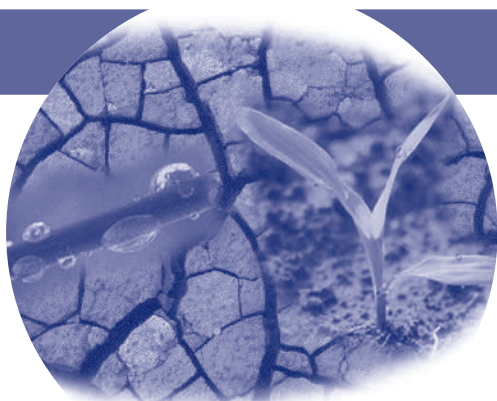


# CERAAS: A regional tool of WECARD/CORAF for co-operation



## Presentation

### History

CERAAS came about as a result of the commitment of ISRA, the research institutes of member countries, their bilateral partners and finally the NARS, of WECARD/CORAF, to respond to the challenges of improving agricultural production under drought conditions. It started in 1982 with the decision made by ISRA and its partners, CIRAD and the universities of Paris 7 and 12, to develop a new scientific approach for improving and/or stabilising peanut production in the North and Central zones of Senegal. A multidisciplinary research team was then constituted in 1983 at CNRA, Bambey, to achieve this objective (Figure 1). The first tangible results were quickly obtained.

Based on this, in 1987, the research institutes of member countries of WECARD/CORAF in agreement with ISRA, mandated this team to extend its expertise to other research teams in the sub region working on the same problem. ISRA, CORAF and its member institutions then started to develop the CERAAS concept which was geared towards achieving this objective. It involved consolidating the expertise of the existing team and building the capacity of research teams in the sub region by putting at their disposal an efficient scientific tool, which no other institution in the South, on its own, had the financial means and human resources to do. With the help of this new institution, the sub regional teams should be able to integrate the knowledge, methods and techniques

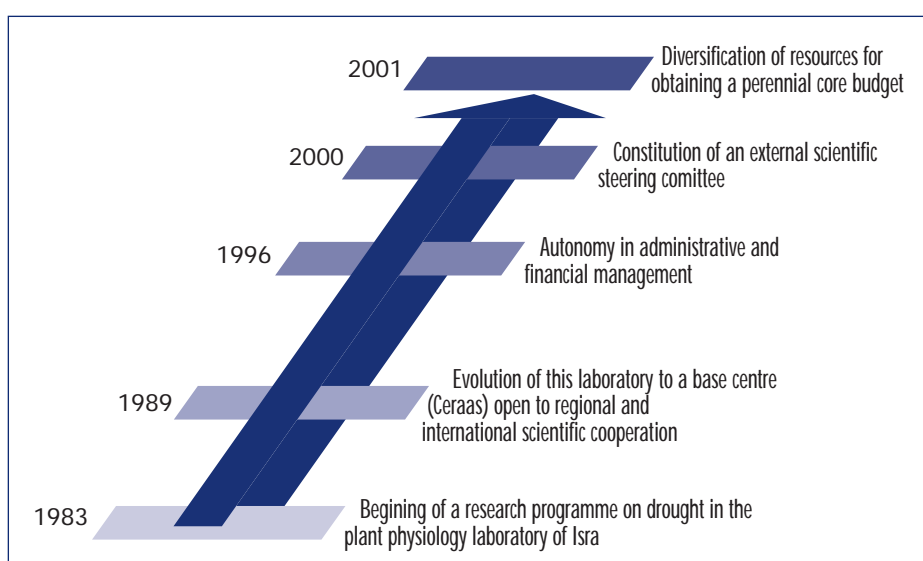


Figure 1. Evolution of CERAAS.

necessary to conduct their own breeding for drought adaptation and extension programmes. This institution should be capable of conducting innovative as well as adaptive research on different cultivated species in the sub region. This concept was fixed in 1988, and CERAAS was officially created in 1989, as a national laboratory with a regional vocation, specialised on plant adaptation to drought research, for research teams in the WECARD/CORAF zone.

The partnership that developed with the institutions in the north was based on quality and equality, and resulted in the accelerated transfer of knowledge, the mastering of methods and techniques in the area of drought. This helped to bridge the existing gap between research teams in the North and South. It also led to the creation by research teams in the sub region, of plant varie-

ties adapted to drought and decision-making tools, for the benefit of their agriculture.

The development of CERAAS as a pilot institution, or more precisely as a test-laboratory for new partnership modes between Senegalese stakeholders, WECARD/CORAF and their partners in the North, continued to progress. In 1996, ISRA and WECARD/CORAF decided to consolidate the regional position of CERAAS. The NARS in the region strengthened their contribution to the partnership by accepting, for example, to define and experiment new forms of mobility and exchange programmes of local experts. In 1997, three main stakeholders of the Senegalese NARS, ISRA, ENSA and UCAD, decided to invest in CERAAS and its expertise by creating a training programme open to the sub region and leading to the award of diplomas in

plant adaptation to drought. In order to integrate this new dimension, the new infrastructure of CERAAS was implanted within the campus of ENSA at Thiès in 1997.

CERAAS thus constitutes a model of the new research tools of NARS and WECARD/CORAF, capable of responding to the challenges of local development, of strengthening the capacity of the South and of promoting the development of equal partnership between research teams in the North and the South. It is also a generator of significant and reciprocal added values for each of the stakeholders and their clients.

## Objectives

The general objective of CERAAS is to propose plant varieties adapted to drought, methods of analysis and decision-making tools, which contribute to improving and/or stabilising agricultural production in arid and semi arid zones. The classical methods of plant breeding have shown their limits under conditions in which drought is becoming more and more severe and multiform.

The specific objectives are therefore to:

- develop a multidisciplinary approach, closely associating agronomy, physiology, breeding, modelling and molecular biology, which could be integrated in breeding programmes of research teams of NARS, so as to optimise them,
- use the knowledge acquired from research to develop methods of analysis and decision-making tools for agricultural systems with limited water resource,
- strengthen the capacity of research teams of NARS by reducing their isolation and facilitating access to knowledge as well as their transfer.

## Scientific area

In the area of natural resources management and in particular that of genetic resources, CERAAS deals with problems related to plant adaptation to drought. The disciplines covered are agronomy, agroclimatology, physiology, biochemistry, genetics and mole-

cular biology. Biometrics and applied mathematics (modelling) are disciplines developed to support research activities.

## Area of intervention

CERAAS is located in Senegal in the Sahelian zone. From its mandate, the main areas of intervention are the arid and semi arid zones of West and Central Africa. However, it has, because of its expertise, developed partnership with other countries in Africa (Burundi, Botswana, and Madagascar) and countries in other continents (Argentina, Brazil, and Vietnam).

In the framework of this same partnership, it also receives many students and research scientists from countries in the North for research activities or training.

# Stakeholders

## Beneficiaries

- Farmers in dry areas, in liaison with the extension services of their countries, are the main beneficiaries of plant varieties adapted to drought resulting from research programmes.
- Development institutions (agricultural departments, professional organisations and NGOs) use the decision-making tools developed by CERAAS.
- Research teams of NARS have, through CERAAS, an easy access to knowledge, methods and tools, which allow them to improve the efficiency of their breeding and plant creation programmes.
- Universities and advanced agricultural colleges have access to a tool that brings together in synergy, teaching, advanced and adaptive research on plant adaptation to drought. The idea is that research should nourish teaching and that the latter should benefit from an adapted training.
- Research laboratories in the North benefit from the scientific environment and infrastructure of CERAAS, where they can validate their hypothesis and their new methods.

## Scientific partners

### Research

- West and Central Africa: the agricultural research institutes of Burkina Faso, Benin and Niger.
- Other regions in Africa: the agricultural research institutes of Botswana, Tunisia and Madagascar.
- Other countries in the South: Brazil (Federal University of Fortaleza and University of Rio de Janeiro), Argentina (Inta, Cordoba), Vietnam (Opi).
- Countries in the North: France (CIRAD, IRD, Universities of Paris 7 and 12, ENSAM), Belgium (Université Libre de Bruxelles, Université Catholique de Louvain), Portugal (Estação Agronómica Nacional), Denmark (Royal University of Denmark), United Kingdom (Centre for Arid Zone Studies, Wales).

### Training by research

- Senegal: UCAD, ENSA, ENCR, and ESP.
- West and Central Africa: the agricultural research institutes of the following countries: Burkina Faso, Benin, Niger, Mali, Congo, Côte d'Ivoire, Guinea Bissau, Guinea, Sierra Leone, Togo, Nigeria, Central Africa, Gambia.
- Other regions in Africa: agricultural research institutes of Burundi and Madagascar.
- Other countries in the South: Brazil (Federal University of Fortaleza and University of Rio de Janeiro), Argentina (Inta, Cordoba).
- Countries in the North: France (CIRAD, University of Paris 12, University of Orsay, University of Montpellier 2, University of Saint-Etienne, ENSAM, ISTOM), Belgium (Université Libre de Bruxelles, Université Catholique de Louvain), Germany (University of Göttingen).

### Training leading to the award of diplomas

- Senegal: UCAD, ENSA and ENCR.
- West and Central Africa: the agricultural research institutes, universities and advanced agricultural colleges of Chad, Niger, Central Africa, Burkina Faso and Côte d'Ivoire.
- Other regions in Africa: agricultural research institute of Burundi.
- Countries in the North: France (CIRAD, University of Paris 7, ENSAM), Belgium (Université Libre de Bruxelles, Université Catholique de Louvain).

## Financial partners

### National level

— ISRA: puts at the disposal of CERAAS a part of its laboratories and experimental fields, hostels for lodging visiting students and research scientists, and facilitate its management.

— ENSA: accommodates the new infrastructure of CERAAS in its campus, provides it with experimental plots at Thiès and hostels for lodging visiting students and research scientists.

### Sub regional level

— NARS of countries in West and Central Africa: sends sub regional research experts to CERAAS who continue receiving their salaries from their institution of origin, whereas CERAAS pays them an allowance.

### Multilateral co-operation

— Europe (RIP EDF 7 and EDF 8): funds the scientific programme of CERAAS proposed by some ACP countries as a priority in West and Central Africa. The EDF 7 programme has financed the acquisition of infrastructure (laboratories and hostels), equipment, research and training as well as scientific exchange activities.

— Europe (Competitive funds, STD 2, STD 3, 5e PCRDT): funds research projects proposed by consortia in which CERAAS participates.

### Bilateral co-operation

— Bilateral public funds (France, Belgium, United Kingdom): funds research and training activities, equipment, scientific exchange missions as well as technical support (positions of experts)

— Co-operation with the North (CIRAD, University of Paris 7, Université Libre de Bruxelles): translated by the secondment of experts to CERAAS, the training of research scientists at CERAAS as well as technical support missions.

### Other

— Professional organisations, institutional partnership: CERAAS intervenes as consultants (Figure 2).

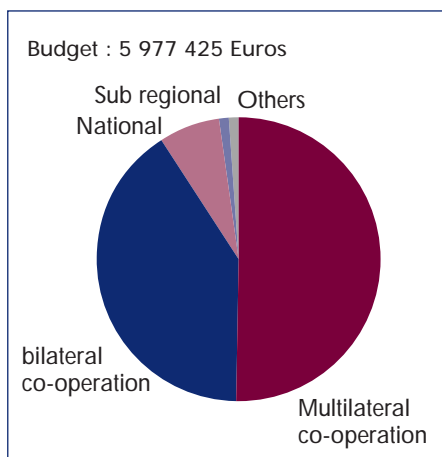


Figure 2. Main financial sources of CERAAS since its creation (1989-1999).

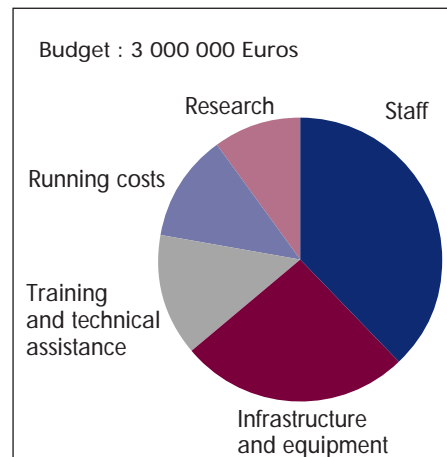


Figure 3. Budget for consolidation phase of CERAAS (2000-2003).

## Budget

The financial needs of CERAAS for its consolidation phase (2000 to 2003) have been estimated at 3 million euros (Figure 3). The European Union in the framework of the EDF 8 programme has accepted to finance the activities of this phase, which will include the strengthening of its staff (2 research scientist positions), infrastructure and equipment for CERAAS and its partners (UCAD and ENSA) in the framework of the training leading to the award of diplomas.

CERAAS will pursue its research for financial subsidies, which will ensure its maintenance. Its annual core budget is estimated at 230 000 euros.

## Results and Impact

The results obtained by CERAAS are transferable and are being applied in Senegal, the WECARD/CORAF zone and beyond (Figure 4).

## Research

— Improving knowledge on the mechanisms of the adaptation of eighteen cultivated species to water deficit.

— Utilisation of old and new physiological criteria of adaptation for proposing new strategies for improving plant varieties, mainly for peanut, cowpea, millet and sorghum.

— Revelation of new criteria at the cellular level as well as biochemical and molecular markers in cowpea, with the perspective of transferring drought tolerance traits.

— Development of plant engineering through the establishment of concepts, tools, methods and original techniques for characterising plants.

## Development products

— Integration of the peanut variety, Fleur 11, in a recurrent breeding programme.

— Creation, in collaboration with ISRA, of a new peanut variety with a very short life cycle, GC 8-35. This variety will eventually replace the variety 55-437, processed for its oil, and cultivated in Senegal in an area of about 130 000 ha. The increase in yield estimated for one growing season will reimburse the investments made in research work conducted over a period of 15 years for creating this variety<sup>(1)</sup>.

— Creation, in collaboration with ISRA, of about thirty peanut varieties potentially more interesting than the varieties GC 8-35 and 55-437 in terms of their production as well as their drought resistance capacity. From this pool of

1. The projection has been estimated based on the following :

— estimated increase in yield of the new variety : + 10%, corresponding to + 8 000 tons,

— producer price: 130 F CFA/kg (mean over the last five years),

— gain for the farmer: 1 billion F CFA/year,

— research cost during 15 years (1 national research scientist and the overheads of a research institution type CERAAS): 30 million F CFA/year, corresponding to 450 million F CFA for 15 years

improved genetic material, several countries (Burkina Faso, Botswana, and Brazil) have selected lines whose agronomic and physiological response to drought are superior to those of the local varieties. Some are already being disseminated.

Creation and registration of eight sorghum varieties of agricultural importance in the Official seed catalogue of Mali, These eight varieties often cover up to 95% of the surface cultivated with sorghum in the CMDT zone, thereby representing an alternative to the cultivation of cotton. One of them, Migsor 86-30-03, is particularly resistant to drought and beating down by the wind. It is also used as a genitor in breeding programmes in Africa and the United States.

— Development and proposal of methods for scheduling irrigation, based on the water status of the soil and the plant. This results in a 20% economy of the amount of water

consumed without reducing yield. These results are of interest to Sahelian countries faced with the problem of drought and whose agricultural policies are more oriented towards irrigated agriculture (Senegal, Mali, Mauritania, and Niger).

Development of a plant model (ARABHy), coupled with a GIS, allows the estimation of peanut production one month before harvest. Elaborated in the beginning for peanut, this model can be adapted to other plants (mil, cowpea, and soybean) and to other environment, as has been done in Argentina. At the country level, the uses of this tool considerably reduce the costs involved in identifying agricultural calamity zones and contribute therefore to a more efficient and effective management of food security for populations. Moreover, this model constitutes an excellent pedagogic tool, which could be used by the entire scientific community.

## Capacity building

### Training by research

— Reception of 57 technicians, students in agriculture or related disciplines, and agriculturists coming from research and training institutions of 25 countries situated in Africa (77%), in South America (14%) and in Asia (9%). Their mission is to either acquire new methods and techniques or conduct, with the assistance of CERAAS, experiments in the framework of their local research programmes. This training also favours the development of joint research proposals with partners, involving the new methods acquired. This facilitates the development of their own drought resistant breeding programmes, as has been the case in Mali, Botswana, Burkina Faso and Brazil, for peanut and sorghum.

— Reception of 66 technicians, students in agriculture or related disciplines for the preparation of their degrees or diplomas coming from Africa (62 %) and from the North (38 %) (Figure 4). Their research work at CERAAS has resulted in the realisation of 39 first-degree dissertations, 4 DESS, 6 DEA (degrees equivalent to masters) and 11 doctorate thesis.

— Association of research scientists of Nigeria and Benin working on perennial plants at CERAAS has contributed to the motivation of research activities in the area of adaptation of perennial plants to drought and the elaboration of a project for the creation of a regional centre for studying the tolerance of perennial plants to drought, involving colleagues from Nigeria, Benin as well as those from Ghana and Côte d'Ivoire (with respect to the latter, CERAAS participated in a workshop organised at Pobé in Benin from the 14 to 16 December 1999).

— Organisation of four scientific workshops on the techniques for studying plant adaptation to drought, uniting a total of about a hundred research scientists.

— Registration of 2 research scientists of CERAAS for doctoral programmes in partner universities in France and Belgium.

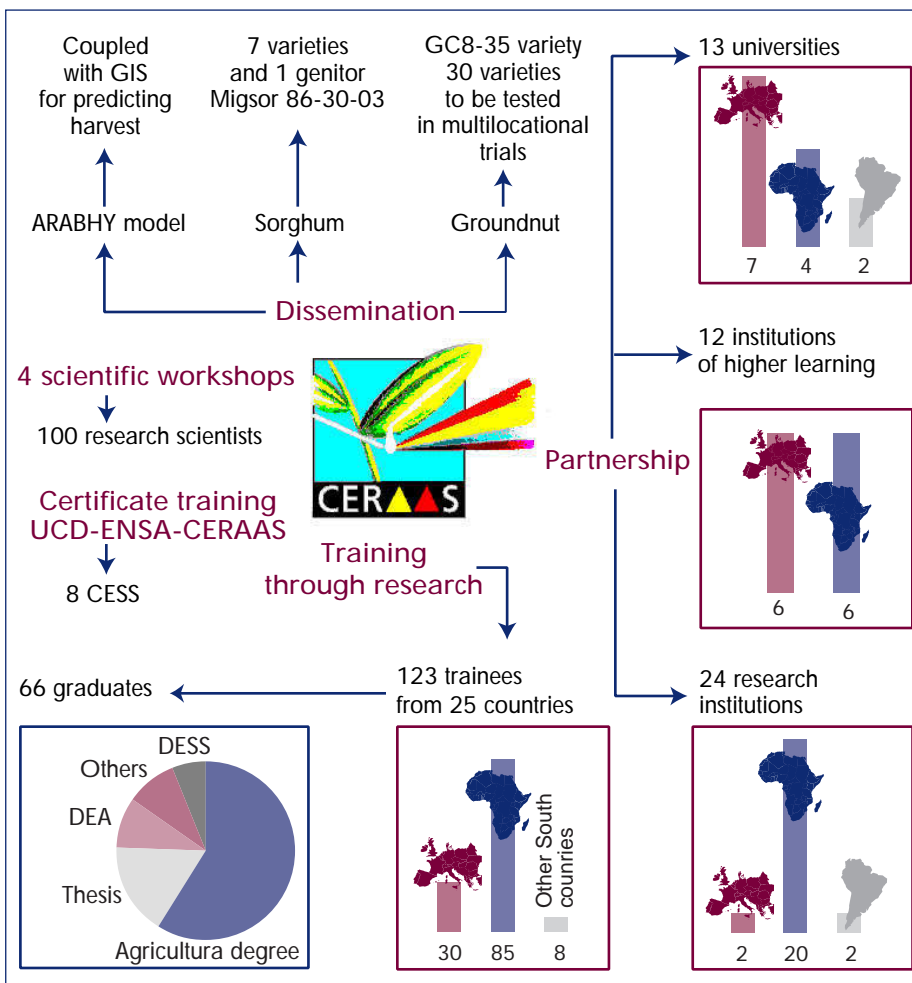


Figure 4. Impacts of CERAAS.

## Training leading to the award of diplomas

— The creation in 1999 of a specialised training in plant adaptation to drought (CESS), open to the sub region, was in response to the numerous demands of the NARS of the region to validate the research approach developed by CERAAS and its partners. This training is co-organised by UCAD, ENSA and CERAAS. It also involves the universities of Paris 7 and 12 in France and the universities of Brussels, Louvain and Gembloux in Belgium. This training mobilises about 20 lecturers and/or research scientists from the North and South, specialists in the various disciplines concerned with the study of plant adaptation to drought. This initiative allows the consolidation of the relationship existing between agricultural research institutions, universities and advanced research colleges, and the strengthening of the regional competence in this area, at a very low cost.

— Reception of 16 agriculturists in the framework of the CESS, 8 of them coming from Senegal and the other 8 from other countries in Africa (Burkina Faso, Niger, Central Africa, Chad, Côte d'Ivoire and Burundi). At the end of the first year (1999), five of them returned to their institution of origin, one has been integrated in a development organisation and participates in the definition of agricultural policies in dry areas and two have been registered for the academic year 1999/2000 at UCAD in the masters programme, which includes a specialisation in improving plant adaptation to drought.

## Partnership

### Role

CERAAS is a national laboratory with a regional vocation. It is a research unit of ISRA and conducts for the latter research activities on the improvement of plant adaptation to drought. It has been mandated by WECARD/CORAF and CILSS to organise and conduct scientific activities and develop partnerships at the regional level on one of

the themes of the regional networks, R3s, "Physiological mechanisms of plant adaptation to drought and creation of varieties".

CERAAS conducts activities, privileging a multidisciplinary approach, which lead to the development of appropriate methods for plant breeding and creating varieties better adapted to drought, improving planting techniques and managing climatic risks in arid and semi arid zones.

CERAAS is also responsible for strengthening, in both qualitative and quantitative terms, the competence of countries in the South in the different disciplines concerned with the study of plant adaptation to drought. It receives research scientists of institutions in the sub region for research and training. These conduct their research activities themselves on their own plant material and on return to their institution of origin, they exploit the results acquired and distribute them using the existing classical schemes. The dissemination of research products relies on the extension services associated with the different NARS.

Since its creation, CERAAS has developed and is extending its scientific partnership to research institutions in the North with which it conducts research and training programmes.

The staff of CERAAS consists of 29 persons as follows:

#### *Scientific personnel*

— 9 cadre: the director and 8 research scientists (4 Senegalese nationals, 2 from the sub region and 3 from the North);

— 11 agents: technicians, computer and information science specialists (Senegalese nationals).

#### *Support staff*

— 9 agents: accountant, secretaries, maintenance staff, administrative agent, drivers (Senegalese nationals).

CERAAS is subjected to the modalities of control, monitoring and evaluation by the scientific and technical committee of ISRA for activities conducted at the national level, and by the steering committee and the general assembly of the R3s for activities conducted at the regional level.

CERAAS finds itself in an intermediary position; the methodological and applied research level, in the research-development continuum. It is constructed on the basis of a strong scientific partnership with the NARS of countries in the South as well as those in the North, which confer upon it several comparative advantages.

## Added values due to partnership

— Easy identification of research problems of priority in the area of plant adaptation to drought.

— Improved evaluation of research and training demands in order to better respond to them.

— Organisation of research and training activities concerning the adaptation of cultivated plants species to drought for the NARS, at very low costs.

— Rapid transfer and at lower costs to the South, of new methods and techniques.

— Emergence of new synergies between complementary scientific teams thus favouring the elaboration of joint research projects, involving partners in the South and the North.

— Easy distribution of research results to farmers, through development organisations of NARS.

— Rapid distribution of scientific results between institutions.

— Improvement of the relevance of the choice of research subjects in universities.

— Easy access to the most advanced technologies and research results of countries in the North.

— Maintenance of the level of expertise of scientific teams of NARS and the quality of teaching in the case of the training leading to the award of diploma.

— Rapid acquisition of new concepts and methods, which are then validated and then transferred to partners in the South.

— Better positioning of research teams in the South with regards to competitive funds (e.g. 5e PCRDT), the main funding sources for research activities.

— Better synergy between teaching, and fundamental and adaptive research.

## Conclusion

CERAAS is an illustration of the modern tools of NARS, which respond to problems of a regional dimension and develop equal partnership with more advanced partners. The nature of this partnership ensures the quality, relevance and the validity of the research conducted and the training proposed. This has made it a place for scientific exchange, thereby contributing to the emergence of a solid scientific community specialised in the area of study and comprising research scientists from Africa, South America and Europe.

CERAAS is now recognised by the international scientific community working in the area of plant adaptation to drought and constitutes an original model of regional and international co-operation. The NARS and also WECARD/CORAF have thus demonstrated that a new type of tool, intermediate between the NARI and the CGIAR centres, has its place in North-South research and scientific co-operation. They have decided to capitalise on this model and to maintain the dynamism that it inspires. The recruitment of an African research scientist specialised in molecular biology with notions in breeding and a biometrician will complete the scientific staff of CERAAS.

A scientific committee is being constituted. It will be responsible, with the national scientific and technical committee and the R3s, for evaluating the quality and the relevance of its scientific programmes, verifying the coherence of its research orientations with regional priorities and certifying the quality of its administrative and financial management.

The main challenge for the future of these tools is the definition of appropriate modalities, which will ensure the evolution and sustentation as expected by the NARS and their partners.

Analysis of the basic running cost of CERAAS, when compared to the number of scientists benefiting from it, shows that these new tools are the most economical at the moment and provide the best added value and returns for NARS and their partners.

However, experience shows that difficulties persist regarding funding of its running costs, for which it depends, to a large extent, on project funding obtained by CERAAS. The participation of NARS is already significant compared to their real means. It is important, therefore, that the international community mobilises in order to provide the necessary financial means for the basic running of some of these tools like CERAAS, knowing well that they are very effective in procuring competitive funds. In effect, this was how the IARCS and other sub regional research organisations were constructed. Efforts must be deployed in order to support these new tools of co-operation that are being constructed by the NARS. For the future of CERAAS, the search for an appropriate response is imperative and its survival depends on this. All its partners are together engaged in thinking of various possible solutions for guaranteeing the durability and maintenance of the model of reference that it constitutes for sub regional co-operation in the WECARD/CORAF zone.

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### ABBREVIATIONS

ACP: Afrique, Caraïbe and Pacific

ARABHY: Arachide bilan hydrique

CERAAS: Centre d'étude regional pour l'amélioration de l'adaptation à la sécheresse

CESS: Certificat d'études supérieures spécialisées

CILSS: Comité inter-états de lutte contre la sécheresse au Sahel

CIRAD: Centre de coopération internationale en recherche agronomique pour le développement (France)

CMDT: Compagnie malienne de développement du textile (Mali)

CNRA: Centre national de recherche agronomique (Senegal)

DEA: Diplôme d'études approfondies

EDF: European development funds

ENCR: Ecole nationale des cadres ruraux (Senegal)

ENSA: Ecole nationale supérieure d'agriculture (Senegal)

ENSAM: Ecole nationale supérieure d'agronomie de Montpellier (France)

ESP: Ecole supérieure polytechnique (Sénégal)

FAO: Food and agricultural organisation (United Nations)

FPARTD: Framework programme on research and technological development

CGIAR: Consultative group on international agricultural research (United Nations)

GIS: Geographic information system.

IARC: International agricultural research center

INSAH: Institut du Sahel

IPO: Institut des plantes oléagineuses du Vietnam (Vietnam)

IRD: Institut de recherche pour le développement (France)

ISRA: Institut sénégalais de recherche agricole. (Senegal)

ISTOM: Institut des sciences et techniques d'outre-mer (France)

NARI: National agricultural research institut

NARS: National agricultural research system

NGO: Non governmental organisation

RIP: Regional indicative programme (EFD)

R3S : Réseau de recherche sur la résistance à la sécheresse

STD: Science and technic for development

UCAD: Université Cheikh Anta Diop (Senegal)

WECARD/CORAF: West and central african council for agricultural research and development/Conseil ouest et centre africain pour la recherche et le développement agricoles.