved from: https://www.researchgate.net/publication/261773532_Focus_Groups

Morgan, D.L. (1997) Focus Groups as Qualitative Research, Portland State University, *Qualitative Research Methods Series*, Vol. 16, Second Edition. Retrieved from https://www.kth.se/social/upload/6566/Morgan.pdf

Muriisa, K. Roberts (2010). It is Not All About Money: Financial Governance and Research in Public Universities in Uganda, in Berhanu A. Kassahun, Tor Halvosen and Mary Mwiandi, Shaping Research Universities in the Nile Basin Countries, Book 2, Kampala: Fountain.

Muriisa, R.K. (2014). Rethinking the Role of Universities in Africa: Leadership as a Missing Link in Explaining University Performance in Uganda, Council for the Development of Social Science Research in Africa, *Journal of Higher Education in Africa / Revue de l'enseignement supérieur en Afrique*, Vol. 12 (1), pp. 69-92. Retrieved from: https://www.jstor.org/stable/jhigheducafri.12.1.69

North, D., Zewotir, T., Murray, M. (2011). Demographic and academic factors affecting research productivity at the University of KwaZulu-Natal, *South African Journal of Higher Education -SAJHE*, Vol. 25 (7), pp 1416–1428. Retrieved from: https://journals.co.za/doi/abs/10.10520/EJC121398

Nunan, David. (1992) Research Methods in Language Learning, Cambridge: Cambridge University Press. Retrieved from: https://archive.org/details/ilhem_20150321_1947

Ondari-Okemwa, E. (2011). Knowledge production and distribution by institutions of higher education in sub-Saharan Africa: Opportunities and challenges, *South African Journal of Higher Education* – SAJHE, Vol. 25(7), pp 1447–146. Retrieved from: https://journals.co.za/doi/10.10520/EJC121396

Pinto, H., Nogueira, C., & Edwards, J. (2021) Higher Education and Smart Specialisation in Portugal, JRC Technical Report, Joint Research Centre. https://data.europa.eu/doi/10.2760/21040

Quaden, Rob., Ticotsky, A., & Lyneis, D. (2006) The Shape of Change in Creative Learning Exchange, Making Thinking Visible: Connection Circles. Retrieved from: http://www.clexchange.org/gettingstarted/connectioncircles.asp

Ruben, B. D. (2018). Quality in higher education. Routledge

Sarriot, E., & Kouletio, M. (2014). Community health systems as complex adaptive systems: Ontology and praxis lessons from an urban health experience with demonstrated sustainability. *Systemic Practice and Action Research*, Vol. 28(3), pp. 255–272. Retrieved from: https://link.springer.com/article/10.1007/s11213-014-9329-9

Sigué, S.P. 2012. The challenges of research in African business schools, *Journal of African Business*, Vol. 13(2), pp. 83-86. Retrieved from: https://www.researchgate.net/publication/275137830_The_Challenges_of_Research_in_African_Business_Schools

Sousa Santos, Boa Ventura. (1999). Da ideia da universidade à universidade de ideias, Capítulo 4, *Pela mão de alice, O social e o político na pós-modernidade*, 7ªedição, nº489, Edições Afrontamento, Porto, pp. 163-196. Retrieved from: https://www.academia.edu/31425655/SANTOS_Boaventura_de_Souza_Pela_M%C3%A3o_de_Alice_o_social_e_o_pol%C3%ADtico_na_p%C3%B3s_modernidade

Smith, M., Ceni A., Milic-Frayling, N., Shneiderman, B., Mendes Rodrigues, E., Leskovec, J., Dunne, C., (2010). *NodeXL: a free and open network overview, discovery and exploration add-in for Excel 2007/2010/2013/2016 from the Social Media Research Foundation*, https://www.smrfoundation.org

Snowden, D. J., & Boone, M. E. (2007). A leader's framework for decision making, Harvard *Business Review*, Vol. 85(11), pp. 68–76. Retrieved from: https://www.researchgate.net/publication/5689229_A_Leader's_Framework_for_Decision_Making

Ssekamatte, David. (2022). The role of the university and institutional support for climate change education interventions at two African universities, *Higher Education*, Department of Management, Uganda Management Institute, Kampala, Uganda. Retrieved from: https://doi.org/10.1007/s10734-022-00828-6

Teixeira, A. A.C., & Mota, L. (2012). A bibliometric portrait of the evolution, scientific roots and influence of the literature on university–industry links, *Scientometrics*, Vol. 93, pp.719–743. Retrieved from:https://www.academia.edu/29245656/A_bibliometric_portrait_of_the_evolution_scientific_roots_and_influence_of_the_literature_on_university_industry_links

Uyarra, E. (2010). Conceptualizing the Regional Roles of Universities, Implications and Contradictions, European Planning Studies, Vol. 18(8), pp. 1227-1246. Retrieved from: https://doi.org/10.1080/09654311003791275

Uyarra, E., Flanagan, K., Magro, E., Wilson, JR., & Sotarauta, M. (2017). Understanding Regional Innovation Policy Dynamics: Actors, Agency and Learning, Environment and Planning C: Politics and Space, Vol. 35(4), pp. 559-568. Retrieved from: https://doi.org/10.1177/2399654417705914

Vera-Cruz, A. (2014) What are the university-productive sectors links that matters in a small island country? the case of Cabo Verde, *African Journal of Science, Technology, Innovation and Development*, Vol. 6 (2), pp. 425–38. Retrieved from: What are the university-productive sectors links that matters in.pdf (altecasociacion.org)

Virtenen, A. (2010). Learning for climate responsibility: Via consciousness to action, In W. L. Filho (Ed.), Universities and climate change, pp. 231–240, Springer. Retrieved from: https://link.springer.com/chapter/10.1007/978-3-642-10751-1_19

Walton, Mat. (2014). Applying complexity theory: A review to inform evaluation design, Evaluation and Program Planning, Vol. 45, pp.119-126. Retrieved from: https://www.sciencedirect.com/science/article/abs/pii/S014971891400041X

Williams, Alex. (2019). Complexity from the Sciences to Social Systems, Political Hegemony, and Social Complexity, pp 15-38. Retrieved from: https://link.springer.com/chapter/10.1007/978-3-030-19795-7_2

Wimsatt, W. C. (1994). The ontology of complex systems: Levels of organization, perspectives, and causal thickets, *Canadian Journal of Philosophy*, Vol. 24(sup1), pp. 207–274. Retrieved from: https://doi.org/10.1080/00455091.1994.10717400

Windeløv-Lidzélius, C. (2018). The School as a Living Lab – The Case of Kaospilot, Chapter 5, *Digital Participation through Social Living Labs*, Valuing Local Knowledge, Enhancing Engagement, Chandos Information Professional Series, pp. 77-96. Retrieved from: https://doi.org/10.1016/B978-0-08-102059-3.00005-8

Wong, G. (2013). Is complexity just too complex? *Journal of Clinical Epidemiology*, Vol. 66 (11), pp. 1199–201. Retrieved from: https://doi.org/10.1016/j.jclinepi.2013.06.019

Zanello, G., Fu, X., Mohnen, P., & Ventresca, M. (2016). The Creation and Diffusion of Innovation in Developing Countries: A Systematic Literature Review. *Journal of Economic Surveys*, Vol. 30 (5), pp. 884-912. Retrieved from https://doi.org/10.1111/joes.12126

Zavale, N.C., (2018). Expansion versus contribution of higher education in Africa: University–industry linkages in Mozambique from companies' perspective*, Science and Public Policy,* Vol. 45 (5), pp. 645–660. Retrieved from: https://doi.org/10.1093/scipol/scx089

Zeelen, Jacques. (2012). Universities in Africa: Working on Excellence for Whom? Reflections on Teaching, Research, and Outreach Activities at African Universities, *International Journal of Higher Education* Vol. 1 (2). Retrieved from: https://files.eric.ed.gov/fulltext/EJ1057260.pdf

Zhou, Sindiso. (2020). The Hybrid Administrator-scholar Paradigm in Higher Education Leadership in Africa, *Journal of Higher Education in Africa - HEA/RESA*, Vol. 18 (2), pp. 5-27. Retrieved from: https://journals.codesria.org/index.php/jhea/issue/view/246

Annex 1. Interview script

UNIVERSITY: _____

NAME OF RESPONDENT: _____

INTERVIEWEE'S POSITION: _____

Characterization of the *interviewee*

1. Scientific field and year of completion of the doctorate (or highest degree obtained)
2. Briefly explain your entry and current roles in this Higher Education Institution (HEI)

Characterization of the university

3. How would you characterize, in general, your university (size, organization/structure, etc)?
4. What are the main areas of training and research? Do they correspond to needs of other national or regional actors (such as companies, government(s), etc)?
5. What are the strengths that you highlight about this university?
6. What are the weak points of this university?
7. What opportunities?
8. What threats?

Role of the university

9. Mention relevant contributions of your university to national and regional development.
10. How can the university be relevant to the local community?
11. How does the university articulate with the geological sector? Can the university contribute more to the development of this sector? How?

Capacities

12. How do you evaluate your university in terms of its capacity to train human capital, in particularly advanced training?
13. How do you rate your university in terms of its ability to produce new scientific knowledge, in particular, the publication of articles in refereed journals?
14. How do you rate the university in terms of its capabilities to transfer scientific knowledge to business and society in general?
15. What kind of resources and other forms of institutional support are provided by university management to the academic community?

Sustainability

16. What stimuli are students (particularly, doctoral students) offered for personal and professional development for greater civic engagement?
17. Is the university committed to addressing today's societal challenges? If yes, give some examples.
18. Do you feel that the university is integrated into the dynamics and strategies of sustainable development (local, national, international)? How can the university support sustainable development?

Partnerships and collaborations

19. Identify your university's main partners (3-4 entities):
    - Governance Bodies
    - Other HEIs and public research entities
    - Other private research entities
    - Companies
20. What are the constraints blocking cooperation between African universities and European universities and other public research entities?
21. What are the constraints that block cooperation between African universities and the business and social fabric, locally/regionally, but also nationally and internationally?
22. How to improve the performance of the university, in the formation, production and transfer of knowledge?

Expectations for the SUGERE Project

23. What are the expectations for the future of the SUGERE project?

Annex 2. Interviewees participants

REGION	UNIVERSITY	INTERVIEWEE	INTERVIEWER
Eastern Southern Africa (Mozambique)	Eduardo Mondlane (UEM) Instituto Superior de Ciências e Tecnologias de Moçambique (ISCTEM)	**Salvador Mondlane** (Professor of Economic Geology) **Carvalho Madivate** (Director general)	Gabriela Vieira (CES, junior research fellow)
Western Southern Africa (Angola)	Instituto Superior Politécnico Tundavala (ISPT) Agostinho Neto (UAN)	**Carlos Ribeiro** (Associate and deputy director in the scientific area) **Cristina Rodrigues** (Associate professor in the Department of Geology)	
Center Portugal (Coimbra)	Universidade de Coimbra (UC)	**Alexandre Leal** (Head of division)	
Northwest Spain (Salamanca)	Universidad de Salamanca (USAL)	**Raúl Prieto** (Director of the Department of Modern Philology in the Faculty of Arts and delegate of the rector for International Networks)	
West Africa (Cape Verde)	Universidade de Cabo Verde (UniCV) Universidade de Santiago (US)	**Fátima Fernandes** (Assistant professor in the Languages, Literatures and Cultures course) **Nardi Sousa** (Head of the Department of Legal and Social Sciences, professor, and coordinator of the master's degree in public policy and local development)	
Northern Italy (Turin)	Università degli studi di torino (UNITO)	**Alessandro Pavesse** (Professor of mineralogy and the head of the Department of Earth Sciences)	

Annex 3. Focus group participants

UNIVERSITY	PARTICIPANT	MODERATORS
UniCV	**Sónia Silva** (Vice-Rector and Assistant Professor)	Hugo Pinto (CES, research fellow) Gabriela Vieira (CES, junior research fellow)
US	**Nardi Sousa** (Head of the Department of Law and Social Sciences, professor, and supervisor of three courses)	
UEM	**Daud Jamal** (Associate Professor) **Estevão Sumburane** (Assistant Professor and head of the department)	
UAN	**Cristina Rodrigues** (Associate professor) **Pedro Claude Nsungani** (Associate Professor)	
UC	**Nelson Rodrigues** (Associate Professor and Coordinator of two Master´s degrees)	

LEAD PARTNER

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PROJECT WP9 COORDINATED BY

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Centre for Social Studies
University of Coimbra

SUGERE PARTNERS