

## 2030 – Making the Great Green Wall in the Sahel a success; *scientific research in action*

*The first progress report on the impact of the Great Green Wall (GGW) initiative in the Sahel (September 2021) highlighted the urgency of coordinated actions involving all stakeholders if the ambitions announced in 2007 were to be achieved. Today, these actions have fallen short. To support the Pan Africa Agency of the Great Green Wall, the GGW Accelerator was created in 2021<sup>1</sup> to ensure more coordinated support to the member states, organisations and institutions of the GGW through a multi-player, structured, five-pillar approach<sup>2</sup>.*

*This article highlights the importance of co-constructing more accurate knowledge and developing processes to further GGW projects, in the light of these aims. It provides various examples of projects demonstrating the role of scientific research in implementing and achieving the goals of the GGW.*

### STABILITY AND SECURITY IN THE SAHEL

In the central Sahel, the GGW passes through areas that are prey to growing insecurity issues. A combination of causes is making room for armed groups and closing the area off from the State. Most of the factors underlying destabilisation and insecurity in the Sahel are structural: i) fragile States perceived as unroyal, distant, unjust, unequal and unprotective; ii) access to natural resources hindered by rising needs due to population growth and climate change; iii) a sense of exclusion as regards social categories («social non-firstborns», particularly young people and pastoral societies), and the spread of rigid religious movements.

Research can shed light on these changing contexts, and ensure that development donors' projects and humanitarian actions i) are based on the capitalisation of existing knowledge gleaned from local experience and various development or research initiatives, which need keeping up to date, ii) prioritise the views of those benefiting from interventions rather than transposing imported solutions, iii) factor in micro-local contexts, which are extremely variable, while simultaneously promoting a regional ambition that reflects the scale of the problems concerned.

These observations and proposals show how vital it is for the GGW to rely on research that has been carried out in its territories for years, and which explores the same situations (the sometimes conflicting management of resources, and populations' need for services to be rolled out efficiently).

1. <https://www.oneplanetsummit.fr/les-coalitions-82/accélérateur-de-la-grande-muraille-verte-193>

2.

Pillar 1: Investment in small and mid-sized farms and the strengthening of value chains, local markets, and the organization of exports

Pillar 2: Land restoration and the sustainable management of ecosystems

Pillar 3: Climate-resilient infrastructures and access to renewable energy

Pillar 4: An economic and institutional framework fostering effective governance, sustainability, stability and security

Pillar 5: Capacity building



## A PLATFORM FOR ANALYSIS, MONITORING AND LEARNING IN THE SAHEL

**Research in the PASAS (Sahel Analysis, Monitoring and Learning Platform) programme involves two levels: supervision and proposals.**

1/ it is essential to guard against concepts and terms that are endlessly repeated but never questioned (terrorists, jihadists, State fragility), which mingle variable realities and determinants, and to avoid soothing explanations that are not explanations (saying that the crisis is «multifactorial»);

2/ these prerequisites result from field surveys and data collection closely concerning populations, and lead to concrete proposals in terms of:

- **Education:** recognising that the emergency is not always linked with the security crisis but more broadly with structural problems, and that action should target the system (the quality of training for trainers);
- **Justice:** recognising that customary justice, while not applicable to all disputes, is an element of social cohesion that should be combined with formal justice;
- **Relations between communities:** recognising that the social bond has deteriorated and that though conflicts are not new, the way they are resolved has become increasingly violent;
- **Intra-community relations:** starting from the observation that we are seeing a social rebellion («social non-firstborns») and that in both cases new, practical systems are needed, combining dialogue and compensation for damage (the «culture of forgiveness» is no longer tenable or accepted);
- **The presence of the State:** moving towards alternative solutions to compensate for its absence in regions where it is not or is no longer established (via «mobile» or delegated services and the strengthening of decentralised authorities).

**More information:** <https://www.ird.fr/pasas-plateforme-danalyses-de-suivi-et-dapprentissage-au-sahel>



## SUSTAINABLE RURAL DEVELOPMENT AT THE HEART OF GGW PROJECTS

The Great Green Wall is designed as a series of actions whose primary objectives concern the rehabilitation of natural areas, particularly forest zones, as well as pastoral and farming areas with local development in view. These actions thus involve the different uses of resources by local populations. The contribution of GGW actions to local development and an improved quality of life is, if not a guarantee, a vehicle for the success of these actions and their appropriation by the inhabitants. The collective dimension at different scales is one of the features of this initiative.

However, any change in access to natural resources will have repercussions on local uses and may restrict the resources of certain social categories. At local level, contributing to rural sustainable development also means aiming to reduce social inequalities. Beyond the local constraints dictated by the natural environment, the use of rural and territorial development approaches based on the mobilisation of stakeholders and the qualification of a territory's resources must support the co-constructive aspect of GGW actions and inform decisions on the types and locations of interventions to be encouraged as a priority. These approaches ensure that the various local stakeholders are recognised and supported in their initiatives and the achievement of their projects. Inhabitants' participation, considered upstream through the expression of their projects and needs, the definition of project actions and their follow-up methods, and downstream through the monitoring and assessment of these actions, is a major vehicle for the appropriation of future GGW actions. Lastly, to achieve a sustainable impact, actions requiring support for land management and rehabilitation need to be based on local organisations. Beyond the issues of land development and restoration, the challenge more broadly involves strengthening the capacities of the local governance responsible for the land and territories concerned.

At regional level, the actions to be considered must lead to exchanges of knowledge between countries so that the GGW also becomes a regional instrument for enhancing and sharing knowledge in land rehabilitation and natural resource management. It is important to consider human capital, social capital and natural capital simultaneously. Finally, the inclusion of social, collective and economic aspects in GGW projects, designed to improve living conditions, can play a role in fostering social acceptability, particularly any actions that temporarily restrict local uses and the extraction of natural resources.

## The «Sahelian Forest and Landscape Restoration» project

Its aim is to promote the creation of communal funding platforms for forest restoration actions. This project combines natural resource management actions with income-generating activities targeting non-timber forest production, where the goal is to create micro-businesses. Scientific research is developing an innovative monitoring and assessment system based on measuring the effects of its actions on forest cover, carbon storage and biodiversity, as well as its socio-economic effects.

**More information:** [www.ffem.fr/fr/carte-des-projets/restaurer-les-forets-et-les-paysages-et-gerer-durablement-les-terres-au-sahel](http://www.ffem.fr/fr/carte-des-projets/restaurer-les-forets-et-les-paysages-et-gerer-durablement-les-terres-au-sahel)

## PREVENTING, REDUCING AND REVERSING LAND DEGRADATION

While it is accepted that the Great Green Wall programme cannot involve the establishment of continuous afforestation, the place of land restoration in this dynamic deserves to be thought out and defined. The quality and fertility of the land appear essential to meet major environmental and development challenges. According to the recommendations of the United Nations Convention to Combat Desertification (UNCCD), it is important to include restoration actions in the overall approach, i.e. prevent, reduce and reverse degradation, and integrate restorative actions as far as possible into a holistic and territorial approach to integrated land management.

Scientific knowledge shows the advantage of combining various restoration actions at territorial level. This involves not only the ecological restoration of natural ecosystems, with rewilding and dedicated protected areas with connectivity, but also the restoration of soils and plant cover and their productive capacities to meet the needs of populations and conserve environmental assets as far as possible. The rehabilitation of agrosystems and the agroecological intensification of farming are vital to increase productivity and avoid agriculture expanding into new areas. This restoration cannot involve the application of a simple corrective technique, however useful that might be. It consists of undertaking a progressive approach towards the kind of land development that increases both productivity and the other services linked with the proper functioning of ecosystems and their health. Implementation methods will be decisive, as most measures will only be effective if the land users play a central role in decision-making, and if their rights and aspirations are respected. Agroecology can then be a vehicle for this restoration while rural activity is maintained.



## AGROECOLOGY: A VEHICLE FOR TRANSFORMATION

In the Sahelian zones, agriculture faces multiple challenges: food and nutritional security for a growing population, climate change, land degradation and the maintenance of biodiversity. To achieve its objectives, the GGW initiative thus needs to promote an agricultural development that is compatible with all these issues, and attractive enough to get all the stakeholders in these regions on board. In this respect, agroecology represents a coherent alternative for achieving this. It proposes an intensified agricultural production based on improving the efficiency of ecological processes and the sustainability of the natural resources used (land, water, biodiversity, etc.). It relies on the diversification of plant species present in agro-ecosystems, and the respect of natural species that are important for their role in the ecosystem services provided. It advocates the integration of farming activities, particularly agriculture/livestock breeding interactions, at farm and/or territorial level. Lastly, it is based on a consultative process between all the stakeholders in the territory, in view of building sustainable development dynamics compatible with maintaining a shared capital, particularly natural resources, while building better-balanced and more favourable links with the markets. It thus offers the conditions for an agriculture compatible with preserving natural vegetation and its ecosystem, and even greening these rural areas.

### Research on building technical pathways for agroecological intensification and optimised ecological processes

- **The research project RAMSES II** (Roles of agroforestry in sustainable intensification of small farms and food security for societies in West Africa) aims to develop innovative management scenarios with local stakeholders for the sustainable intensification of agroforestry parks in West Africa, at plot or village territory level.
- **The FAIR Sahel project** (agroecological intensification for farm resilience in the Sahel) promotes participatory research on different scales to develop innovative agroecological systems with producers, and act on the sociotechnical conditions of change in connection with public policies, services and markets.
- **The AVACLIM project** (value agroecology for drylands) aims to produce a scientific framework for the multi-criteria assessment of agroecological initiatives, co-constructed with players in the field, so that the evaluation can guide operational action in the field.
- **The international joint laboratory IESOL** (ecological intensification of cultivated soils in West Africa) studies the biological functioning of soils, in view of designing sustainable strategies for intensified cropping systems in West Africa, based on ecological engineering approaches.

#### More information:

RAMSES II: <https://anr.fr/Projet-ANR-18-LEAP-0003>

FAIR: [www.fair-sahel.org/](http://www.fair-sahel.org/)

AVACLIM: <https://avaclim.org>

LMI IESOL: <https://sites.google.com/site/iesolafrica/home>



## PASTORALISM AND AGRO-PASTORALISM ESSENTIAL TO SAHELIAN SOCIO-ECOSYSTEMS

The rationale and assets of pastoral and agro-pastoral farming systems were long underestimated and their economic importance considered negligible, because illogical, limited to subsistence and archaic. But pastoral development theory and the understanding of pastoral and agro-pastoral ecosystems were radically transformed during the 1990s and 2000s, leading to a reassessment of their economic contribution. In most African countries with robust pastoral systems, this contribution represents a significant proportion of the gross domestic product and exceptionally high returns on investment.

Powerful advocacy by professional organisations at sub-regional level, based on extensive research, has helped to promote new national and regional policy commitments to pastoral development. This has resulted in various programmes, like the wide-ranging PRAPS (Regional Sahel Pastoralism Support) programme. This integrates activities involving pastoral and hydraulic resource management, pastoral economics and crisis resilience (PRAPS I 2015-2020 and PRAPS II 2021-2026, coordinated by the CILSS (Inter-State Committee for Drought Control in the Sahel), with funding from the World Bank<sup>1</sup>).

3. <http://praps.cilss.int>

### Ongoing crop-livestock farming research

Recent research on these livestock farming systems (see, for example, the PPZS (Pastoralism and Drylands in West Africa) partnership) confirms (i) the importance of the contribution of pastoralism to the redistribution of soil fertilisers within territories through their mobility; (ii) the importance of free-range livestock income for the budgets of pastoralist and agro-pastoralist households in Sahelian countries; (iii) the strong interactions between livestock activities and the sustainable management of wood populations in the Sahel; and (iv), the opportunities offered by well-managed Sahelian pastoral systems for producing goods and services in a climate change-neutral way. The regional project CaSSECS (carbon sequestration and greenhouse gas emissions in Silvopastoral Ecosystems in the Sahelian States), coordinated by ISRA (Senegalese institute of agricultural research) and funded by the EU (European Union), is currently working to produce solid scientific and technical references on this topic.

**More information:** [www.ppzs.org](http://www.ppzs.org) ; [www.cassecs.org](http://www.cassecs.org)

More recently, stakeholders in the sector initiated a space for exchanging experiences and various research studies on securing agro-pastoral land tenure and conflict prevention in West and Central Africa. This event, supported by regional institutions, States and the Technical Committee on Land Tenure and Development of the AFD (French Development Agency), resulted in a political declaration<sup>4</sup>. The GGW's action should be fully in line with this new regional framework integrating livestock farming into territorial management, to help define and implement proactive, consistent policies for the management of land and the pastoral natural resources essential to equitable, sustainable economic development, socio-ecological viability and peace.

4. Déclaration de N'Djaména : [www.foncier-ndjamena2021.org](http://www.foncier-ndjamena2021.org)

## WATER: AN ESSENTIAL BUT UNCERTAIN RESOURCE

For the rehabilitation of forest, pastoral and agricultural areas, the presence of sufficient quantities of high-quality water is essential. From Dakar to Djibouti, the GGW crosses the basins of the Senegal, Niger, Volta, Logone, Chari and Nile rivers, where large hydraulic works have been built for drinking water distribution, irrigation and energy production. However, they are still insufficient to ensure the rehabilitation of the soil and vegetation and the establishment of sustainable production systems. In addition, groundwater is often the only resource available in the huge arid or semi-arid areas of the Sahel.

It is thus vital to have in-depth knowledge of their potential and vulnerability before undertaking local or regional projects to develop this resource, and to call on the national services responsible for water resources, which need to work in close collaboration with the other sectoral services (agriculture and livestock farming) in an integrated approach to territorial development.

### In most cases, it will be necessary to:

- improve/strengthen existing hydraulic works (reservoirs, boreholes, cemented wells);
- identify the sites and facilities needed: (i) water collection facilities on the slopes to be reforested, (ii) small dams, excavation basins for irrigation and herd watering, (iii) village wells, boreholes for human consumption, pastoral hydraulics and small-scale irrigation;
- ensure the involvement of populations during the construction, and, importantly, the equitable, sustainable management and maintenance of the facilities;
- integrate biodiversity issues into all decisions concerning water management and collection.

Several countries concerned by the GGW have developed a national pastoral water strategy involving the ministries for water and livestock breeding and professional organisations (Niger, Mali, Burkina Faso and Chad; Mauritania has also initiated a similar process). The actions supported by the GGW should thus be part of these dynamics, which are essential for the more sustainable management of pastoral resources and the resilience of pastoral systems.



## A MORE ACCURATE DESCRIPTION AND UNDERSTANDING OF BIODIVERSITY FOR MORE EFFECTIVE ACTION

The biodiversity of arid and semi-arid environments, its functions and the services that humans derive from it are largely unknown. The GGW needs to be a major field of research, as its success depends on this knowledge. Four aspects of research emerge as priorities.

The first step is to describe biodiversity, its dynamics and the interactions between living species. Ambitious programmes designed to describe the biodiversity of soils and ecosystems in an integrated manner, using new environmental genomics tools and involving local research structures, will be needed to understand the interactions of the various components of this biodiversity more fully, and to take action on both its conservation and the services rendered by this biodiversity (see agroecology).

The second area of research involves ecosystem services, which need to be assessed more accurately because of their importance for these (semi) arid ecosystems: soil fertility, pollination, the regulation of water and air quality, the mitigation of extreme climatic events, carbon capture, the regulation of plant, animal and human pathogens, and the resource supply. The biodiversity of soils and the services they provide to humanity should be a particular focus as they often underpin the rest of the ecosystem (via water retention and plant health). More generally, restoration policies should factor in all the impacts on the living, functional and evolutionary aspects of biodiversity, including the ability of reintroduced species to adapt to their new environment. For example, recent work has shown significant changes that are complex to analyse (spatial heterogeneity, factors, impacts, functionalities, etc.) in wood populations in the northern Sahel, which play a major role not only in the functioning of ecosystems but also in food for livestock.

The Great Green Wall is in itself a nature-based solution that should be comparable to technological, engineering or intensive management solutions (e.g. implemented in intensive agriculture, or to mitigate climate change). Nature-based solutions propose a necessary holistic vision that integrates ecological (maintenance of ecological functions), economic and social benefits, such as the quality of life of local populations, and the medium-term resilience of the restored ecosystem in every respect – genetic, specific, functional, landscape-wise and social.

Lastly, it is vital to factor in the diversity of the territories and the knowledge and values of local populations if they are to adhere to programmes like the GGW. Research at the crossroads of ecology, sociology, law, economics and governance is essential to accurately pinpoint the brakes and levers for successful restoration actions in the long term.

These different aspects of research on biodiversity, which concern both its description and the understanding of its dynamics, the solutions it provides, the services it renders and the brakes and levers for its restoration, must be supported so that initiatives like the Great Green Wall benefit from the best available knowledge for implementation and success.



## QUANTIFYING THE ROLE OF THE GREAT GREEN WALL IN CLIMATE CHANGE MORE ACCURATELY

The Great Green Wall can be seen as a nature-based solution for mitigation and adaptation to combat the effects of global warming. Restoration activities within the GGW can have a mitigating effect on global warming by sequestering carbon in the above-ground biomass of trees and shrubs in natural, pastoral or cultivated areas, and in the soil. Restoring forest cover is also an adaptation strategy to a warmer climate, as trees reduce air temperature in summer through the sheltering effect of the forest canopy and tree transpiration in summer. Trees and shrubs absorb water from the soil, which rises to the leaves and evaporates into the atmosphere, helping to cool the ambient air. The protection and even regeneration of wood cover in pastoral and cultivated areas through agro-sylvopastoralism is thus fundamental.

However, once the GGW is fully implemented, its benefits in the fight against global warming are still very uncertain, and even controversial. To date, there is very little information on biomass, soils and carbon in the Sahel to assess the impacts of the Great Green Wall on carbon sequestration. In addition, the positive effect on climate change mitigation assumes that carbon sinks persist for a long time – but the integrity of these carbon sinks may be threatened by a climate that has become too unfavourable, by atmospheric CO<sub>2</sub> levels that have become too high and reduce the efficiency of CO<sub>2</sub> absorption by the plant cover, or by anthropogenic deforestation actions that release carbon into the atmosphere. Furthermore, the effects that large-scale greening could have on local, regional and global climate are still inadequately studied. Partial results of climate modelling do not show only potentially positive effects of the Great Green Wall on the climate: quite the reverse. On a local scale, more vegetation would increase the water content of the atmosphere and intensify rainfall events, which are already a major problem caused by global warming. On a regional scale, large-scale reforestation could drastically modify not only the African monsoon circulation but also the global climate, by disrupting many factors underlying thermal gradients between the continent and the ocean (less dust in the atmosphere, more incident solar radiation, more atmospheric humidity, lower albedo in vegetated areas, and so on).

Further research is needed to more fully assess and quantify the effects of GGW projects, based on improved biodiversity management in agro-ecosystems, and on their capacity to adapt and mitigate climate change.

## NETWORKED INTERDISCIPLINARY SCIENTIFIC RESEARCH

The Great Green Wall has an important role to play in improving human capital. It is an opportunity to improve scientific knowledge. As the land concerned may be forested, pastoral or cultivated, possible rehabilitation techniques are highly varied. Their success depends on several factors that can be usefully documented by research. The core contribution of scientific research involves not only bringing new knowledge to light, but also assessing the performances and impact of land rehabilitation actions. These performances are multidimensional, multi-scalar and contextual. They concern the human and natural environment, and involve different scales of analysis. One key aim is to be able to reconstruct and analyse the changes occurring on a regional scale, particularly at the environmental level, but also in social, economic and political terms. Furthermore, scientific research can support GGW projects, upstream and during their implementation, by working on identifying and improving knowledge on rehabilitation techniques based on the local knowledge of the beneficiary stakeholders, and previous experience. Through participatory approaches, it can i) assist local players in the design and adaptation of innovative agricultural production systems compatible with this restoration, ii) document the constraints to dissemination, and the local conditions for these systems to be adopted by rural societies. To meet these ambitions and thus make the GGW a success in 2030, the region's researchers, cooperating at regional and international level, represent an essential force. In Ferlo, in Senegal, the international Tessekere Human-Environment Observatory (<https://ohmi-tessekere.in2p3.fr>) illustrates the cooperation between researchers and stakeholders in the field.

A “scientific reflex” needs to be established among the promoters and pilots of the GGW. To support the efforts of local scientists, international cooperative research also needs to provide the means to strengthen their capacities. The creation of a regional scientific network and the introduction of mobility and study scholarships for young researchers from the region would contribute to both capacity building and scientific support in GGW projects.



## SCIENTIFIC PUBLICATIONS

Assouma M.H., Hiernaux P., Lecomte P., Ickowicz A., Bernoux M., Vayssières J., (2019). Contrasted seasonal balances in a Sahelian pastoral ecosystem result in a neutral annual carbon balance. *Journal of Arid Environments*, 162:62-73. <https://doi.org/10.1016/j.jaridenv.2018.11.013>

Côte, F. X., Poirier-Magona, E., Perret, S., Roudier, P., Rapidel, B., & Thirion, M. C. (2019). *La transition agro-écologique des agricultures du Sud* (p. 368). éditions Quae.

Dendoncker M., Brandt M., Rasmussen K., Taugourdeau S., Fensholt R., Tucker C.J., Vincke C. (2020). 50 years of woody vegetation changes in the Ferlo (Senegal) assessed by high-resolution imagery and field surveys. *Regional environmental change*, 20 :1-13.

Droy I., Amsallem I., Bonnassieux A., Bonnet B., Cabri C., Coronel C., Derkimba A., Hofmann E., Khadraoui H., Lambert A., Loireau M., Requier-Desjardins M., Treboux M. (2019). *Questions de genre en zones sèches : les femmes, actrices de la lutte contre la désertification*. Montpellier (France) : CSFD. Comité Scientifique Français de la Désertification. 54 p. (Dossiers Thématiques, n. 13).

Grémont C., (2021) « Sociétés pastorales et État au Mali : histoire d'un hiatus », *Politique étrangère*, 4, pp. 145-159. <https://www.cairn.info/revue-politique-etrangere-2021-4-page-145.htm>

Guiryman O. (Coord), Codjo C, Ouedraogo, Traoré K, El-ALby M, Kirchner M, Sawadogo AS, Sadio Ndiaye AB et Assemal D Madji-Yabe, (2021), Éducation en situation d'urgence, de crises et de vulnérabilités au Sahel : quels mécanismes d'adaptation de l'aide au développement Plateforme d'Analyse du Suivi et d'Apprentissage au Sahel, Production Pasas <https://pasas-minka.fr/fr/resources/download/333>

Hagberg S. (coord), Koné YF, Kibora L, Hamani O, Kansaye I, Koné B, Arou O, Barry S, Kaboré A, Konkobo A, Hassane R, Mohamed M, Abdouramane O, Weber J et Nikiéma A, (2022) Liens sociaux et crises sécuritaires : Étude anthropologique des populations et des contextes socio-politiques et culturels du Liptako Gourma, Plateforme d'Analyse du Suivi et d'Apprentissage au Sahel, Production Pasas. <https://pasas-minka.fr/fr/resources/download/282>

Loireau M. & Ben Khadra N. (Rédacteurs en chef invités), (2017). *Désertification et système terre : de la (re)*

*connaissance à l'action*. Liaison Énergie Francophonie, 2017, 105. Editions IFDD (Directeur de la publication: J-P Ndoutou), OSS, IRD : 138 p. ISSN 0840-7827 : <http://www.documentation.ird.fr/hor/fdi:010070726> ; <https://www.resad-sahel.org/Actualites/En-amont-de-la-COP-13-un-point-sur-la-desertification>

Scoones I. (1999). *Nouvelles orientations du développement pastoral en Afrique*. CTA Wageningen-Karthala Paris, 351p.

Traore S.A.A., Requier-Desjardins M. (2019). *Étude sur l'économie de la dégradation des terres au Burkina Faso*. 84 p. Rapport pour le Projet « Réhabilitation et protection des sols dégradés et renforcement des instances foncières locales dans les zones rurales du Burkina Faso » de l'Initiative « Un seul Monde sans Faim » (SEWoH), mis en oeuvre par la Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

Wane A., Cesaro J.D., Duteurtre G., Touré I., Ndiaye A., Alary V., Juanès X., Ickowicz A., Ferrari S., Velasco G., (2020). The economics of pastoralism in Argentina, Chad and Mongolia. Market participation and multiple livelihood strategies in a shock-prone environment, *FAO Animal Production and Health Paper*, 182. <https://doi.org/10.4060/cb1271en>

## BOOK

Dia A., Duponnois R. (ed.) (2012). *La Grande Muraille Verte : capitalisation des recherches et valorisation des savoirs locaux*. Marseille : IRD, p. 321-349. (Synthèses). ISBN 978-2-7099-1738-4.

## CSFD THEMATIC REPORTS

L'ingénierie écologique pour une agriculture durable dans les zones arides et semi-arides d'Afrique de l'Ouest. <http://www.csf-desertification.org/dossier/item/l-ingenierie-ecologique-pour-une-agriculture-durable-dans-les-zones-arides-et-semi-arides-d-afrique-de-l-ouest>

Ressources en eau profonde du désert du Sahara et de ses confins arides et semi-arides <http://www.csf-desertification.org/dossier/item/ressources-en-eau-du-desert-du-sahara-et-ses-confins-arides-semi-arides>

Pastoralisme en zone sèche. Le cas de l'Afrique subsaharienne : <http://www.csf-desertification.org/dossier/item/dossier-pastoralisme-en-zone-seche>

## CSFD BRIEFS

Le projet africain de Grande Muraille Verte. Quels

conseils les scientifiques peuvent-ils apporter ? <http://www.csf-desertification.org/combattre-la-desertification/item/fiche-le-projet-de-grande-muraille-verte>

## AGROPOLIS INTERNATIONAL THEMATIC REPORT

Transformations agroécologiques pour des systèmes alimentaires durables - Panorama de la recherche France-CGIAR : <https://www.agropolis.fr/publications/agroecologie-dossier-thematique-agropolis-international.php>

## WEB SITES

Agence Panafricaine de la Grande Muraille Verte : <http://grandemurailleverte.org/>

Déclaration de N'Djamena sur la sécurisation du foncier agro-pastoral : <https://www.inter-reseaux.org/ressource/declaration-de-ndjamena-sur-la-securisation-du-foncier-agro-pastoral>

Initiative Grande Muraille Verte, CNUCLD : <https://www.unccd.int/our-work/ggwi>

Laboratoire Mixte International IESOL : <https://sites.google.com/site/iesolafrika/home>

Observatoire Hommes-Milieus International Tessékéré <https://ohmi-tessekere.in2p3.fr>

Plateforme d'analyse, de suivi et d'apprentissage au Sahel : <https://www.ird.fr/pasas-plateforme-danalyses-de-suivi-et-dapprentissage-au-sahel>

Pôle Pastoralisme et Zones Sèches (PPZS) : <https://www.ppsz.org>

Projet « Roles of agroforestry in sustainable intensification of small farms and food security for societies in West Africa » : <https://anr.fr/Projet-ANR-18-LEAP-0003-FAIR> : [www.fair-sahel.org/](http://www.fair-sahel.org/)

Projet « Élevage Sahélien et bilan Carbone (CaSSECS) : [www.cassecs.org](http://www.cassecs.org)

Projet « Intensification agroécologique pour la résilience des exploitations au Sahel » ; <https://www.fair-sahel.org>

Projet « Restauration des forêts et des paysages sahéliens : [www.ffem.fr/fr/carte-des-projets/restaurant-les-forets-et-les-paysages-et-gerer-durablement-les-terres-au-sahel](http://www.ffem.fr/fr/carte-des-projets/restaurant-les-forets-et-les-paysages-et-gerer-durablement-les-terres-au-sahel)

Projet « Value Agroecology for Drylands » AVACLIM : <https://avaclim.org>

## Publication Director

Jean-Luc Chotte, Chairman of the CSFD (French scientific committee on desertification)

## Scientific Coordination

Jean-Luc Chotte

## Authors

Albergel J. (MESRI (Ministry of Higher Education, Research and Innovation)/IRD: Institute of Research for Development), Bonnet B. (IRAM: Institute of Research and Applications of Development Methods), Chotte J.-L. (IRD), Cornet A. (CSFD: French scientific committee on desertification), Heulin T. (CNRS: National Centre for Scientific Research), Hiernaux P. (Pastoralism consultancy), Ickowicz A. (CIRAD: Centre for International Cooperation in Agronomic Research); Loireau M. (IRD); Requier-Desjardins Mélanie (IAMM: Mediterranean Agronomic Institute of Montpellier), Scopel E. (CIRAD), Sultan B. (IRD), Thibon M. UNCCD: United Nations Convention to Combat Desertification ) Travi Y. (University of Avignon). With contributions from Hélène Soubelet (FRB: Foundation for Research on Biodiversity,) and Laurent Vidal (IRD).

## Proofreading

Isabelle Amsallem (Agropolis Productions)

## Layout

Frédéric Pruneau Production

## Photo credits

- P.1: *Faidherbia albida* park in the Serer region, Senegal. © C. Clermont-Dauphin
- P. 2: Transplanting shea wildlings in a field using an extractor, Gonsé, Burkina Faso. ©J. Seghier
- P. 3: Agricultural work in a field in Senegal. ©Tiphaine Chevallier, IRD
- P. 4: Agroecology in Senegal. ©Tiphaine Chevallier, IRD
- P. 5: A cowherd and two young Fulanis tending a small herd of cows, Bororo, Komakokou (Niger). ©P. Hiernaux
- P. 6: Ground nut seeds, Éthiolo, Senegal. © V. Labeyrie, CIRAD
- P. 6: Women farmers in a cashew orchard, Burkina Faso. © A. A. Lourme-Ruiz
- P. 7: Training a group of Fulani women in yoghurt production, Koumbia, Burkina Faso. © E. Vall

## Printing

LPJ Hippocampe (Montpellier, France)

## ISSN

2550-8857 (print version) and 2551-3079 (online)  
Legal deposit on publication  
© CSFD/May 2022

## Contact us

CSFD  
Comité Scientifique Français de la Désertification  
Agropolis International  
1000 Avenue Agropolis  
F-34394 Montpellier CEDEX 5  
France  
Tel. + 33 (0)4 67 04 75 75  
Fax + 33 (0)4 67 04 75 99  
[csfd@agropolis.fr](mailto:csfd@agropolis.fr)  
[www.csf-desertification.org](http://www.csf-desertification.org)

