

Turning Resource Scarcity into an Abundance of Applied Research Opportunities in a Financially Strained University: The Case of Chemical Sciences at the National University of Lesotho

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Abstract: With the never improving capital investment towards higher education in most African countries, the level of infrastructure in the universities thwarts academic programs in the applied sciences. These programs require that students be afforded some industrial experience on internship programs while at the same time continuing the learning process through research projects supervised by both the industrial and academic supervisors. These requirements become almost impossible to fulfil without the necessary infrastructure. This is the case in small countries like Lesotho, which do not have sufficient science-based industry; as such these programs are severely affected. This paper explores the possibility of turning this limitation into an opportunity for applied research in the form of technology transfer and business incubation, through placement of the students in small to medium enterprises, institutions and community-based organizations that seem to be more receptive than bigger businesses. The initial trial of this approach at the National University of Lesotho has demonstrated considerable potential, with students engaging with small enterprises in areas such as waste recycling, food processing and testing, and leather tannery, to mention only a few. Hence, the program has witnessed a positive turn from resource scarcity to abundance of opportunities, proving that financial scarcity does not necessarily translate into a corresponding scarcity of ideas.

I. Introduction

Higher Education Institutions (HEIs) are widely recognized as central organs in the economic development and well-being of any community. It is therefore not surprising that governments globally commit resources to this important sector, although there is a downward trend in capital funding in favor of basic primary education (Parker, 2010). This has

put an immense pressure on public HEIs to seek alternative funding (Mutala, 2001). These HEIs are compelled by these budgetary challenges to undergo regular, and sometimes arbitrary academic programs reviews, restructuring processes designed solely to meet the expectations and desires of the government of the day while ignoring the other important, stakeholders, namely students and the public at large, or alternatively, to face some form of

extinction (Rakotsoane, 2012). On the other hand, Greenberg (2013) calls on academia to “claim” their “political power” – exploit the ability and responsibility of academia to influence national politics rather than acceding to the views of governments that some academic programs are irrelevant to the economic conditions. As such governments usually pressure the HEIs to offer more “applied” programs with the hope that the graduates from these can easily be absorbed into the job markets.

While this may be true, some of these programs require the same job market to help the teaching process by offering internships (variously referred to as learnership, studentship, experiential training/learning, industrial attachment, etc.). Where resources allow, most of these programs are usually offered by technical colleges (also formerly referred as technikons in South Africa) or universities of technology (Rosenfeld, 1998; Backhouse J, 2009).

The importance of internships cannot be over-emphasized, especially in the era where work experience seems a major determinant of whether one gets employed or not. Besides, there is always an issue with relevance of the programs offered at the HEIs, in that they do not respond to the skills demand of the labor market (Alexander, 2000; McGrath & Akoojee, 2009). The internship programs can aide in driving two important goals of sustainable development: increasing academic relevance and the establishment of public-private-academia partnerships (Etzkowitz & Leydesdorff, 2000).

Academic relevance is a complex and contentious issue leading to ferocious debates in different forums. Expansion of programs in tertiary education in pursuit of greater relevance - teaching for special needs of all economic sectors - has detrimental effects, as it overstretches already meagre resources of institutions that are not afforded levels of funding corresponding to the demands made upon them. Such efforts to increase the multiplicity of programs that are offered in the effort to improve inclusivity and accessibility of higher education tend to jeopardize the quality of education on the one hand (Alexander, 2000; Määtta, 2001), while it also does not necessarily translate into employability (Maharasoia & Hay, 2001). Teichler (1999) argues that sometimes the employers in these sectors are not even clear about what they require from the

HEIs. The second aspect of relevance is ‘massification’ – enrolling too many students in a certain program beyond the routine numbers for that program. This term is also used to describe “changes in the social dynamics of higher education when the number of students entering universities exceeds a certain figure” in certain disciplines (Välimaa et al., 2001). The non-responsiveness of the market and massification together lead to excessive concentrations of graduates in certain areas of specialization and to high graduate un-employment, a situation likened to a “ticking time bomb” (Ighobor, 2013; Schucher, 2014). This effect can already be observed in Lesotho, where even a once highly absorptive profession, teaching, has seen serious lack of ability to handle the levels of new graduates, prompting the king to declare unemployment situation in a Lesotho a national crisis (King Letsie III, 2015).

The establishment of partnerships between academia and the private sector has attracted considerable interest globally, since partnership has been identified as an effective policy tool to foster the translation of basic science into the final applied product (Chai & Shih, 2013). These partnerships are multi-lateral and include HEIs, the ministry of education, business, industry, non-governmental and service organizations as well as schools (Alpert, 2009). These partnerships allow academia easy and definite access to internship opportunities, while the private sector benefits through access to access to academic research and development at a much lower investment (Elmuti, Abebe & Nicolosi, 2005).

The close cooperation of these different sectors leads to a formation of “hybrid organizations” that link these sectors together into a tripartite unit called Triple Helix Model (Dooley & Kirk, 2007; Etzkowitz, 2011). This model can further diffuse into Knowledge, Innovation and Consensus Spaces in recognition of the roles played by each of the sectors in the original model (Etzkowitz & Ranga, n.d.), thus placing the knowledge economy and the issues of relevance and governance at the center of these interactions (Leydesdorff, 2012). This fusion of the multi-variate sectors is believed to hold key for sustainable development, as new companies can be borne out of these partnerships with the help of academia, which is believed to provide a “seed-bed for new firms” and innovation (Mansfield, 1991; Etzkowitz & Leydesdorff, 2000).

Internships also offer industry the chance of identifying candidates with ideal aptitude and attitude, thus increasing employee retention and saving companies the time and expense involved in hiring employees that are not a good fit for the organization. Since the prospective candidates are already vetted and on site it is easier for the company to decide whether to offer permanent contracts or release the students at the end of the internships.

Despite the discussed benefits of internships to all the stakeholders involved--students, industry, academia and public sector -- the concerned programs still face major challenges. Potential host institutions lack willingness to absorb these students during their training, claiming that students and academia often fail to take internships seriously enough to create mutual benefit. Another factor that leads to reluctance by the private sector to offer internships is said to be the often vague and inconsistent policies of HEIs typified by constant policy "surprises and reversals, uncertain contract enforcements and general corruption" (Brunetti, Kisunko & Weder, 1998; Lehmann et al., 2012).

This paper is aimed at exploring the challenges posed by insufficient science and technology infrastructure and the underdeveloped chemical industry in Lesotho. I will also explore how this can be turned into an opportunity for applied chemistry research and development in the National University of Lesotho, the only university in Lesotho that offers internationally recognized degrees in the natural sciences. I will first contextualize my analysis with a discussion of the role of research in academia and social transformation. Thereafter I will outline the challenges faced by academia, and finally suggest some opportunities presented by the perceived predicament.

Perhaps before I delve into the issues of central importance to this discussion it is prudent to introduce Lesotho as the subject of this study. Lesotho is a small, wholly landlocked country inside South Africa with close to 68% of its population living below the national poverty line (CBL, 2009). Its largest export is fresh water, famously termed the "white gold", to the neighboring South Africa (Tafirenyika, 2011; World Report, n.d.). The major revenue source, besides water, has largely been the tax collection from the regional bloc termed Southern African Customs Union encompassing other four countries in the region, namely Botswana,

Namibia, South Africa and Swaziland, dating back more than a century (SACU, 1910). The largest population of Lesotho's workforce, both skilled and non-skilled is migrant in South Africa, the economy of which is considerably better, often leading to the conceptualization of the former as being the labour reserve of the latter (Murray, 1976; Cobbe, 2012).

II. The role of research in university grading, staff promotions and alternative funding

HEIs are rated according to criteria that vary by country. For example, in South Africa, measures include percentage of headcount enrolment in science, engineering and technology; postgraduate enrolments; student-staff ratios; permanent staff with doctoral degrees; private and government income; student fee income; as well as the output variables such as student success rates, graduation rates and weighted research output per permanent staff member (McGregor, 2010).

Most African universities rank lowly in the global universities ranking. Arguably this is not due to lack of qualified and capable staff, since most of the staff are trained globally, but rather due to poor funding and lack of functional infrastructure for research (Jansen-van Vuuren, Buchanan & McKenzie, 2013). According to two global ranking institutions, no African university appeared in the top 100 universities in science and technology between 2012 and 2013 (QSIU, 2013; Cybermetrics, 2013). Those that are top ranked in Africa come mainly from the Arab States and South Africa. Even then, those South African universities high on the list do not include universities marginalized prior to the end of racial discrimination (Mammino, 2011). This further supports the argument that the progression in the ranking is consistent with the capital investment and funding accessibility.

The role of HEIs in society has recently become a subject of robust debate in many forums resulting from an observation that a shift towards more integrated multi-disciplinary approach places processes of learning and knowledge generation as central to attaining a competitive advantage (Aranguren, Larrea & Wilson, 2009). Development of interdisciplinary curricula is highly recommended in order to respond to industrial concerns (Ray, 2013). The academic freedom of universities provides "protected space" and a safe environment set apart from the interests, orthodoxies and pressures

(Brennan, King & Lebeau, 2004). This freedom however does not abrogate the responsibility of the academics to maintain high standards of professionalism and ethics, or to serve “key public purposes” that the job requires (Broad, 2010). Nor are public HEIs freed from public scrutiny of their use and management of the public funds on which they are heavily dependent (Alexander, 2000).

Clearly, research is very important, but can cutting edge, socially beneficial or profitable research be carried out under the stated circumstances – poor funding and infrastructure?

III. Challenges faced by academic applied sciences programs due to lack of science-based industries – the context of Lesotho

The absence of science-based industries in Lesotho not only frustrates the absorption of the appropriately qualified graduates as evidenced by the exodus to Lesotho’s only neighbor, South Africa (George, 2014); but it also makes industrial internships very difficult to supply in sufficient numbers. The majority of the few the existing companies in Lesotho are owned by South Africans, and as such tend to be uninterested in investing in Lesotho’s education sector. Some go as far as giving internships to students from South African universities, rather than those from Lesotho. This perhaps calls for indigenization of the few existing industries/businesses, but the country lost this opportunity during the late 1990s when privatization of parastatals was undertaken in response to pressure from international organizations. Massive labor retrenchments in the public sector followed, threatening the country’s political stability and security (Akokpari, 2005). The non-implementation of the National Science and Technology Policy, which advocates for establishment of Science and Technology hubs and funds supporting research and development, also exacerbates this problem both industrially and academically in Lesotho (LNSTP, 2006).

These challenges are apparently not unique to Lesotho. Others have argued that there are weak science and technology institutions in the majority of Africa (Chataway, Smith & Wield, 2005); thus perpetuating a lack of strong science-based industry. This deficit has been traced to generally poor appreciation of science (Irwin & Wynne, 1996; Pouris & Pouris, 2009), as well as the excessive

bureaucratic bottlenecks from African governments through their trade, industry, foreign affairs, energy, science and technology departments, research institutes, as well as financial institutions and policies (Amigun, Sigamoney & von Blottnitz, 2008).

IV. Turning the tide – realizing the abundance of opportunities in applied research

Given the receptive nature of small business and community-based organizations (CBOs), and their need for technical expertise in business and otherwise, it is believed that this sector can be profitably transformed, while at the same time providing the required student attachment programs. Once small business and CBOs have grown to the level of companies or industries, through the support of the HEIs, it is believed they can continue to support the HEIs by providing internship opportunities. Strong linkages between HEIs and the private sector could result in the development of new products and processes and support the formation of larger manufacturing firms (Mansfield, 1991).

This opportunity gives impetus to a call for integrating entrepreneurship into HEI’s programs. The success of such an effort was demonstrated in Nigeria, where a group of unemployed graduates were given training on small-scale manufacturing, and the majority of them subsequently started their own small companies (Owualah, 1999).

IV. Some examples of possible collaborations with cooperatives and small to medium enterprises in Lesotho

Lesotho has traditionally been a country of community formations for collective work called “matsema” (Silici, 2010). This led to establishment of formal community-based organizations, most of which are now engaged in applications of some basic science concepts such as soap/candle making, beverage preparation and bottling, etc. These organizations are in dire need of technical assistance in areas such as chemical and market analyses. The few areas where chemical sciences can be or have been used are discussed below.

(a) Food processing, packaging and quality control

Lesotho has been consistently plagued with food insecurity over the past two decades (WFP, 2011); hence a policy shift towards promotion of agriculture is widely regarded as necessary for the economy for Lesotho (ADB, 2013). Unfortunately the impact of domestic food spoilage on the attainment of food security seems oblivious. For example, post-harvest loss in Rwanda was reportedly between 25% and 50% in 2013 (Kalibata, n.d.). A good opportunity, then, for science-based, HEI assisted industrial development would be in the areas of post-harvest treatment/processing of foodstuff, processing of dairy products, meat products, fruits and vegetables. Due to the minimal use of chemicals in food production, most Lesotho products are highly valued internationally as they are considered safe and often classified as "organic" (Tibbits, 2013). Currently some processed (canned) fruits are exported to Europe, although the production scale is still too low to make a considerable impact on the economy. Only one local cooperative has partnered with the university for testing of their beverages, which are already in the market (George et al., 2014; George & Moiloa, 2015). These areas of collaboration and production of mutual benefit should be multiplied and explored further.

(b) Detergents and cosmetics

There are a lot of small-scale manufacturing ventures currently being undertaken by local Basotho, mostly by those who do not have basic or chemical sciences education. This activity is a response to scarcity of job opportunities, as noted in the introduction and the earlier sections. A number of skin products, creams and lotions are being produced and sold in the local markets. However, these producers are constantly struggling to grow their business due to a number of factors, including lack of comprehension of the processes involved in manufacturing and limited business management skills. This is an area of potential collaboration that has received a lot of attention from the university and the local manufacturers. Recently a student took an internship with a small-scale detergent manufacturer and he managed to improve the production costs by over 10% after factoring all the stages of the entire production line including taxes (George & Motsamai, 2015).

The very same student has now started his own small detergent manufacturing company.

(c) Herbalism and Local Traditional Medicines

Due to its unique climate, Lesotho produces some valuable and high quality varieties of herbs. There is some demand in Western Europe for Lesotho-grown herbs for medicinal applications, especially since the advent of HIV-AIDS (Mills et al., 2005). Lately, there is enormous production and sale of herbal medicines informally in the streets of major towns (FAO, n.d.). Unfortunately, regulation regarding production and sale of these products is limited to those practitioners registered with the Ministry of Health (WHO, 2001). Most, if not all of the herbalists that prepare these medicines do not have any formal pharmaceutical, biological nor chemical knowledge. The ensuing deficiency of documentation about the composition, storage, expiry date, effect of exposure to sun, etc. for these products is daunting to the health regulators. This situation is made worse by the fact that some of these herbs have been implicated in murder cases, whether homicidal or suicidal, posing serious challenges to the forensic investigations. Involvement of university students in efforts such as these could add some value and address some of these issues, presenting an opportunity for both producers and students.

(d) Environmental monitoring and support of other services

The impact of the textile industry on the environment remains a contentious issue, posing the dilemma of whether to enforce strict regulations to the responsible factories and risk significant job losses. Since this industry is fully owned by foreign nationals, especially from China, the owners always threaten to close down when regulatory bodies try to enforce environmental standards. Instead of threatening these industries, efforts could be directed at reducing the environmental impact of their waste through collaboration with the university, which already has sufficient technological resources for monitoring of water pollution (FWT, 2013), as well as finding ways of beneficiating this waste for further use.

(e) Production of renewable energy sources

The effects of climate change have led to an increasing imperative for the conservation of existing resources. Lesotho is no exception to this; the effects of climate change have been experienced and are widely recognized, as evidenced by a recent study of one grassroots smallholder farmers' community (George, 2014). There are suggestions that the conditions in many developing countries are ideal for growing algae for biofuels. As such there has been speculation about the potential for biofuels to reduce oil imports, stimulating rural economies, and thus reducing hunger and poverty (Adenle, Haslam & Lee, 2013). Biofuel generation harnessing the abundance of water resource endowment of the country is one of the potential areas for technological and economic development in Lesotho. There is currently one project that has received some funding from United Nations Development Programme under Global Environment Facility Small Grants Program. The project develops methods for biofuel production from sewage sludge using microbiological digestion, which seems more potent than the widely used natural means of biodegradation (Mekbib et al., 2014). While this area still needs further development, there is hope that with the amount of research in this area new applications and products will be created that will enable industry to sustainably harness Lesotho's natural resource endowment (Slate & Bauen, 2013).

(f) Material science and new products developments

Lesotho is endowed with a lot of stone resources ranging from softer clarence to harder basalt rocks. These stones can be exploited in either engineered and carved products or even in the production of ceramics (Thamae et al., 2014). The collaboration between the university and private sector in this area has been a resounding success with the formation of a company co-owned by the university and the partnering business. A number of different products are being prototyped and incubated in preparation for commercialisation. Some products that are produced from waste paper in collaboration with some CBOs are already on the market, albeit at a very low scale. Efforts are being made to raise funds for the

technical assistance of this business through training the members in relevant chemistry and business management skills.

IV. Conclusion

The issues raised in this essay provide a bird's eye view of some of the challenges that the National University of Lesotho faces, as the sole university responsible for producing skilled human resources in the area of natural sciences. The impacts of the paucity of resources on carrying out impactful research have been outlined, and I have offered some proposals as to how the present predicament can be reinterpreted as a considerable potential for meaningful and responsive research by the university. I have argued that blame-shifting between different sectors should be avoided and replaced by systematic engagement between the departments of education, trade and industry, science and technology, the business community, as well as all other relevant organizations, as proposed by the Triple Helix Model. Policy support for such cooperation should provide for seed funding to establish technology incubators that can nurture new graduates in developing their own innovations, products and services, as well as providing some funds for research and innovation in the university. The strategy proposed here could position the university as a significant player in the economic transformation of the country.

I further recommend that national policies should incentivize entrepreneurship and the reduction of reliance on an almost non-existent private sector for job opportunities, with the goal of expanding industry and promoting the growth of a knowledge-based economy. Without the backing of national policies, university efforts to meet the expectations of graduates and the community are simply unrealistic, and the achievement of these goals will likely remain elusive. It must be further emphasized that the university needs to be viewed as one of the key drivers that the government can use to achieve its mandate of improving the livelihoods of the nation, and it should thus work together with the university to achieve this common goal.

Having observed that there is still a considerably low appreciation of the so-called 'third mission' of the higher education – the responsibility to community development and support, or social entrepreneurship as it has been termed more

recently—I recommend the establishment of the university-public liaison structure. The liaison's responsibilities could include fostering partnerships with both the public and private sectors, and facilitate strengthening the few existing ongoing initiatives being pursued by some individual university staff with the CBOs. As it stands, these initiatives are too heavily dependent on the

continued presence and eagerness of the staff involved, which makes them vulnerable to collapsing should the concerned staff lose interest or decide to leave the university. This would further secure the position of the university as a most indispensable player in the country's economic and academic prowess.

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