

Valorization Potential Assessment: Senegal

Table of content

Introduction.....	2
1. National strategy on biodiversity.....	2
2. Overview of actors potentially using or involved in R&D on GR in Senegal	3
1.1 Methodology.....	3
1.2 Main results: the most relevant actors related to GR	4
1.2.1 National actors.....	4
1.2.2 Foreign actors that operate in Senegal.....	7
1.3 Key findings	7
3. Biodiversity in the patent system for Senegal: overview of the economic potential of the species	8
1.4 Species that are known to be distributed in Senegal and elsewhere.....	8
1.5 Species that were directly sourced from, or potentially originate from, Senegal based on distribution data.	8
4. Links between patent documents, value chains and markets.....	9
1.6 Methodology.....	9
1.7 Main results of the analysis linking patent documents to value chains and markets.....	10
1.8 Key findings	12
Conclusion and recommendation	13
Bibliography.....	16
Annex 1: Key words used to identify actors relevant to R&D on GR	17
Annex 2: List of all the actors found in the scope of the assessment related to R&D and the economic valorisation of biodiversity, biological and genetic resources.	18
Annex 3: List of the most relevant actors found in the scope of the assessment related to R&D and the economic valorisation of biodiversity, biological and genetic resources.....	19
Annex 4: List of the patent documents examined for linking species with markets and value chains	20

Introduction

The main objective of this assessment is to support the valorization of genetic resources (GR) and to inform the development of national access and benefit-sharing (ABS) frameworks. With a view to increasing the potential benefits arising from the utilization of GR, there is a need to bridge the gap between providers of GR and their potential users in foreign countries. For this purpose, the following key elements are examined.

Section one examines the national strategy on biodiversity.

In section two, an overview of the actors in Senegal potentially using or involved in R&D on GR is presented. It seeks to answer the following questions: Which actors are valorising and/ or utilising GR in Senegal? How are they connected to each other and to foreign users? What are their key R&D activities? Are there synergies or potential gaps with the users R&D requirements?

In section three, an overview of the economic potential of the species is drawn from the separate study 'Biodiversity in the Patent System: Senegal', where the main question examined is: what can patent information teach us about the range of potential economic uses of African GR and traditional knowledge (TK).

In section four, the link between patent documents, value chains and markets is presented. Examples were selected to illustrate different types of commercialization and to highlight the economic potential of the species. Analysis of the value chain or profits that have been derived from the commercialization of products based on these GR/species is beyond the scope of this assessment.

Finally, a conclusion is presented. It include an overview of the country's strengths and weaknesses with regard to R&D on GR and their economic valorization, from which country specific recommendations are drawn. It should be noted that for the six countries (Cameroon, Kenya, Madagascar, Mozambique, South Africa, and Senegal) general recommendations are presented in the synthesis "Economic potential and valorization opportunities for genetic resources in six African countries". They seek to answer the following questions: What are the practical steps to improve the valorisation of GR within the ABS framework? What kind of business, legislative and regulatory environment is favourable for this purpose?

1. National strategy on biodiversity

The issue of ABS has not yet been specifically addressed through national legislative, administrative or policy measures.

A national strategy on biodiversity¹ comprises four major objectives, including '*the fair sharing of roles, responsibilities and benefits in regard to biodiversity management*'. The action plan of the national biodiversity strategy² includes activities to improve the conservation of gene banks, the rehabilitation of the existing botanical garden as well as the creation of a herbarium. Other activities which could

¹ <http://ns.cse.sn/sid/biblioth/biodiv/biodiv2.htm>

² <https://www.cbd.int/doc/world/sn/sn-nbsap-01-fr.pdf>

relate more specifically to the economic valorization of biodiversity and GR are unclear. No further information on the implementation of the strategy, its evaluation or monitoring could be found.

There is also a national program for the management of GR for food and agriculture³. While there is existing capacity⁴ related to bioprospecting for food and agriculture, it is unclear to what extent the research activities are covered by Multilateral System of the FAO Treaty (MLS) of the International Treaty on Plant Genetic Resources (ITPGRFA) or by the Nagoya Protocol (NP).

2. Overview of actors potentially using or involved in R&D on GR in Senegal

This analysis focuses on Senegalese and foreign actors that operate in Senegal. An identification of the relevant actors for the valorization of biodiversity has not yet been carried out at the country level. The following is therefore based on publicly available information that could be identified through desktop and internet research which limits its depth.

Overall, limited information is available on the internet on actors operating in Senegal. Actors involved in the valorization of biodiversity generally have a limited public profile as they are often a technical intermediary in long and complex R&D processes. Finally, actors that do not have an internet website are therefore not taken into account in the study. While some potential leads are identified, only partial conclusions can be drawn.

1.1 Methodology

The methodology used to identify the actors that are potentially using or involved in R&D on GR was based on the following steps:

- The characteristic of the country's economy was first examined to identify the key players that could be involved in the utilization of GR (e.g. conservation, main economic actors).
- An internet search based on key words was carried out. They are presented in annex one.
- When possible, interviews were realized with individuals having a good knowledge of the actors related to the utilisation of GR, R&D and the valorization of biodiversity in the country⁵.
- Specific internet research for each actor was carried out to identify: area(s) of R&D, maintenance of collections (e.g. genes), potential uses of GR and any collaborations with foreign actors (as a basis for potential exchanges of genetic material). For the last two categories, a basic Yes / No / Unclear categorisation was used.
- Based on the facts compiled, 22 institutions stood out as potentially relevant for ABS as their activities are related to the utilization of GR.

While a total of 45 actors were identified (listed in the annex two⁶), the most 22 relevant actors are examined in this report (and listed in annex three). They are categorized as follows:

³ www.biodiversityinternational.org/uploads/tx_news/1277.pdf p. 314

⁴ FALL Cheikh Alassane, 2008. SENEGAL : Deuxième Rapport sur l'état des ressources phylogénétiques pour l'alimentation et l'agriculture. ISRA, FAO, Dakar, Sénégal et Rome, Italie. iii + 48 www.fao.org/docrep/013/i1500e/Senegal.pdf

⁵ Mr. Samuel Dieme, Point Focal APA Sénégal.

⁶ Considering the limited information available, further analysis may indicate that they should be integrated into the core actors concerned by ABS and the economic valorisation of GR.

- **Actors providing GR:** they are officially designated under national legislation as institutions with mandate to provide GR
- **Actors which may utilize GR in the context of their broader activity:** it is unclear if they specifically use GR, but it is a possibility in consideration of their mission statement, activities and area of expertise. Based on the limited information available, it is not possible to confirm this. There are two sub-categories: public researcher institutions and other institutions (e.g. NGOs, private sector).
- **Actors of the support environment:** they do not directly use GR but they contribute to an enabling valorization environment by providing financial, technical and organizational support to providers, users and other actors. They are classified in two sub categories: those that effectively contribute to the support environment and those with a potential to do so.

1.2 Main results: the most relevant actors related to GR

The following examines both national actors and foreign actors operating in Senegal that seem of particular relevance to the utilisation and valorization of GR. However, due to the limited information available, it was not possible to examine the specific areas of research, projects, technical capabilities or the network of these actors. Although all these actors are involved in activities related to the valorization of biological resources (BR), it is unclear if and how they utilize GR.

1.2.1 National actors

- Actor providing GR

No institutions are designated as official provider of GR.

- Actors which may utilize GR in the context of their broader activity

Public Research Institutions

In total, six public research centres, two universities, five botanical gardens and one multi-stakeholder entity were identified. Also, some of the providers identified above conduct R&D on GR, such as IFAN.

There are five botanical gardens⁷ with potential to conduct R&D on GR:

- **L'Institut fondamental d'Afrique noire⁸** (IFAN) works in social and natural sciences. It houses one of the major botanical gardens in West Africa and carries out ethno-botanic research⁹ (Approx. no. of herbarium specimens: 110,000).

⁷

<http://www.google.fr/url?sa=t&rct=j&q=&esrc=s&source=web&cd=5&cad=rja&uact=8&ved=0CDsQFjAE&url=http%3A%2F%2Fwww.cbd.int%2Fdoc%2Fworld%2Fsn%2Fsn-ex-bg-en.doc&ei=Ci8-VPanCcGUaPDwgoAL&usq=AFQjCNGXJZLRHm6iahd46qa7Ej9i1lhqIg&bvm=bv.77412846,d.d2s>

⁸ <http://www.tela-botanica.org/actu/article6279.html#>

⁹ Gueye et al. 2009 [www.sud-expert-plantes.ird.fr/writable/versions/sep/projets/dossier_204-upload-](http://www.sud-expert-plantes.ird.fr/writable/versions/sep/projets/dossier_204-upload-204-Information_Herbiers_et_Etudes_Ethnobotaniques.pdf?1385983875)

[204-Information_Herbiers_et_Etudes_Ethnobotaniques.pdf?1385983875](http://www.sud-expert-plantes.ird.fr/writable/versions/sep/projets/dossier_204-upload-204-Information_Herbiers_et_Etudes_Ethnobotaniques.pdf?1385983875) HERBARIUM COMPUTERIZATION AND ETHNOBOTANICAL SURVEY: THE CASE OF APOCYNACEAE IN IFAN HERBARIUM, SENEGAL

- **Jardin Botanique de la Faculté des Sciences, Université de Dakar** (Approx. no. of herbarium specimens: 8,000).
- **Jardin Botanique des Parcs Forestier et Zoologique de Hann** (No. of taxa: 1,300).
- **Jardin d'Expérimentation des Plantes Utiles**, Laboratoire de Pharmacognosie et de Botanique, Faculté de Médecine de Pharmacie et d'Odonto-stomatologie, **Université Cheikh Anta Diop**, CAPETOWN-DAKAR.
- **Jardin du Centre d'Application en Développement Intégré, Centre El Hady Thierno**

The **Laboratoire National de Recherche sur les Productions Végétales**¹⁰ (**LNRPV**) carries agricultural research across Senegal agro-ecological areas. It has for instance programmes on agricultural biodiversity and another one on biofuels. It also has two partnerships with the French **Institut de recherche pour le développement (IRD)**¹¹ and **Université Cheikh Anta Diop de Dakar (UCAD)**, with which it co-manages departments such as: microbial ecology of tropical soils and agrosystems¹², a joint microbial laboratory¹³, and economic macro analysis¹⁴. It has specific partnerships with foreign actors such as the Centre d'étude régional pour l'amélioration de l'adaptation au changement climatique¹⁵, the University of Ouagadougou, Oregon State University, and the Centre de coopération internationale en recherche agronomique pour le développement (CIRAD)¹⁶.

The **Institut de technologie alimentaire (ITA)** carries out research on food and nutrition. It has a biotechnology department that focuses on microbiology and fermentation. The **Institut Pasteur**¹⁷ (a Senegalese foundation) carries out research on health related issues. The **Institut sénégalais de recherches agricoles**¹⁸ (**ISRA**) carries out research on agriculture. It published in 2014 a report on two non-timber forest products¹⁹.

Université Cheikh Anta Diop de Dakar (UCAD)²⁰ has various research departments including: natural products, bioactives compounds, bacteriology and virology, and biotechnology (vegetal, mushroom). It organised in 2013 a research congress on 'vegetal biodiversity and therapeutic resources in Sahel'²¹ in partnership with foreign institutions. It included topics such as ethnobotany, ethnopharmacology, and clinical trials. Further information is available on the congress website²². The **University of Thiès**

¹⁰ www.lnrpv.sn/le-lnrpv/presentation

¹¹ www.ird.fr

¹² www.ird.sn/activites/lemsat

¹³ www.lcm.ird.sn

¹⁴ www.bameinfopol.info

¹⁵ <http://ceraas.org>

¹⁶ www.cirad.fr

¹⁷ http://www.pasteur.sn/index.php?option=com_content&view=article&id=128&Itemid=463

¹⁸ www.isra.sn

¹⁹ *Enquêtes socio-économiques sur les PFNL fruit de Adansonia digitata et gomme Sterculia setigera dans les Régions de Tambacounda et de Kédougou au Sénégal.*

www.google.fr/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCEQFjAA&url=http%3A%2F%2Fwww.coraf.org%2Fdocuments%2Fpublication%2F2014-04%2Fsenegal_rapport_enquetes_socioeco.docx&ei=fXw5VKieJs3zasfpggAD&usg=AFQjCNE95J_CKOfjLnVu7F_ngg1JWQVg2A&bvm=bv.77161500.d.d2s

²⁰ www.ucad.sn

²¹ www.cnrs.fr/infoslabos/conferences-colloques/docs/affiche_colloque_2013_vFinale.pdf

²² fst.ucad.sn/index.php?option=com_content&view=category&layout=blog&id=83&Itemid=92&limitstart=6

carries out research on agriculture and health²³. It has a plan to further connect its research with development. No further information could be identified.

SODEBIO²⁴ is a multi-stakeholder initiative that works on agricultural transformation with national (e.g. ITA, UCAD) and foreign actors (Centre Wallon de Biologie Industrielle, Faculté Agronomique de Gembloux et Université de Liège, Belgique). No further information with respect to activities related to the utilization of GR could be found.

For the actors related to agronomy, it is unclear if these R&D activities are covered by the Multilateral System of the FAO Treaty (MLS) of the International Treaty on Plant Genetic Resources (ITPGRFA) or by the NP.

Other actors

Of particular relevance to this study, one NGO and three companies, potentially doing R&D on Senegal BR and GR were identified. **Prometra Sénégal** is an NGO that carries out research on traditional medicine. It trained traditional healers on basic healthcare, using the World Health Organisation toolkit²⁵. In the private sector, **Setexpharm**²⁶ is specialized in the valorization of natural products such as Bissap and other plants with pharmaceutical applications. It has research partnerships with national universities and research centers. **Nexeria** is a large producer of Acacia gum and does R&D²⁷. It collaborates with the ISRA. The **Compagnie Sucrière Sénégalaise** produces sugar and ethanol based on by-products²⁸. For these four cases, no further information was found on the utilisation of GR. Finally, a **list of 36 biology laboratory** is available online²⁹ but their activities are unclear.

- **Actors of the support environment**

A few actors were identified which seem to contribute and/or support the valorization of BR and possibly GR.

CBI³⁰, the Dutch development cooperation agency provided capacity development to the **Agence sénégalaise de la promotion des exportations**³¹ to promote exports. No further information was found with respect to potential activities related to the valorization of GR.

A **project was launched to conserve forest fruits**³² which could potentially contribute to the valorization of GR. It is financed by CORAF. Although no information was found with respect to potential activities related to the utilisation of GR, this project is of relevance for two reasons. First, such conservation activities are often a starting point for R&D. Second, most of the actors implementing the project are research organisations (ISRA, IFAN, UCAD).

²³ www.univ-thies.sn/index.php?option=com_content&view=article&id=104&Itemid=18

²⁴ www.ita.sn/ita/sobedio.htm

²⁵ www.prometra.org/representations_nationales/Senegal.html

²⁶ www.investinsenegal.com/IMG/pdf/newsletter_6.pdf

²⁷ www.nexira.com/Acacia-gum-specialist_50.html

²⁸ www.css.sn/culture.php3

²⁹ [www.annuairemedical-](http://www.annuairemedical-senegal.com/recherche.php3?count=1&select3=&search=1&textfield=®ion=0&departement=0&ville=0&id_rubrique=18)

[senegal.com/recherche.php3?count=1&select3=&search=1&textfield=®ion=0&departement=0&ville=0&id_rubrique=18](http://www.annuairemedical-senegal.com/recherche.php3?count=1&select3=&search=1&textfield=®ion=0&departement=0&ville=0&id_rubrique=18)

³⁰ www.cbi.eu

³¹ <http://www.asepex.sn/Statistiques,72.html>

³² www.leral.net/Lancement-d-un-projet-pour-preserver-les-fruits-forestiers-a-Tambacounda-et-Kedougou_a83007.html

1.2.2 Foreign actors that operate in Senegal

- Actors which may utilize GR in the context of their broader activity

La **Grande Muraille Verte**³³ is an international reforestation project across Sahel. It is co-managed by the French Centre for National Research (CNRS)³⁴ with Senegalese public institutions (Agence nationale de la grande muraille verte³⁵ and the Direction de l'Environnement et des établissements classés³⁶). No further information was found on the utilization of GR. This project is of relevance to the valorization of GR because the identification of species traits that are adapted to climate change is currently a business opportunity in the biotechnology sector. Considering the R&D expertise of the actors involved in this project, the pursuing of this opportunity could be a possibility.

- Actors of the support environment in operation

Three actors were identified but no further information was found with respect to potential activities related to the valorization of biodiversity.

The **Conseil ouest et centre africain pour la recherche et le développement agricoles (CORAF)** finances a project for the sustainable management of non-timber products³⁷. The **Agribusiness in Sustainable Natural African Plant Products**³⁸ (**ASNAPP**) is a multi-stakeholder initiative (business, scientist, government) to enhance growth of African indigenous plant products and horticultural industries by intervening and building capacity along the supply chain and increasing private/public investments to reduce poverty and hunger. Finally, **AIDGUM**³⁹ is an NGO that promotes the development of natural gums.

Phytotrade Africa⁴⁰, a continental business organisation, is going to open a national branch in West Africa, including Senegal. Its members make products using the species that are harvested by African rural producers. Members can access Phytotrade's expertise on R&D, market opportunities, ABS and regulatory knowledge.

1.3 Key findings

At the national level, only few public actors doing R&D and potentially using GR could be identified. There is no official provider of GR. Research is taking place in universities and public institutions, however their specific fields of activities are unclear. There is a leading regional actor (IFAN) which houses one of the major botanical gardens in West Africa and carries out ethno-botanic research. There is a national program that aims to valorise traditional medicine, but no further information could be identified. The R&D capacity of national institutions and their level of engagement with foreign actors is unclear apart from a few cases (e.g. LNRPV). There are three companies involved in natural products and biotechnology and one NGO that carries out research on traditional medicine. However,

³³ www.mediaucad.com/tessekere

³⁴ www.driihm.fr

³⁵ www.angmv.sn

³⁶ www.denv.gouv.sn

³⁷ www.coraf.org/documents/fiches_projets/MDF-Policy_Support_for_Sustainable_Use_and_Management_of_Non.pdf

³⁸ www.asnapp.org.za/

³⁹ www.aidgum.com

⁴⁰ www.phytotradeafrica.com

their R&D activities and the utilisation of GR is unclear. Hence, based on the information available, the breadth of the R&D taking place seems rather limited.

Multi-stakeholders partnerships in reforestation, biotechnology and agro-industry (e.g. GMV, Sodebio LNRPV) are also worth noting. This indicates a capacity for stakeholders to collaborate at the national and international level, which is a key success factor for the valorization of GR.

A few of the actors identified seem to contribute and/or support the valorization of BR and possibly GR. This includes collaborations with foreign development agencies for the promotion of exports, which could be further explored in relation to GR. There is also a project to conserve forest fruits, which could potentially contribute to the valorization of GR. However, as overall limited information was found, it is difficult to draw any conclusions regarding their potential effectiveness in promoting the valorization of GR in Senegal.

With respect to foreign actors, a few actors operating in Senegal are of potential interest, including one reforestation project, one NGO that promotes natural gums, one donor organisation and a multi-stakeholder initiative aiming to enhance growth of African indigenous plant products. However, no further information was found with respect to potential activities related to the utilisation of GR.

3. Biodiversity in the patent system for Senegal: overview of the economic potential of the species

The separate study 'Biodiversity in the patent system: Senegal' available at: http://www.abs-initiative.info/fileadmin/media/Knowledge_Center/Publications/Patent_Studies/Senegal_Country_Report_12072013_complete_SMALL.pdf. It presents the results of the analysis of patent activity for the country's GR and TK. Key insights are drawn from this study, related to the economic potential of species.

1.4 Species that are known to be distributed in Senegal and elsewhere

GBIF⁴¹ indicates 5 988 accepted species names for Senegal⁴². In total, 5 445 species names that are known to occur in Senegal were identified in the patent data from the major jurisdictions.

1.5 Species that were directly sourced from, or potentially originate from, Senegal based on distribution data.

In total, 18 species were identified that were directly sourced from or likely to originate from Senegal (amongst these, six were examined regard the status of their commercialization or R&D). They are mostly plantae with markets in a wide range of sectors, as two major commodities are included. The main technology areas are biocides, organic chemistry and heterocyclic compounds. Some species are the focus of activity for a range of different products, technology and markets.

⁴¹ The Global Biodiversity Information Facility (GBIF) is an international open data infrastructure, funded by governments. It allows anyone to access data about all types of life on Earth, shared across national boundaries via the Internet.

⁴² In total 6,327 species names were listed in GBIF for Senegal linked to 5,988 accepted species names.

The claims in the patent documents refer to compositions (e.g. extracts, compounds or combination of ingredients), methods (of producing a plant, a compound or desired outcome), and processes (for producing a desired product). In practice close attention is required to both the type and the content of patent claims as well as where and whether the patent is in force. The analysis based on patent citations, revealed three species where there is indication of further economic potential. The analysis of the patent family allowed the identification of two species of potentially high business importance to the applicants; where further R&D partnership could be explored.

4. Links between patent documents, value chains and markets

Out of the 18 species identified, six species were selected to illustrate different types of commercialization and to further explore the economic potential of the species. In some cases this analysis uncovered additional information on the current R&D and commercial developments that can be of interest for future exploration of the economic potential of the species or the specific GR. The table in annex four presents the patent documents with all the information identified on the status of the R&D and linkages with value chains and markets. Based on this data, a summary table of the patent documents examined is presented below.

Finally, the existence of TK related to the species was also reported. This information was either obtained from the patent document or incidentally found during the internet search. It is important to note that the information is only about the existence of TK on the species and it is not specifically related to the innovation.

1.6 Methodology

An internet search was conducted in order to link patent documents to value chains and markets. This consisted of the following steps:

- The analysis of the country' biodiversity in the global patent systems provides a list of patent documents of potential economic interest as they directly relate to Senegal (see separate study 'Biodiversity in the patent system: Senegal')
- From this list, six species, found in over 1 000 patent documents⁴³, were selected using the following criteria:
 - o The species that were most referred to in the patent documents, or that had a high number of patent citations⁴⁴ or large patent families⁴⁵ were analyzed in priority
 - o When there were too many patent documents to examine for a same species, either a focus was given to those held by the patent assignees that hold the majority of them or in some complex cases a random selection was realized
- Finally, 11 patent documents (spanning across the six species) were selected
- Each patent document was then analysed in two phases:

⁴³ The main reason explaining this high number is the presence of 2 renowned commodities (*Acacia Senegal*, *Cordylobia anthropophaga*) that have respective, 429 and 598 patent documents.

⁴⁴ The more often that a patent is cited by later patents is a measure of importance and impact of that patent within the patent system.

⁴⁵ A patent family is a set of patents that links back to an original parent filing.

- First, in order to understand what the innovation is about, a thorough understanding of the patent document was necessary. For this purpose the analysis focussed on some sections of the patent document: title, abstract, main claims and prior art.
- Secondly, an internet search was conducted in order to identify the status of the R&D and the presence of the GR in a value chain or on a market. For this purpose, specific key words were used (e.g. the species name, the patent assignee, the inventor, the innovation patented and the targeted market)
- When no product, service, or ongoing R&D could be found a second search was done by visiting the patent assignee's website to identify potential R&D hints
- Finally, the following classification, with a basic Yes / No / Unclear categorization, was devised to indicate the degree of linkages with a value chain or a market :
 - Evidence that a product or service is marketed or under active R&D (code : yes)
 - Presumption that a product or a service is marketed or under active R&D but there is no clear evidence (code : unclear)
 - No information could be found about a product, a service or active R&D (code : no)

One limitation of this approach is that it mostly allows to access information regarding marketing activities in the 'business to consumer' segment, as information is often publicly and readily available. Other types of commercialization protected through licenses and trade secrets for example in the 'business to business' segment are difficult to capture because they are seldom publicly available. Furthermore, in many cases it was difficult to confirm the presence of a species in a product due to corporate marketing practices that rarely disclose such information (e.g. rebranding of species active molecule, trademarks). Also, in some jurisdictions companies are not legally required to disclose the product's list of ingredients.

1.7 Main results of the analysis linking patent documents to value chains and markets

The six species (examined across the 11 patent documents) are the focus of development of products in a wide range of sectors.

For *Acacia senegal* one patent document was linked to a market with a final product (composition of a cosmetic product for eye lashes⁴⁶). However, it should be noted that it is a major commodity distributed across the region. With 429 patent documents owned by large corporations (e.g. Coca Cola, Danisco, Danone) and by universities (e.g. Ohio, Auburn) this example of commercialization is not representative⁴⁷.

With respect to three other species, the links between the patent documents with a market or value chain were unclear:

- *Balanites aegyptiaca* (two patent documents): It is widely used in industries (e.g. food, pharmaceutical, bio-energy, cosmetics) as saponin nanovesicles to encapsulate molecules (e.g. vitamins, pesticides, nutrient, minerals). Due to lack of disclosure of the products ingredients

⁴⁶ www.lorealparisusa.com/en/products/makeup/eyes/mascara-primer/voluminous-million-lashes-excess.aspx#ingredients

⁴⁷ In many cases, for industries, the patent documents seek to protect methods or compounds useful in areas such as human treatments, prosthesis, compositions of cosmetics or food products. For universities, the patent documents seek to protect methods of molecular biology to synthesize genes for production of gum peptides.

or limited information in the business to business segment, there is no clear link between the patent documents and market or value chains.

- *Desulfohalobium retbaense* (four patent documents): In one case, there is indication that the patent assignee uses the process subject to the patent document but it is unclear if the species is used as it is not disclosed⁴⁸. In another case, information could not be found to confirm that it is used. For the two remaining cases, the analysis could not be carried out as the company website was out of order when doing this research⁴⁹.
- *Holarrhena floribunda* (one patent document): The patent assignee may use this species in its cosmetic products but it does not appear in the list of the ingredients. It is possible that only the active compound is disclosed⁵⁰.

For the remaining two patent documents for *Aframomum melegueta* and *Cordylobia anthropophaga* no link between the patent documents with a value chain or a market could be identified. It should be noted that there is a total of 598 patent documents for *Cordylobia anthropophaga*. It is the target for pesticide compositions⁵¹.

It is also interesting to note that for six patent documents there is TK related to the species: *Acacia Senegal*, *Aframomum melegueta*, *Balanites aegyptiaca*, and *Holarrhena floribunda*. However, the link between the TK and the inventions disclosed in the patent documents was not examined.

⁴⁸ <http://en.paques.nl/products/featured/thiopaq>

⁴⁹ www.lucatechnologies.com

⁵⁰ www.skinmedica.com/skin-care-products/lytera-skin-brightening-complex

⁵¹ Generally, patent documents mostly relate to chemicals industries (BASF, Bayer CropScience, Merck, Bio Gene Technologies) or universities. When they are related to industries, they are about chemical and salt compounds useful for animal and pest control in agriculture. For the patent document examined a product is marketed by a patent assignee for combating *Cordylobia anthropophaga*⁵¹. When it comes from universities, they are about methods to identify candidate molecules that mimic insecticidal toxins.

Species Senegal	Spatial origin of the species ⁵²	Methodology to analyse the patent document	Kingdom	Status of commercialisation or R&D	Sector	Traditional knowledge
<i>Acacia senegal</i>	Distributed in other countries	There are 429 patent documents. An overview of the market utilisation is indicated and two specific patent documents were examined for one patent assignee.	plantae	Yes	Wide use in the private sector (e.g. pharmaceutical, cosmetics and food) and in basic research (e.g. methods to synthesize genes for production of gum peptides).	Yes
			plantae	Yes (two patent documents)	Cosmetics	
<i>Aframomum melegueta</i>	Senegalese origin	There is one patent document.	plantae	No	Pharmaceutical	Yes
<i>Balanites aegyptiaca</i>	Senegalese origin	There are two patent documents. Both were examined.	plantae	Unclear	Wide use in Industries (e.g. food, pharmaceutical, energy) as saponin nanovesicles to encapsulate molecules.	Yes
				No (one patent document)	Pesticide	
<i>Desulfohalobium retbaense</i>	c	There are four patent documents. They were all examined.	bacteria	Unclear (two patent documents)	Environmental management (depollution).	No
				No (two patent documents)		
<i>Holarrhena floribunda</i>	Distributed in other countries	There is one patent document.	plantae	Unclear	Pharmaceutical	Yes

Table 1: status of commercialisation and R&D of species related to the patent documents

1.8 Key findings

Considering the small number of species analyzed, only preliminary conclusions can be drawn. Generally, these cases confirm that R&D is currently taking place on species found in Senegal and that in some cases the patent documents can be linked to concrete products on the markets.

The six species are mostly plantae with some bacteria and animalia. The species are used in the 'business to consumer' segment (e.g. cosmetics) and in the business to business segment (depollution). All the patent holders are foreign companies. There is no information available on their potential

⁵² This column indicate if the patent document directly refer to the species as originating from the country (Senegalese origin) or if distribution data suggest that the species is distributed in other countries (Distributed in other countries).

partner or provider in Senegal. There are three species, which are major commodities with a wide distribution, for which R&D is carried out in a wide range of sectors and areas. As a small sample of patent documents were analysed it is not possible to draw meaningful conclusions. For the other species, unclear or no links with markets or value chains could be identified.

Conclusion and recommendation

This assessment shows that there is ongoing R&D on the country’s biodiversity and that GR are of value for public and private actors doing R&D across different sectors. There are therefore potential economic opportunities to further valorize Senegalese GR.

Concretely, for three commodities the analysis of the patent documents – enabled the identification of links with value chains, markets or on-going R&D. For the other patent documents examined focusing on Senegalese species - where there is utilization of GR - to identify links with value chains or markets, no or unclear links could be identified.

The analysis of actors provides a clearer picture of the institutions related to biodiversity conservation and to the valorisation of BR and GR. There are a few initiatives, with foreign partners, with potential to valorize the GR. However, due to the limited information available, it is not possible to determine with certainty: a) which Senegalese actors are clearly using to GR and b) which actors provided the genetic material used for the R&D related to the patent documents. Hence, based on the information available, it is impossible to establish a link between identified users and potential providers. This could be further researched in next steps.

The table two below presents the country’s strengths and weaknesses with regard to R&D on GR and their economic valorization. The strengths relate to features that were identified in this project. The weaknesses relate to characteristics that are clearly missing.

Strengths	Weaknesses
<ul style="list-style-type: none"> - A national biodiversity strategy with a valorisation component - A core set of public actors doing R&D and a few companies related to natural products and biotechnology, as well as an NGO active on traditional medicine - A leading research actors which houses a major regional botanical garden and carries out ethno-botanic research. - Capacity from stakeholders to collaborate at the national and international level, which is a positive key success factor for the valorization of GR 	<ul style="list-style-type: none"> - Limited support to the business environment for the valorization of GR - Few corporate actors, NGOs or civil society organisations - The absence of a national ABS framework

Table 2: Strengths, weaknesses for R&D and to valorize GR under the ABS framework

Overall, there is a leading regional actor (IFAN) and R&D is taking place in a small number of public research institutions. The capacity to transit towards the development phases seems rather limited, especially in consideration of the limited support environment. The minimum set up required for the effective and efficient valorization of GR appears rather limited. In light of the information available, it is impossible to come to any definite conclusions.

Furthermore, insufficient information was available regarding a number of key elements for a strategic valorization of GR. They could be further explored as next steps in order to further inform the analysis of the strengths and weaknesses. These are:

- The evaluation of the success and challenges of the biodiversity strategy
- Valorization of TK
- Capacity of key R&D actors to transit from the research to the development phases (e.g. stable production for industrial phase)
- Level of scientific expertise of Senegalese scientist to meet users R&D needs.

This set up nevertheless does offer a range of opportunities for Senegal to valorize its GR for bio-prospecting and R&D. The opportunities are classified in two sub-categories

General opportunities:

- Further economic opportunities may be identified for the two major commodities produced in Senegal (*Acacia Senegal*, *Cordylobia anthropophaga*) as they are subject to ongoing research
- 12 species identified in the patent documents study were not covered in this country assessment. A similar exploration to the one carried here on the links with value chains and markets could uncover other economic opportunities.
- Furthermore, the confirmation of the link between the innovation in the patent documents and TK could lead to further valorization opportunities.

Species and sectors specific opportunities: These opportunities are related to the analysis of the demand identified in the sectoral analysis on users R&D needs in the pharmaceuticals, biotechnology, cosmetics and functional food.

- The exploration of the outcome of the research congress on ‘vegetal biodiversity and therapeutic resources in Sahel’ organized by UCAD may open new valorization opportunities or partnerships.
- There are biotechnology opportunities related to **Grande Muraille Verte**⁵³. This project is of relevance to the valorization of GR because the identification of species traits that are adapted to climate change is currently a business opportunity in the biotechnology sector.

⁵³ www.mediaucad.com/tessekere

Overall, this raises two key questions for the public policy on ABS and the economic valorization of GR. First, in practice, how to close the gap in order to take advantage of economic valorization opportunities related to GR. Second, what are the policy needs to create a favourable institutional and business environment in order to facilitate access to GR and share in fair and equitable manner the benefits arising from their utilization? For this purpose, general recommendations are presented in the synthesis “Economic potential and valorization opportunities for genetic resources in six African countries” for the six countries. However, for Senegal a range of specific recommendations are put forward:

- **Clarify the needs of actors in Senegal and constraints to valorize GR: Gain a wider understanding of the links between patent documents, value chains and markets** by further exploring the patent documents related to the three commodities.
- **Clarify users R&D requirements and how GR and TK are utilized by different users.** These elements are further presented in the main report and the 4 sector reports of this project. Some initial steps could include to **clarify the users needs and expectations’ that positively qualify a Senegalese R&D actor** to enter in an R&D process. For instance, in existing cases, understand how the GR were accessed, who were the key actors and what specificities did they bring to the R&D process. Build on the trust established with some private partners under the existing R&D initiatives to improve the understanding of user challenges.

In light of the recommendations above and in the synthesis, policy makers may wish to consider the usefulness of developing a valorization strategy. This would take advantage of the economic, environmental and social opportunities related to the utilization of GR, while taking into account the existing gaps between users and providers in innovation and R&D processes.

Bibliography

GUEYE Mathieu, DIOP Seydina, KOMA Souleye, DIOP Doudou, CHEVILLOTTE Hervé et FLORENCE Jacques. HERBARIUM COMPUTERIZATION AND ETHNOBOTANICAL SURVEY: THE CASE OF FAPOCYNACEAE IN IFAN HERBARIUM, SENEGAL. Ann. Univ. Lomé (Togo), 2009, série Sciences, Tome XVII : 59-7

www.sud-expert-plantes.ird.fr/writable/versions/sep/projets/dossier_204-upload-204_Information_Herbiers_et_Etudes_Ethnobotaniques.pdf?1385983875

Oldham P, et al. 2013. Biodiversity in the patent system: Senegal

Annex 1: Key words used to identify actors relevant to R&D on GR

Note: traditional knowledge was not in the scope of this institutional analysis.

- a. Generic websites
 - For all countries : World Bank : strategy for developing agriculture in the country, focusafrica.gov.in,
 - For English speaking countries : www.commonwealthofnations.org
- b. Generic key words for key stakeholders
 - Chamber of commerce
 - Trade associations and business federation
 - University
 - Herbarium
 - Museum
 - Laboratory
 - Research institutes
 - Botanical gardens
- c. Specific actors (mostly international actors likely to do R&D and use GR from the country)
 - Research (CIRAD, CIFOR, Kew, IRD (Sud Expert Plantes), CBI)
 - Development (FAO, ITCSD, UNDP)
 - Development agencies (AFD, GIZ, USAID)
- d. Types of genetic resource: forest, marine, animal, agricultural, plantae, microbe, microorganisms, bacteria, fungi
- e. Sectors and R&D⁵⁴:
 - Pharmaceutical
 - Biotechnology
 - Horticulture
 - Food : crop improvement, breeding, pest protection, stress resistance
 - Health food : nutraceutical, agro-biodiversity, plant for food and alimentations
 - Cosmetics: Oils, fats and waxes, gums, extracts and saps, colorants, formulation, anti-oxidant
- f. R&D activities, processes and technologies: bioprospection, raw material, sample, valorisation, extraction, metabolic processes, molecular technique, nanotechnology, liquid chromatography devices, nuclear magnetic resonance, spectrometers.

⁵⁴ A focus was done on the health food and cosmetics sectors as they are thought to be the easiest targets for providers of GR to engage with in R&D processes.

Annex 2: List of all the actors found in the scope of the assessment related to R&D and the economic valorisation of biodiversity, biological and genetic resources.

[Click here to view annex 2.](#)

Annex 3: List of the most relevant actors found in the scope of the assessment related to R&D and the economic valorisation of biodiversity, biological and genetic resources

[Click here to view annex 3.](#)

Annex 4: List of the patent documents examined for linking species with markets and value chains

[Click here to view annex 4.](#)