

Research Application Summary

**Building excellence in science through innovative financing scheme of higher education and research**

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**Abstract**

Funding research and research facilities is a key challenge in developing countries universities. In addition to these challenges, graduates face difficulties in transiting to labor markets due to the lack of practical experience. In this perspective, the Laboratory of Genetics, Biotechnology and Seed Science (GBioS) at the University of Abomey-Calavi (Benin) developed an innovative-funding scheme which allowed the team to build and acquire equipment. An innovative approach has been developed to conduct research and develop business skills among graduates, support the creation of start-ups which in the medium term will fund the lab activities. This approach is based on a set of informal learning skills acquisition through self-directed learning, experiential learning and socialization. Through this approach, students are guided to exert their vocation. In the national context, this initiative is a ground-breaking strategy that contributes to sustainable development and from which other research institutions in developing countries can get inspiration.

Keywords: Benin, entrepreneurship, GBioS laboratory, youth unemployment

**Résumé**

Le financement de la recherche et des installations de recherche est un défi majeur pour les universités des pays en développement. En plus de ces défis, les diplômés rencontrent des difficultés pour transiter vers les marchés du travail en raison du manque d'expérience pratique. Dans cette perspective, le Laboratoire de Génétique, Biotechnologie et Science des Semences (GBioS) de l'Université d'Abomey-Calavi (Bénin) a développé un système de financement innovant qui a permis à l'équipe de construire et d'acquérir des équipements. Une approche innovante a été développée pour mener des recherches et développer les compétences commerciales des diplômés, soutenir la création de start-ups qui, à moyen terme, financeront les activités du laboratoire. Cette approche est basée sur un ensemble de compétences d'apprentissage informelles acquises par l'apprentissage autodirigé, l'apprentissage par l'expérience et la socialisation. Grâce à cette approche, les étudiants sont guidés pour exercer leur vocation. Dans le contexte national, cette initiative est une stratégie novatrice qui contribue au développement durable et dont peuvent s'inspirer d'autres institutions de recherche dans les pays en développement.

Mots-clés : Bénin, entrepreneuriat, laboratoire GBioS, chômage des jeunes.

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## Introduction

Access to quality education is a key driver of sustainable development and improvement of the people's livelihood. This is recognized by the international community through the Sustainable Development Goal 4 "Ensure inclusive and quality education for all and promote lifelong learning" (United Nations, 2020). However, graduate unemployment rate is high across developing countries including Benin where about 33% of the population is between 15 and 35 years old and suffer severe unemployment or underemployment (INSAE, 2016). As far as higher education is concerned, training programs have not been well adjusted to fill the gap between the participation of youth (18-35 years old as defined by African Union) to labor markets and skills needed (Nordman and Pasquier-Doumer, 2014). Indeed, skill and educational mismatches are prevalent in Africa with 17.5% of employed youth are over-skilled, 28.9% under-skilled, 8.3% overeducated and 56.9% undereducated (Morsy and Mukasa, 2019). The mismatch between training and the labor market demand makes most of graduates less competitive in a globalized job market (Herrera and Merceron, 2013; Morsy and Mukasa, 2019). Job mismatch affects both earnings and job insecurity and, thus, should be considered an extension of the under-employment notion (Herrera and Merceron, 2013). Over-skilling and overeducation are associated with a wage penalty and undereducation leads to a wage premium (Morsy and Mukasa, 2019). In addition, both over-skilling and overeducation reduce job satisfaction and increase youth's likelihood of on-job search (Morsy and Mukasa, 2019). Furthermore, skill and educational mismatches of youth can be persistent over time (Morsy and Mukasa, 2019).

On other hand, while entrepreneurship is recognized as a viable route to economic development due to its effect on employment generation, income growth, and innovation, higher rates of entrepreneurship appear to coexist with high levels of underemployment, low-paying jobs, and high rates of vulnerability (AfDB, 2017; Otchia, 2019). The lack of structural transformation, and poor business environment, as well as the lack of a business culture supportive of skills and entrepreneurship are some explanations of this puzzle (Loayza and Rigolini, 2011; AfDB, 2017; Otchia, 2019). In addition, as entrepreneurship education is at emerging phase with pedagogic approaches not suitable with the practical entrepreneurial needs, graduates are left lacking in many types of entrepreneurial skill-sets (Amjad *et al.*, 2020). In Benin, graduates lack business skills to start their own ventures and their only hope is to be recruited by the State as in a time of a "providential State". For some of the graduates who are willing to engage in business, the environment is not often conducive since through formal education, they are hardly prepared in terms of entrepreneurial skills to run an enterprise (ACED, 2017). Indeed, the literature highlights that lack of entrepreneurial marketing and managerial skill-set is also one of the leading causes of entrepreneurial failure (Amjad *et al.*, 2020).

In addition to the inadequacy of skills development and labor markets' needs, academics are faced with difficulties to have access to funding. In Benin, there is no structured and consistent government research funding scheme. Research laboratories in West African universities are poorly equipped in a context where students are eager to discover the world. Such situation hinders not only the capacity of researchers to develop innovative solutions to challenges faced by communities, but also the creativity and informal learning process of students as argued by Livingstone (2001).

Finding innovative ways to fund research (including research facilities) and reshaping training

through informal learning process to equip graduates with needed skills to address developmental problems and create job require a holistic approach. In this perspective, the Laboratory of Genetics, Horticulture and Seed Science (GBioS) at the Faculty of Agronomic Sciences (FSA) of the University of Abomey-Calavi (UAC) in Benin has developed an innovative strategy to (i) acquire research facilities, (ii) develop business skills of graduates, (iii) support the creation of start-ups which in the medium term will fund the lab activities and research. In this paper, we aim to share the approach and experiences of GBioS to financing higher education and research widely to inspire researchers and graduates in developing countries who are struggling to fund and reduce youth unemployment rate. This present paper is organized as follow: in the first section, we briefly presented the history of the creation of GBioS, followed by a presentation of the GBioS lab with its mission and achievements in the second section; in the third section, we describe the innovative funding scheme in acquiring research facilities, and in the fourth section the informal learning process at the GBioS to complement formal learning process of students. In the last section we discussed key success factors, lessons learnt and the way forward.

### **History of the Laboratory of Genetics, Biotechnology and Seed Science (GBioS)**

It started with few blocks and a strong leadership and commitment of the current Head of the Laboratory, Prof Achigan-Dako with some students to bring about major changes. In 2014, when Prof Achigan-Dako was given opportunity to teach the subject of horticulture, he soon realised that it would be very difficult to transfer practical knowledge to students without sound hands-on-skills tools. He then created the "Horticulture and Genetics Unit". With the assistance FSA farm manager, he got 1.7 acres with the hope to establish a laboratory, what is known today as GBioS. With strong commitment and great hope that the future will be bright, Prof Achigan-Dako used his own financial means to start the construction journey with four freshly graduate students. The students were able to build fences around the garden with local bamboo materials to eliminate animal's disturbance which was frequent. In this farm, some experiments were conducted to teach students the basics of crop experimentation in plant breeding, specifically students being specialised in Biotechnology and Plant Breeding. Students interested in Biotechnology and Plant Breeding were eager to learn, but unfortunately FSA lacked state-of-art facilities for teaching and research. Based on the motivation of the team, an administrative request to establish the laboratory was quickly approved in December 2014 by the Dean of the faculty who allocated additional land to the Lab. At that time, the team had no financial resources to build a single block. The light of hope came from a consultative assignment to translate professional documents from English into French. The consultation was commissioned by the African Forest Forum (AFF, Kenya), a job worth of USD 30,000. With a well selected team of 10 MSc and PhDs students and Prof Achigan-Dako included, quality outputs were delivered, and the team got paid. The team unanimously decided to allocate 80% of resources from AFF consultancies to the lab construction project. About 10% was secured as research funds and 10 % shared among the team of junior consultants. This is how the blocks of hope (Fig. 1) has been initiated with the expectation that only time would tell this great story. It was amazing and energizing to receive the counselling of the former Dean of the Faculty of Agronomic Sciences, Prof Joseph Hounhouigan and the former Vice-Chancellor of the University of Abomey-Calavi, Prof Brice Sinsin who challenged us of rapid growth. In 2017, the Horticulture and Genetics Unit was upgraded to the Laboratory of Genetics, Horticulture and Seed Science (GBioS).



**Figure 1. GBioS Laboratory in early 2015**

**Presentation of the laboratory of genetics, biotechnology and seed science (GBIOS).** The Laboratory of Genetics, Horticulture and Seed Science (GBioS) formerly known as HGU “Horticulture and Genetics Unit” is a laboratory fundamentally oriented towards the conservation of plant genetic resources with the aim to generate and provide quality information on the use and conservation of neglected and underutilized species (NUS), and crop wild relatives (CWR) in Africa, especially horticultural species including fruits, vegetables, nuts, and aromatic, medicinal and ornamental plants. The vision of GBioS is to be a leading Plant Genetic Resources Lab, recognized internationally for its quality, relevance, impact, and sustainability. The laboratory is the very first and the only one genetics and horticulture lab of the School of Plant Sciences at the Faculty of Agronomic Sciences. Currently, the lab staff includes 84 members, two production technicians, three administrative, 29 BSc and MSc students, 26 research assistants, 18 PhD students, five assistant lecturers and one Associate Professor. The staff is actively involved at various levels in the lab activities including: research and teaching, administrative management, technical support, students training, consultancy services, seminars and workshop facilitation.

The Lab has four major components including Research, Training, Production for sales, and Entrepreneurship that are all functional. With its status of academic institution, formal and informal training and research are part of its intrinsic activities whereas Production and Entrepreneurship were designed as supportive and strategic components. It is one of the rare institutions in Benin where research, training, production and entrepreneurship are tied up (Fig. 2).

Research activities at GBioS are facilitated by nine sections: Plant Breeding, Biosystematics, Value chains, Seed Science and Technology, Crop Science, Bioinformatics, Biotechnology, Ethnobotany and Ecological intensification and focus on neglected but promising species including among other, *Synsepalum dulcificum*, *Gynandropsis gynandra*, *Vitex doniana*, *Digitaria exilis*, *Amaranthus* spp, and *Macrotyloma* spp. Research activities also focus on other crops with high interest and value such as pineapple, maize, bananas, tomato, etc.

Regarding the academic training, the lab ensures first year and second year students of the faculty

get hand-on skills in the crop establishment, monitoring, harvest and postharvest management. Students are involved in many theoretical and practical activities. Emphasis is put on traditional vegetables and underutilized species. Besides, students get acquainted with a number of agricultural practices like mulching and intercropping and the utilization of mechanized agricultural equipment (Fig. 3 and Fig. 4). Genebank’s management, trial establishment and data collection are also taught mostly to MSc students (Fig. 5).

As far as the production side is concerned, GBioS’ farm is specialized in horticultural crop production of exotic as well as traditional vegetables such as: *Gynandropsis gynandra* (spider plant), *Amaranthus* spp, *Ocimum gratissimum* (Tchiayo), *Cymbopogon citratus* (lemon grass), *Hibiscus sabdariffa* (roselle), *Ananas comosus* (pineapple) which is directed by a team composed of four technicians assisted by BSc students.

The entrepreneurship component at GBioS promotes the creation and establishment of start-up. The lab currently has five start-up (Fig. 6) all led by graduates with many other start-ups at emerging stages: HomeLand tastes, established in 2016 and specialized in the production of herbal tea based on medicinal plants such as moringa, ginger, roselle, etc.; Seed Services, established in 2016 and specialized in the production and distribution of high quality of horticultural seeds and seedlings; Biolife, established in 2017 and specialized in the production and commercialization of bio-fertilizers and biopesticides for sustainable and environmental friendly intensification of vegetables production in Benin; and created to support the fresh vegetables and fruits production of the laboratory; Cereals Benin also established in 2017 and specialized in the promotion of neglected or/and underutilized cereals like fonio and its derived products; and Grow seeds, a very new startup at the initiation phase aiming at providing producers with tomato seeds with various fruit shape (elongated tomato, ovoid tomato, round tomato, lobed tomato, tomato pepper) and high fruit yield.

These start-ups are expected to provide employment and internship workplace to newly graduate students to overcome the increasing number of unemployment.

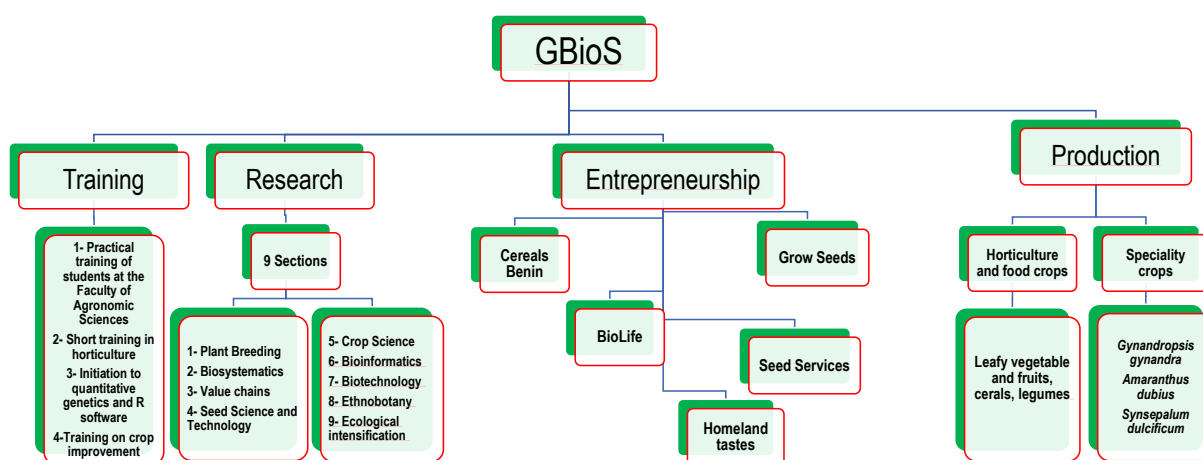


Figure 2. Components of the Laboratory of Genetics, Biotechnology and Seed Science



**Figure 3. Mulching training section**



**Figure 4. Training section on agricultural engine mastering (student handling a lawn tractor)**



**Figure 5. Shelling of Kersting's groundnut for data collection and seeds conservation of Benin landraces in GBioS Genebank**

**Innovative funding scheme in acquiring research facilities and funding research activities.** The Laboratory as most of research entities was supposed to have two funding sources: an external and internal funding source. The startup setting up is a part of new and innovative strategies developed for financial support of research activities in the laboratory. The Laboratory has four components that interplay for a good functioning. Financial resources from vegetables selling (production) and support start-up help support part of research funds (mainly for BSc students) and training activities in the Lab. Since the financial demand from the production and start-up was high, the Director of the GBioS together with assistants and students agreed on “own-funding scheme”. Under the own-funding scheme, each member of the Laboratory is asked to put aside 15% of his allowance (in case of a project)/consultation fees (in case of consultancy work). This was mainly to support the construction of the building (Fig. 7) and other costs related to research activities.



A



B



C



D

Figure 6. Products from some start-ups incubated at GBioS, A- Herbal tea boxes from Homeland Tastes, B- Compost from BioLife site, C- Ecoseed from Seed Services, D- Expected products from Grow Seeds start-up



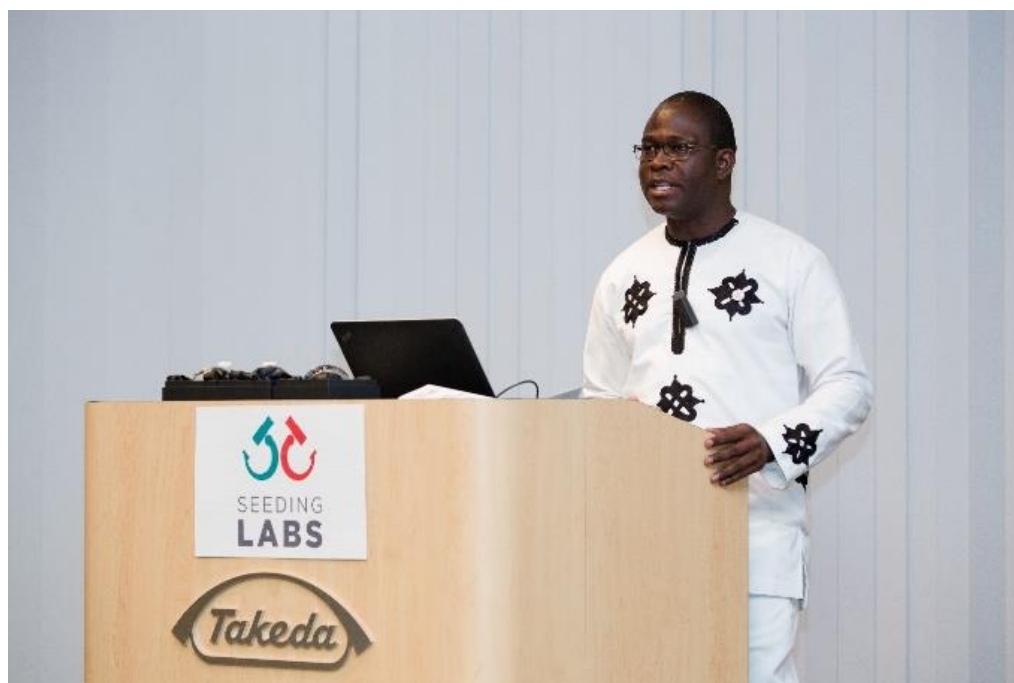
**Figure 7. GBioS Laboratory building in July 2018**

After constructing the first floor of the building, the same process helped to buy small materials such as tables, chairs, beamers, projection screen, motor tricycle (for materials and harvest transportation). As far as laboratory equipment is concerned, there are four major pieces of equipment GBioS has been able to acquire with its own funding-scheme since 2014: one incubator, one oven and two refrigerators. Small equipment include refractometer, hand pH meter, seed containers, weighing scales and calipers. All equipment is in very good conditions and work perfectly. The main challenges of the own-funding scheme used by the Laboratory is that it takes time to get a single major piece of equipment, while time elapsing between acquisition of two major pieces of equipment is long. Fortunately, the tenacity and quality outputs production of the team paid-off. In 2018, GBioS was among the selected laboratories to benefit from Seeding Labs support with equipment after a tough competition (Fig. 8), making the University of Abomey-Calavi, the first Francophone University to benefit from that support.

It is important to stress that up to now, GBioS did not receive any financial support from the University. However, the former Vice-Chancellor Prof Brice Sinsin, the current Vice Chancellor Prof Maxime da Cruz and the former Dean of the Faculty of Agronomic Sciences Prof Joseph Hounhouigan facilitated the administrative process of the Laboratory establishment.

Currently GBioS is involved in many projects/consultation activities and other international collaboration which strengthen its visibility. The partners include INRAB (National Agricultural Research Institute of Benin), Wageningen University, AOCC (African Orphan Crop Consortium), AFF (African Forest Forum), UKZN (University of KwaZulu-Natal), etc.





**Figure 8. Head of GBioS Prof. Achigan-Dako at Seeding Labs event in Boston (USA)**

#### **Informal learning process at the GBioS**

According to Livingstone (2001), informal learning is defined as “any activity involving the pursuit of understanding, knowledge or skill which occurs without the presence of externally imposed curricular criteria”. Schugurensky (2000) has identified three forms of informal learning: self-directed learning defined as learning taking place without the assistance of an ‘educator’; incidental/experiential learning which is a learning process happening without any previous intention of learning and socialization characterized by the internationalization of values, attitudes, behaviors etc. during everyday life. At GBioS, informal learning process happens through all the forms previously defined. Socialization happens when every student, no matter his academic level, intending to be part of the Laboratory follows a presentation on the Lab and code of conducts. Code of conducts at GBioS include the (i) respect including respect of people, respect for the environment, standing by the commitments, observation of deadlines (ii) the punctuality (iii) self-discipline (iii) willingness to be trained and (iv) availability to attend additional trainings at the Lab or outside. Incidental learning happens when new students learn good habits from their seniors who in their turn learn from the head of the Lab who has a strong leadership and serves as a role model. So, through incidental learning, seniors at a higher level are forced to show a good example. Self-learning happens at GBioS and is characterized by the fact that students identified their gaps and organized some groups training to fill the knowledge gap they were unable to acquire or strengthen in formal education. With more space available at the Laboratory, it became possible for the members of the laboratory to organize frequent group seminars, workshops, and group reviews on topics such as plant genetics, crop physiology and breeding. Group reviews are also organized to monitor the progress in research and proposal development. On a regular basis, a get-together known as “Morning Genetics” was organized to help new students update their

knowledge in that field. To strengthen the writing and communication capacity of students and research assistants, English classes are organized and led by students themselves. This is a daily rendez-vous whereby participants are taught grammatical rules, vocabulary, reading, speaking, and listening. Within five years, the scientific production capacity of several members of the lab has increased with a total of 43 publications. Most members are on ‘‘ResearchGate’’ and ‘‘Google Scholar’’, with increasing h-index. Moreover, the lab is targeting Internationalization of training around promoting indigenous crops resources and wild relatives of Africa. In the whole, it came out that the informal learning process set at GBioS allows the production of skillful students highly demanded at national, regional and international levels. Consequently, the underemployment or unemployment rate of students from GBioS is very low.

### **Key successes factors and lessons learnt**

From 2014 onwards, GBioS has received many visitors from different countries in the world. All of them were impressed by the financing model and the tenacity of the team. Many students from GBioS got scholarships with most of them studying in English-speaking countries such as Ghana, Nigeria, Ethiopia, Netherlands and South-Africa. Currently the team of GBioS is involved in many research projects with high and positive impact on smallholder’s farmers including youth and women with a total budget of about 3,500,000 Euros. Products of start-ups are already on sales in the markets; this is the case of HomeLand Tastes already selling the herbal tea boxes in different supermarkets, of Seed Service and of BioLifofe whose ecological seeds and biocomposts have been being used since 2018 in a number of projects funded at the national level.

From the experience of GBioS, it came out that students are the backbone of the university’s development. That is why emphasis should be given to their involvement in projects implementation and management. Sometimes, at GBioS, students are given a decision-making power and responsibilities because the success achieved will not only affect the laboratory alone, but also positively exposes the students during their professional career. Secondly, sharing opportunities, building a scientific community, giving back to undergraduates are some unwritten rules that drive the members of GBioS. ‘‘We constantly look for the wellbeing of each new student and we have to give them the best of our time’’ believes Carlos Houdegebe, a research assistant, now PhD student at the University of KwaZulu-Natal in South Africa.

### **Conclusion and way forward**

The development and capacity building developed and implement at GBioS is reproducible although unique in many ways! Through the five years’ experience, it can be concluded that the future of work in Africa goes with strong institutional support to youth’s initiatives. This was clearly exemplified by the commitment of the Chancellor’s and the Dean’s offices that enriched all initiatives of the Laboratory with counselling and administrative support. This also reflects the fact that a change of paradigm is in motion in African universities, where we have the strong belief that the ‘‘university should build the university’’ and not produce graduates only. ‘‘Universities should produce job creators’’ with their capacity strengthened through informal learning process to reduce unemployment and underemployment rates. As the head of GBioS always teaches to the first-class students, the route to success begins with self-discipline and strong leadership.

Currently GBioS is stuck to its vision and will reinforce partnership with other institutions sharing the same vision regarding agriculture and entrepreneurship development in Africa. GBioS will

continue to incite and support technically the creation of the start-ups because at GBioS, we strongly believe that support for training is more effective in inciting productive and viable start-ups than subsidies, a point of view fully shared by Brixiová *et al.* (2015) in their paper on skills and youth entrepreneurship in Africa: Analysis with evidence from Swaziland.

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