

VALORIZATION OF RESEARCH AND SCIENTIFIC INNOVATION RESULTS AS FACTOR OF SUSTAINABLE DEVELOPMENT OF AFRICAN AGRICULTURE: THE EXAMPLE OF BURKINA FASO

Abdoulazize Banhoro, Rasmata Nana, Mahamadi Hamed Ouedraogo and Mahamadou Sawadogo

Biosciences Laboratory, University Ouaga, Pr. Joseph KI-ZERBO, Burkina Faso

During the 1980s, many development partners in Africa were preoccupied by the application of research results to agricultural development. In Burkina Faso, this awareness led to set structures and mechanisms for the promotion of research results. From the synthesis of critical analyses of the valorization system, it appears that the valorization concept is polysemous. In addition, there has been strong evolution in the mechanisms for promoting research results, development has also been hampered by certain shortcomings. Thus we propose, as a main track for a successful valorization policy, the creation of start-ups constituted of young professionals who possess skills that are specific and complementary. Young university-educated professionals are equipped to understand the new technologies of production and agricultural transformation. With an effective management plan the start-ups they represent could foster an effective application of research results, to improve food security and enhance the competitiveness of Burkina's agricultural products on international markets.

KEY WORDS: VALORIZATION, POLYSEMOUS, START-UP, AGRICULTURE

Introduction

Burkina Faso is a landlocked country located in the heart of West Africa, and covers an area of 274,200 km². Its economy is essentially based on agriculture and livestock, sectors that employ more than 80% of the active population. They also account for 80% of the country's export earnings (FAOSTAT, 2014). Burkina Faso, like other countries in Sub-Saharan Africa, faces enormous challenges in terms of meeting social demands in vital areas such as food, health and education. The situation is exacerbated by the high population growth that is driving development progress (Butare and Zoundi, 2005, PNDES 2016-2020). According to Barrow (1991), in the Sub-Saharan Africa zone, where three-quarters of the 400 million people depend on subsistence agriculture, natural resources (land, water, pasture, forests, etc.) are being degraded to a disturbing extent. To deal with this situation, the Heads of State and Government of the Organization of

African Unity (OAU) suggested that modern science and technology could be valued to solve the problems of desertification, population growth and hunger (MBow and col., 1992). These initiatives reflected the desire to use the results of research and the expertise of scientists for the benefit of agricultural development. In Burkina Faso, this awareness of the important role of research in sustainable development policies led in 1995 to the development and implementation of a Strategic Plan for Scientific and Technological Research. In addition, the issue of valuing the results of scientific research and technological innovation (VRR) for development has been at the center of national development policies. These reflections led to the development of a national strategy for the valorization of technologies, inventions and innovations (SNVTII) and the setting up of research and valorization structures. In view of the importance of the subject, studies have been conducted, by State structures and by national and international authors, to make an inventory of fixtures and produce a critical analysis of the valorization system. The present article provides a synthesis of these works: it reviews significant valorization developments, highlights certain aspects of the valorization process often neglected in development policies and proposes pathways to successful valorization, at the service of the sustainable development of agriculture in Burkina Faso.

Background and rationale

In Burkina Faso, scientific research and innovation has generated many results in biophysical areas (agronomy, the environment, materials, natural resources, etc.), and across the economic, social, human and political sciences, results that can contribute to endogenous development. However, the low levels of use of results by development actors, led policy makers in 1994, to set up workshops to disseminate results for their efficient use. The aim was to promote the results of scientific research and technological innovation as a key factor for sustainable socio-economic development in Burkina Faso. In order to achieve this goal, the state has developed a coherent policy to publicize the results of research to potential users.

Despite these efforts spanning 24 years, the question of the valorization remains problematic. “The impact of research results on socio-economic development remains mitigated and the importance of research remains poorly perceived at the population level”. One of the corollaries of this situation is the threat of food insecurity that hangs over the country following poor agricultural campaigns. Indeed, according to the Minister of Agriculture (RFI, 2018), more than 2.5 million people are threatened with starvation due to the cereal deficit caused by poor rainfall and crops pests. This study is conducted in a context where many indicators of climatic variation affect agriculture in Burkina Faso. Increasing the number of studies related to plant breeding could help boost an agricultural sector that lacks sufficient quantities of quality seeds. The use of the results of research remains embryonic at the level of family farming, which is predominant in Burkina Faso. In view of the adverse effects of climate change on agriculture, knowledge of the results of research and technological innovations in this field are imperative. It is therefore necessary to review the current context of VRR’s mechanisms in order to

better identify the system's shortcomings and suggest solid tracks for developing the agricultural sector.

Valorization concepts

To understand the problematic nature of the valorization of research results, it is essential to understand the different terminologies used by the actors involved. The term “valorization” is polysemic and the definitions given vary according to the organism or the country considered. In fact, in Burkina Faso, Law N ° 038-2013 / AN, which provides for the orientation of scientific research and innovation, defines the valorization of research results as a process of exploiting the results of research for changes favorable to development. This law differentiates between the valorization of research results and its extension. It defines the popularization of research results as the action of raising awareness of research results among main actors and the general public.

However, we note that these terminologies are used differently by different actors. In Africa in general, and in Burkina Faso in particular, valuing results is very similar to popularize them, seen from the standpoint of the broad public. In the ANVAR provisional guide on procedures for the valorization of Research and Innovation Results, valorization is defined in a schematic way, through six categories that are not mutually exclusive: academic or professional valorization, scientific valorization, technological valorization, social valorization, economic valorization and political valorization (SP/ANVAR, 2017). Academic valorization of educational content consists of incorporating the results of the research into the modules of academic training. This is the introduction of an enhancement module for “updating the content of courses offered to students or professionals involved in the process of developing their professional knowledge and skills”.

At the level of scientific research, the exploitation of results consists of disseminating them in the form of scientific publications in specialized journals, communications at conferences and seminars, posters, fact sheets, photos and videos. Media such as radio, television and the print media, public or private, can also be used. For research, Day (1988) said that a scientific experiment, no matter how spectacular the results, is not complete until the results are published. Communicating the results of one's research is therefore an essential aspect of the researcher's work. It is mainly through this means that we understand what has been done, why it was done and what it contributes to knowledge.

Technological valorization refers to the use of research results to develop new processes or to improve existing processes operated by companies created for the purpose. An important element of technological valorization is the existence of networks of innovators comprising Research and Development (R & D) cells in universities and research centers and also the research-industry link.

Social valorization concerns the development of solutions or applications emanating from research, with the aim of solving a known social problem. As a result, the purpose of the valuing would be to demonstrate the social utility of the research and obtain posteriori its public funding.

Economic valorization is a process of implementation by which research results can have a real economic impact. It is the commercial exploitation of research results in the form of goods and services, and increases in productivity and employment.

Political valorization takes into account the research results in the design, implementation and evaluation of the country's economic, social and cultural development policies. Also, political valorization should allow civil society to elaborate some advocacies in order to have a general influence in the decision-making process.

Inventory of fixtures of the valorization of the research results

Acquired

The analysis of the inventory of fixtures of the VRRRI in Burkina reveals a considerable effort has been made by the State. Indeed, aware of the leading role of research results in the socio-economic development of the country, the State has set up several research structures and valorization mechanisms at the research level, in some ministerial departments and to the level of the inventors and private innovators. Thus, since 1995, the State of Burkina Faso has adopted a strategic plan for scientific and technological research. In addition to helping generate results at the research level, this strategic plan has made it possible to set up structures and mechanisms for promoting results in the National Center for Scientific and Technological Research (CNRST). These structures and mechanisms of valorization are namely the Direction of Scientific and Technical Information (DIST), the National Agency for the valorization of the Results of the Research (ANVAR), the National Forum of Scientific Research and Technological Innovations (FRSIT), the services liaison research development, etc. In addition, at the legal and regulatory level, there are texts governing the institutional anchoring of these recovery structures. This legal and regulatory framework is a credible provision that allows structures to carry out their activities.

At the level of the ministerial departments, the valorization is ensured by specialized services in charge of creating the link between research and the exploitation of its results by farmers and enterprises. This device for promoting the use of technologies was established in Burkina Faso with the creation of the Ministries of Agriculture, Livestock and Environment whose main objectives are the promotion of productive agriculture and livestock production and the preservation of the environment through sustainable development. The valorization network in these ministries is supported by the Regional Directorates of Agriculture, Livestock and Environment centrally coordinated by the Direction of Agricultural Popularization (DVA), the Direction of Popularization and Transfer of Technologies (DVTT), the National Forest Seed Center (CNSF) and the National Council for the Environment and Sustainable Development (CAPES, 2006).

The following table summarizes the role to be played by several State structures involved in the VRRRI (DG/ANVAR, 2014; CAPES, 2006; CAPES, 2008).

Structures of VRRRI	Role
Directorate of Agricultural Extension / DVA	<ul style="list-style-type: none"> – guided visits on new technologies and diffusion tests through production test plots (PTP), production plots (PP); – formalized partnership for research supporting the application of technologies retained in school fields; – tests of diffusion of new technologies through the production test plots (PTP) and the production plots (PP); – testing and dissemination of agro-food processing technologies; – the formalized partnership for accompanying research
General Directorate of Plant Production / DGPV	<p>Main component:</p> <ul style="list-style-type: none"> – agricultural mechanization – contributes to the formulation of a national agricultural mechanization strategy; – promotes knowledge and know-how in agricultural mechanization through training, popularization and dissemination of knowledge and new research achievements; – promotes the production / repair / maintenance of agricultural equipment; – controls the quality of agricultural equipment.
Institute of Environment and Agricultural Research (INERA)	<ul style="list-style-type: none"> – liaises between research, extension, peasant organization and NGOs, – involves civil society in the process of generation and transfer of technologies. – organizes and manages the agricultural and environmental research and contributes to valorization of scientific and economic results – maintains the link between research and the development including the transfer of technologies to the producers
Permanent Secretariat of National Forum for Scientific Research and Technological Innovations (SP / FRISIT)	<ul style="list-style-type: none"> – exhibits technological innovations; – promotes indigenous research and technologies; – to interest research partners in the promotion of technologies, the dissemination of results and the financing of research; – establishes a sustained relationship between researchers and other players in technological innovations; – dynamically involves development partners in research activities; – creates synergy and strengthens relations between research structures.
National Agency for the Valorization of Results of Research and Innovations (ANVAR)	<ul style="list-style-type: none"> – coordinates the development and implementation of national policies and strategies for the exploitation of research results and innovations, in conjunction with the administrations concerned; – monitors and evaluates the state of valorization of the results of research and innovation in Burkina Faso; – carries out baseline studies and prospective studies on the valorization of national expertise, research results and innovations in liaison with the administrations concerned; – establishes links between national and international players in terms of the exchange of experiences in the field of the valorization of the results of research and innovation; – investigates requests for partnerships and support from independent and non-independent researchers and innovators, organizations and associations involved in the fields of scientific and technological research and innovation; – develops a human resources development plan in the field of valorization of research results and innovations.

Table 1: Device for disseminating and exploiting the results of research

In addition, the Ministry of Higher Education, Scientific Research and Innovations (MESRSI) ensures the valorization of the results of research through institutes or research centers and universities. For example, at University Ouaga I Pr. JKZ (formerly University of Ouagadougou) there is a Vice-Presidency in charge of University-Business Relations, a Center for Studies, Documentation of Economic and Social Research (CEDRES), and a university press (MRSI, 2012).

In addition, the State of Burkina Faso has established several partnerships with regional and international research institutions that are also keen to foster valorization, according to their specificity, the results of the research (Table 2).

Categories institutional	Executing agency	Center of interest
International	IRD/CIRAD/ICRISAT/ IITA	plant production, varietal selection, crop defense, animal production, forest production, Natural Resource Management and Production System
International	CIRAD	food technology, valorization of local food products, agricultural mechanization
International	CIRAD/2iE/ICRAF	forest production, agroforestry, biodiversity, conservation / regeneration of vegetation cover, forest products valorization, water, energy, environment
International	CIRDES	epidemiology, vaccines, genetic resistance
Regional	WARDA	production and technology transfer, increase the sustainable production of rice-based cropping systems
International	ILRI	increase the productivity of small livestock farms

Table 2: Regional and international research institutes partners in agriculture and environmental fields

IITA-The International Institute for Tropical Agriculture

WARDA - West Africa Rice Development Association

IRD - The Research Institute for Development

2iE - The International Institute of Engineering, Water and Environment

ICRISAT - the International Crops Research Institute for Semi-Arid Tropics

CIRDES - the International Research Center for Livestock Development in the Sub Humid Zone

CIRAD - the Center for International Cooperation in Agronomic Research for Development

ICRAF - International Centre for Agroforestry

ILRI -the International Livestock Research Institute

To this list must be added the participation of farmers’ organizations, private organizations, financial institutions, NGOs and the media.

Thus, in view of all these actions and the continuing production of informed texts, it is safe to say that the valorization system put in place by the state has continued to improve

over the years. In this sense, we can cite, as an example of improvement of the valorization system, the creation in 2011 of the Ministry of Scientific Research and Innovation (MRSI). One of the main missions of this body is the valorization of research results, inventions and innovations. To carry out this mission, the department developed participatory strategic guidance documents. These include:

- the Law of Orientation of Scientific Research and Innovation (National Assembly, 2013)
- National Policy on Scientific and Technological Research (PNRST) (MRSI, 2015)
- the National Strategy for the Valorization of Invention and Innovative Technologies (SNVTII) (MRSI, 2012)
- the National Innovation Strategy (MRSI, 2012a)

For example, in the implementation of SNVTII, the role and responsibilities of the different actors were set during a national validation workshop.

The vision of the strategy is “development actors make better use of technologies, inventions and innovations to improve their living conditions through sustainable valuing structures and mechanisms” (MRSI, 2012). As a global objective, the strategy aims “to promote the intensive use of technologies, inventions and innovations to contribute to the economic, social and cultural development of Burkina Faso”. The specific objectives of the strategy are:

- ensure the firm protection of the Technology of Inventions and Innovations (TII);
- make technologies, inventions and innovations available and accessible to actors;
- set up and / or strengthen the valuing structures of TII and ensure their functioning;
- develop specialized human resources for valuing TII;
- ensure effective communication on the valorization of TII. (SG/ANVAR, 2014)

These specific objectives make it possible to define five strategic axes with a formulation of the stakes, the programs and the strategies of accomplishment (annex 1). Indeed, these axes are an implementation plan to achieve the objectives of SNVTII. Then, axes 2 and 3 focus respectively on strengthening growth poles through the creation of innovation parks; and on accelerating the transfer and adoption of technologies, inventions and innovations by strengthening research-valorization interfaces.

Innovation parks are platforms where several technologies, inventions and promising innovations are identified and arranged, allowing several actors (researchers, academics, companies and Technical and Financial Partners (TFP)) to form close partnerships that aid efficient valorization. These parks constitute a system of pooling resources intended to offer an open community of users the possibility of carrying out one or more projects of valorization on one or more leading products. Innovation parks can be established in a growth center (various activity zones, outskirts of large agglomerations, etc.) to reinforce them. This is the case of Bagrepole, where innovation parks have been established in promising sectors (ANVAR, 2015). To improve these parks, management and animation units as well as technical support for the dissemination and exploitation of technologies and innovation have been implemented.

The innovation platform or multi-actor’s platform is defined as the grouping of means

(equipment and human resources) intended to offer an open community of users, in particular companies, resources (equipment rental, benefits, services, etc.) enabling them to carry out their research and development and innovation projects.

In addition to these two platforms, SNVTII has also initiated a showcase of technologies, a place in which the most conclusive results of research, inventions and innovations are permanently exhibited in order to interest potential private and / or public operators in the valorization (MRSI, 2012).

On the other hand, in order to achieve the strategic objectives of the National Policy for Scientific and Technological Research (PNRST), the government has created the National Fund for Research and Innovation for Development (FONRID) which reinforces the sources of public funding of research previously provided by the Fund for Support to Health Research (FARES) and the National Fund for Education and Research (FONER) (MESRI/LRIS, 2017). Indeed, the FONRID was created by decree of the council of the ministers on October 27th, 2011 and is governed by the law N° 04/25 /AN of March 24th, 2005 regulating the National Funds of financing. (FONRID, 2013).

Previous work on the critical analysis of the valorization system has shown that “financial institutions lack specialist skills in financing and supporting projects to promote research results”. The creation of FONRID therefore responds to this gap. Its 2014-2018 strategic plan, adopted in July 2013, covers seven (07) strategic directions affecting several sectors: agriculture, human and animal health, education, energy and mining, local materials, and the culture of good governance and peace. Thus, Strategic Direction 1 addresses the contribution of FONRID to the improvement of food security and sovereignty through the development of technologies to increase agricultural productivity, preservation, development and sustainable use of natural resources for the well-being of the population. Several projects accompany this orientation, following research themes specific to the constraints of the agricultural production and processing system.

Interviews with the Director of Projects and Programs and with the Head of Studies, Projects and Programs highlighted the mission and methodology of FONRID in the agricultural sector. Indeed, FONRID has the mission to offer a financing framework for research and innovation activities through calls for projects to enable research to occupy a prominent place in the national development policy of Burkina Faso. In practical terms, this is evident in the agricultural sector through project funding to generate results that are disseminated to help improve production. Project proposals are submitted via a competitive call for concept notes for research proposals, and selection is rigorous (FONRID, 2013). For example, the 4th call for submission of the Conceptual Project Notes (NCP) of N° FONRID / AP4 / NCP / PC / 2015 was aimed mainly at research and development projects and projects for the valorization of the results of research and innovation. In the agricultural sector, selected projects included the diffusion of sorghum resistant to striga, the dissemination of improved cowpea varieties, popularization of effective seedling densities, extension of seed drills and mechanical spreaders, etc.

Gaps

Critical analyses of the valorization system have identified a number of shortcomings. Despite the many efforts devoted to the creation and popularization of high-performance technologies, agricultural development is failing to achieve its intended purpose. These analyses have revealed certain aspects of valorization that are not sufficiently exploited by development policies. These include:

- the low consideration within academic and professional circles of the mechanisms of valorization of the State. Most research activities lead to formal knowledge or procedures. To understand them and grasp their scope, people need to be trained. So professional centers and universities can be effective forums for understanding, disseminating and exploiting research results as long as they are included in training programs.
- the lack of a critical mass of communicators specialized in scientific popularization and technological innovation.
- the weak organization of the production and processing sectors which does not allow the professionalization of the actors, thus constitutes a brake on the establishment of public-private partnerships.

In addition to the shortcomings mentioned in previous studies on VRRI, it should be noted that in the agricultural sector, methods of communication are not adequate. The key actors in the sector are farmers, mainly living in rural areas. The massive use of the media (press, poster, television, etc.) certainly has its advantages but is not a suitable tool to reach the maximum number of people in the countryside. While the targeted communication initiative of the high-yield maize development project in the UEMOA area is to be welcomed (ANVAR, 2018), it is worth emphasizing that this type of project for the dissemination of improved varieties that take into account the social context is limited to specific areas. In the ANVAR draft guide on VRRI procedures, very interesting communication methods have been proposed that are adapted to the national context (annex I). It would therefore be necessary to adapt these methods specifically, *mutatis mutandis*, to the agricultural sector. Also, at the level of agricultural research, the potential of results generating patents is problematic. Because the researcher is considered an employee of the State, the results of his work are considered as belonging to his employer who represents the public mass. The problem is that the mechanism that allows the transfer of the results of the researcher to the public mass (example of the production of seeds), is typically run by private structures, and generates large sums of money. The awards given at FRSIT's biennial editions to the best inventors and innovators as a reward are very good initiatives. But these rewards do not concern all researchers and do not guarantee an equitable sharing of the benefits derived from exploiting the results of their work. This situation gives rise to two major problems:

- the researcher himself becomes a specialist in valorization by embarking on agricultural production activities;
- the researcher mainly uses these results for his promotion to CAMES without really worrying about their local extension.

On the other hand, it should be emphasized that there is no private sector specialized

in research for industrial recovery. This issue should be addressed in a fundamental approach with a view to understanding new technologies. Thus for instance, in the sector of seed production, Dr. Tinland, an expert in the agricultural sector, said during an interview: “the first country in West Africa to develop a leading seed industry, and consequently to become a leader in the agricultural sector, will be the one that will empower its industry and make regulatory systems predictable”. The lack of private interest makes the yield of some agricultural crops consistently low. Public research often bears no responsibility when results made available to farmers fail or cause losses. During the interviews, we met some producers who complained about the quality of the improved seeds. These are often problems related to the development cycle of the plant or problems of heterogeneity of the material whose merits have been bred as hybrids. The importance of the private sector is its obligation to have satisfactory results in order to ensure the quality of its product and maintain its clientele. The existence of this type of enterprise could revive agriculture by strengthening it in agricultural biotechnology if accompanied by an effective audit mechanism.

From our analysis of the interviews, it appears that the real problem of valorization is social and industrial. In fact, at the social level, farms are for the most part family legacies and production is mainly intended for family consumption. The population does not perceive agriculture as a profession that can properly sustain and enrich those who practice it. As a result, agriculture is in the majority subsistence farming of the rain-fed type, characterized by low productivity which is linked to the tools used, the non-mastery of modern techniques of production and the weak use of the quality inputs (improved seeds and fertilizers). The other social aspects that constitute an obstacle to the valorization of the research results include the lack of awareness of the potential of modern techniques of production and the cultural context (habit and mentality). As a result, Burkina Faso has remained on the margins of the green revolution that has helped some countries to see a substantial reduction in undernourishment (China and India, for example) or even become exporters of rice (Thailand, Vietnam, Indonesia) (FAO, 2000).

On the economic front, the current industrial development of Burkina Faso does not allow for the establishment of an effective Research-Development partnership. The research-SME / SMI collaboration makes it easy to establish user-oriented research because the main characteristic of SMEs is their ability to innovate quickly to adapt to market competition. The Ivorian economic model, after the 2011 crisis, largely dominated by agro-industry (TANO, 2013; MAAF, 2015), can be a perfect example for Burkina Faso. Indeed, once jewel of the West African economy with a representation of 40% of economic activities of the UEMOA (World Bank, 2010), the Ivory Coast experienced in 2012, a remarkable economic recovery. After the socio-economic crisis that degraded the country's economic system, this recovery was mainly driven by the activity of SMEs. The Ivorian Minister of Commerce wrote in 2016, on his Twitter account: “SMEs represent 98% of the formal economic fabric, 20% of national wealth, 12% of investment and 23% of the workforce.” (Izo, 2016). This sector is at the center of the current governance policy that aims to make the Ivory Coast an emerging country with a strong industrial base by 2020.

The impact of this level of industrialization is the establishment of an appropriate framework for the public-private partnership at the heart of the strategy of the National Development Plan (NDP) 2016-2020. The public investment program of the new Ivorian NDP, estimated at CFAF 30,000 billion, is funded 37.6% and 62.4% by the public sector and the private sector respectively (PND 2016-2020). The private sector is therefore at the center of Ivory Coast's development strategy.

Conclusion / Recommendation

The valorization of research results for the sustainable development of agriculture involves taking into account the national context. Despite the political will displayed in the form of strategies, actions, institutional and private support, the valorization of scientific results continues to disappoint expectations. Agricultural biotechnologies are little used by producers because of their inaccessibility and low diffusion. However, the current national context shows a satisfactory evolution towards a dynamic system, giving pride of place to the modernization of the agricultural system. For instance, mechanization and the increased use of improved seed types by small producers can be noticed. So themes such as “national economic recovery from SMEs” and “socio-professional integration of young people in the agro-sylvo-pastoral system” are at the center of discussions. Also, the notion of agribusiness now widespread among the population, especially at the level of the educated fringe, has made it possible to understand that agricultural exploitation can be very profitable.

It is therefore timely to underline that in Burkina Faso several professional training courses (Table 3) are provided in the agricultural sector, generating considerable potential. Indeed, Burkina Faso's education system has a wealth of young professionals who can be involved at different levels of the agricultural chain. These young professionals, specialists in the agricultural field, equipped to understand the new technologies of production and agricultural transformation, would constitute a nursery for the revival of agriculture in Burkina Faso. The idea would therefore be for the State to initiate, from universities and vocational training centers, the creation of “start-ups” constituted of young professionals possessing a complementary range of specific skills. These start-ups with their different sector activities can be used to build a value chain around a given speculation.

University or professional center	Training	Some training contents	Focal points for the implementation of the start-up
University Ouaga Pr. Joseph Ki-Zerbo	Professional Master in selection and valorization of plant genetic resources	Plant breeding, seed production, agronomy, agro-economy, entrepreneurship	Performing genetic material development with specific technology qualities and adapted to the needs of different markets
University Ouaga Pr. Joseph Ki-Zerbo	Professional Master in Seed Selection and Conservation	Seed production system, seed technology, agronomy, agro-economy, entrepreneurship, plant breeding	Quality seed production
University Ouaga Pr. Joseph Ki-Zerbo	Professional Master in Plant Protection and Breeding	Mastery of pests, defense and plant breeding, agronomy, entrepreneurship	Large production of development varieties for a specific processing industry
University Nazi Boni, CAP-Matourkou, Dedougou University	Agronomist and agricultural technician	Crops production	
University Ouaga Pr. Joseph Ki-Zerbo	Professional Master in Post Crop Management of Plant production	Crop degradation agents; Post-harvest routes; Value Chain and Marketing; Post-harvest processing; Post-harvest conservation techniques ; Control and inventory management	Post-harvest control and inventory management
University Ouaga I Pr. Joseph Ki-Zerbo	Specialization of CNRSBAN	food industry; food technology and nutrition; quality control, option food industry	Agro-industrial processing of agricultural products
University Nazi Boni,	Socio- economy	Sociology and rural economy, agricultural extension	Facilitate the adoption of new technologies and agro-industrial products manufactured locally
University Ouaga II	Agro-economy	Agricultural economic analysis, project design and management,	Identifying needs, Project development, Farm business management; introduce local consumer markets, integrate marketing sub regional and international channels for agricultural and agro-industrial

Table 3: Some agricultural training courses in universities and vocational centers in Burkina Faso

This will be a holistic approach that will move from the plant breeder to the agricultural extension officer; from the design engineer to the agricultural technical officer. It is therefore an idea that requires a high level of organization and the development of a solid project; but at the end of execution it will make the following possible:

- Introduce young graduates into entrepreneurship, give them work and so reduce unemployment and dependence on public service competition. At the state level, it will be mainly facilitation for the recruitment and emoluments of these agents.
- Start-ups can form a network of “model farmers” or “contact farmers” working with extension institutions that can influence the local population in a sustainable manner and their ease of understanding and exploitation of technological leaps made in agriculture (biotechnology and agricultural mechanization). They will thus constitute local experts who can provide support-advice to the population. In addition to being effective and a sustainable rostrum of valorization of the results of the research, they will be a showcase for the valorization of human resources.
- This initiative can help to professionalize the agricultural sector and establish strong competition in the production and transformation systems of agricultural sectors. Competitiveness is governed by the capacity for rapid innovation, production of quantity and quality at a lower cost in order to adapt to market conditions. We can therefore have very strong research and development liaison services, a well-developed public-private partnership and the rapid industrialization of the agricultural sector.
- They will also allow for the implementation of water management and control techniques, the integrated management of soil fertility as well as the strict maintenance of the technical itineraries of the speculations established by the research to obtain maximum yields.
- Lastly, we hope that the overall implementation plan will lead to an efficient valorization of research results, achieve food security and make Burkina’s agricultural products competitive in international markets.

Acknowledgements

This study has been lead in the framework of course on “Modern breeding techniques of maize” and show as poster in the IPBO meeting in Ghent on the theme “Scientific innovation for a sustainable development of African agriculture”. These activities are linked to my internship for Master degree at the University Ouaga I Pr. Joseph KI-ZERBO, which is being implemented at SEMAFORT, a seed production company.

So I am grateful to my professors at University who provided us with a thorough training in research activities. My gratitude also goes to the Directors and agents of ANVAR, FRSIT, FONRID, CNRST, INERA for agreeing to share information with me on the topic. I also thank Dr. Tinland, Mrs. Hawa T. Kone and their staff for accepting me in their company. At end all my gratitude towards VIB/IPBO/UGENT and the MARC AND NORA VAN MONTAGU FUND for supporting my attendance on the summer course.

References

- Anvar/General direction of the studies and of the sectorial statistics, 2015. Review of the 2013-2015 operating action plan of the national strategy for the valorization of technologies, inventions and innovations. 14p.
- Anvar, 2018. Technical sheet: project to valorize high yielding corn varieties in the UEMOA area
- Barrow C. J., 1991. Land degradation: development and breakdown of terrestrial environments. Cambridge, UK: Cambridge University Press 283p.
- Butare I. and Zoundi J. S., 2005. Enlightening Political Decision Making in Sub-Saharan Africa: A New Deal for Agricultural and Environmental Research. 2nd Butare and Zoundi, Dakar, Senegal; 96p.
- Call for submission of concept notes on projects (NCP) of N ° FONRID / AP4 / NCP / PC / 2015. 7p.
- Center for the analysis of economic and social policies (CAPES), 2006. Results of research, invention and technological innovation in Burkina Faso: State of play of exploitation for sustainable development, 56p.
- Center for the analysis of economic and social policies (CAPES), 2008. National center of the Scientific Research and Technological (CNRST) major results of research: what use for the development? 158p.
- Consultative Group / Ivory Coast National Development Plan 2016-2020, cape on the emergence with shared growth. Website consulted <<http://www.initiative-ppp-afrique.com/Afrique-zone-franc/Pays-de-la-zone-franc/Cote-d-Ivoire/Cadre-strategique>> 14/08/2018
- Day, 1988, In 'How to Write and Publish a Scientific Paper' 3rd Ed
- [FAO] Food and Agriculture Organization of the United Nations. 2000. World Food and Agriculture Situation: Lessons from the Past 50 Years. FAO Agriculture Series, no. 32. Rome, Italy: FAO. 356 p.
- FAOSTAT. 2014. (Food and Agriculture Organization of the United Nations / Statistics Division). Via delle terme di caracalla 00153, Itatie
- General secretariat / National agency for the valorisation of research and innovation results, 2014. Organization chart: Decree carrying organization and working of the National agency of Valorization of the Results of research and innovation (ANVAR). 16p.
- General secretariat / National agency for the valorisation of research and innovation results, 2017. manual of procedures for the exploitation of research results, inventions and innovations (Provisional document), 23p.
- IZO, 2016. Ivory Coast economy. Website consulted <<http://news.abidjan.net/h/579905.html>> 14/08/2018
- Mbow A.M., Niang M., Aguessy H. and Mbow P. 1992. Science and technology in developing countries for a scientific renaissance of Africa. Dakar, Senegal: Association of Senegalese Researchers (ACS).
- Minister of higher education of scientific research and innovation / leader of the research and innovation sector, 2017. sectoral policy research and innovation (PSRI) 2018-2027. 74p.
- Ministry of agriculture, agri-food and forestry, 2015 agricultural policies across the world some examples: Ivory Coast 10p. Website consulted <<file:///C:/Users/User/Desktop/new%20organization/Article/Bibliographie/Créer%20ole%20dossier/epo/1506-ci-resinter-fi-cote-ivoire.pdf>> 11/04/2019
- Ministry of scientific research and innovation, 2012. National Strategy for the Valorization of Technologies, Inventions and Innovations (SNVTII), 39p.
- Ministry of scientific research and innovation, 2012a. National Policy on Scientific and Technological Research (PNRST) 2013-2025, 34p.
- Ministry of scientific research and innovation, 2015. National Strategy of Innovation (2016-2025), 16p.
- National assembly, 2013. LAW N ° 038-2013 / AN on the law of orientation of scientific research and innovation, deliberated by the National Assembly at its meeting of November 26, 22p.

- National economic and social development plan (PNDES) 2016-2020, 2016. 126p.
- National research and innovation for development fund (FONRID), 2013. Strategic Plan 2014-2018. 77p.
- Permanent secretariat / national forum of scientific research and technological innovations (palm editions from 1996 to 2012), 2012, Role of Scientific Research in National Socio-Economic Development, 32p.
- Radio France Internationale, 2018. Burkina Faso: Grain deficit threatens famine for thousands of families. Website consulted <<http://www.rfi.fr/afrique/20180507-burkina-faso-deficit-cerealier-famine-milliers-personnes>> 14/08/2018
- Tanoh G., 2013. Ivorian economy in 2012: How has growth rebounded? Consulted <<http://news.abidjan.net/h/452641.html>> 11/04/2019
- World Bank, 2010. Ivory Coast: The economic revival of the Ivory Coast requires a revitalization of small and medium-sized enterprises. Website consulted <<http://www.banquemondiale.org/fr/news/feature/2010/09/01/restoring-cote-divoires-economy-revitalizing-small-medium-sized-enterprises>> 14/08/2018

ANNEXES

Annex 1: Strategic axes the National Strategy for the Valorization of Invention and Innovative Technologies (SNVTII)

Strategic axes	Strategies	Programs
<p>Axis 1: Protection of technologies, inventions and innovations and promotion of the public-private partnership ;</p>	<p>to create, within the actors of the research, the invention, the innovation and valuation, a true culture of protection support the realization of the protection of more technologies, inventions and innovations</p>	<p>Program 1: Protection of Technologies, Inventions and Innovations</p> <p>Program 2: Public-Private Partnership (PPP) and Exploitation of Technologies, Inventions and Innovations</p>
<p>Axis 2: Strengthening growth poles through the creation of innovation parks</p>	<p>To identify in a participatory way in each growth pole the promising sectors. Then gather as innovation park, all technologies, successful innovations, transfer mechanisms and the existing skills of the identified pathways</p>	<p>Program 1: Support for the identification of promising sectors and / or available technologies and innovations by growth pole</p> <p>Program 2: To create innovation parks to support growth poles</p>
<p>Axis 3: Faster transfer and adoption of technologies, inventions and innovations by strengthening research and valuation interfaces</p>	<p>Develop participatory mechanisms to involve actors in a sector concerned in the diagnosis of constraints, the analysis of the value chain and the development of technologies and innovations. Use of multi-stakeholder innovation platforms and technology incubation centers for the development of technologies and innovations</p>	<p>Program 1: Creation and animation of multi-stakeholder innovation platforms</p> <p>Program 2: Creation and animation of technology incubation centers</p>
<p>Axis 4: Development of human resources specialized in the protection and valorization of technologies, inventions and innovations;</p>	<p>Instilling a culture of efficient valuation TII to researchers, inventors, innovators and developers through awareness and training. This culture of valuation will place particular emphasis on communication training, marketing and entrepreneurship. Pride of place will be given to young promoters of companies</p>	<p>Program: Capacity building of actors in entrepreneurship and exploitation of technologies, inventions and innovations</p>
<p>Axis 5: Strengthening communication on technologies, inventions and innovations</p>	<p>take advantage of all channels, means and communication tools available to inform and reach the greatest number of actors who can contribute to the exploitation of research results, inventions and innovations</p>	<p>Program: Strengthening Communication on Technologies, Inventions and Innovations</p>

Annex 2: The diffusion of the RRII convincing:

- Identify the target audience according to the nature of RRII
- Identify and identify broadcast relays (local radio, TV, etc.)
- Sign a partnership agreement with the media
- Instance a permanent working relationship with the media (invite them to events organized by ANVAR, involve them in meetings on the valorization process).
- Organize caravans and theaters forum in rural areas (DIOBASS experience)
- Design the brochure, posters of the RRIIs incubated.
- The actors involved in this phase will be focal points, opinion leaders, customary leaders, religious and mayors will serve as relay for the dissemination of RRII in these localities (regions, township).

