

African Union Research Grant Programme

Promoting Science and Technology
for the Sustainable Development of Africa



10th European Development Fund
The African Component of the ACP Research
Programme for Sustainable Development
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- AFRICAN UNION RESEARCH GRANT PROGRAM

Acknowledgments

Disclaimer

The views expressed in this report are those of the lead project beneficiaries and not necessarily those of African Union Commission.

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This report highlights the results of the 20 projects from the African Union Research grant programme.

The report underpins scientific advances and technological changes embarked on, as key to solving African's challenges for socio economic development. To make this happen, the African Union Commission (AUC) with the support from the Secretariat of the African, Caribbean and Pacific (ACP) Group of States and European Commission (EC) initiated the first Pan African Research Grant framework – the African Union Research Grants programme.

With the network of collaboration established, this programme further responds to the need for increased inter Africa collaboration in scientific outputs to address findings reported in ASTII policy brief on scientific productivity of the African union member states (2005-2010), in which only

4.3% of papers in 2008 -2010 included inter-Africa country collaboration in contrast to 40% for extra – Africa collaboration.

This programme presents an exciting and new paradigm shift for Research and Innovation in the continent, as it links the regions of Africa through research, empowers institutions to acquire needed infrastructure for research, building capacity of students and researchers, through training, mentoring, knowledge sharing and transfers across regions, thereby learning from each other. This is one sure way to promote Pan Africanism, build regional integration and guarantee a sustainable future.

“Before this funding opportunity, our laboratories were colonized by rats but today we have a functional laboratory, with modern equipments and we now serve students from different countries to meet their research needs” says researcher DIEDHIOU, one of the successful beneficiaries of the grant.

As most end results of the projects provides solutions that goes back to the local communities, Researcher – Community trust is heightened and encourages further cooperation. In one of the research locations, the communities were trained to plant *Jathropha* plants, process the oil and use the same to generate electricity for homes and for milling their grains. The transformation of knowledge into practice allowed for the improved economy at local and national level.

More needs to be done to improve government participation in this programme, however, many local communities are taking ownership and are actively involved in the quest for its sustainability. With this new commitment from local communities in addition to the growing pockets of efforts for research that impacts the society here and there, we are hopeful that Africa economic emergence will be sustained.

Dr. Martial De-Paul Ikounga

Commissioner for Human Resources, Science & Technology
Africa Union Commission

African Union Research Grant

The African Union Research Grant (AURG) is one of the activities initiated within the Department of Human Resources, Science and Technology (DHRST) to support research and development through grants and direct funding. It provides the needed opportunity to use Science and Technology (S&T) as a tool for sustainable development, build and strengthen Africa's S&T capacities, and also serves as a platform for the implementation of the Consolidated Plan of Action on Science and Technology (CPA), which has given later rise to the Science, Technology and Innovation Strategy for Africa (STISA-2024).

Why an AU research grant? The AURG initiative is a continental programme whose benefits trickles down to regional and national levels, the focus of AU for Pan-Africanism and African Renaissance

makes the Commission a custodian for any initiative that can enhance integration and support an African alliance through collaborative networks in Science and Technology, geared towards empowering African researchers to contribute and overcome her differences and collectively address common developmental challenges in Science and Technology. Hence the programme provides a framework for the African Union Commission to deploy and to improve research in science and technology so that it contributes to Africa's poverty reduction, economic growth and social development efforts. And specifically to:

- Build the AU Commission capacity to create a sustainable system of competitive research grants at Pan-African level and to put in place procedures and processes to manage

such grants with the ambition to utilize the accumulated experience to develop a fully fledged African Framework Programme for research;

- Innovatively and sustainably build Africa's research capacities through direct funding of the AU Science and Technology Policy, particularly implementation of the Africa's Science and Technology Consolidated Plan of Action and its Lighthouse Projects; and
- Enhance intra-regional scientific research collaboration and cooperation that contributes to Africa's sustainable development.

Where is this programme moving Africa to?

The AURG ultimately targets towards moving to a more united and self reliant Africa in Science, Technology and Innovations breakthroughs in food security, energy efficiency, clean and potable water.

How is this programme coordinated?

The programme management unit is fully supported, both financially and technically, by the European Union delegation to the African Union. There were five proposal assessment phases (based on agreed methodology and criteria - Figure 1) by external assessors and supported by in-house members of evaluation com-

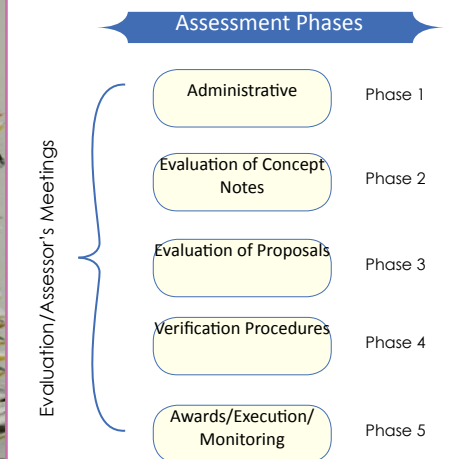


Figure 1: Phases of the evaluation process

African Union Research Grant

mittee and the programme management unit of the African Union Commission. At every assessment phase, those applications not meeting the threshold are eliminated while those proceeding to the next phase are ranked by scores.

What has been achieved so far?

Two calls have been launched and 20 institutions, listed in the Grant Beneficiaries Section below, have received grants totaling up to \$20 million, to do research in three thematic areas namely: Post-harvest and Agriculture; Renewable and Sustainable Energy; Water and Sanitation by forming consortia of institutions. These projects are executed in 46 locations across Africa. The two calls have also facilitated the es-

tablishment of 54 research networks within the framework of the programme (Figure 2). If this tempo is sustained, we should, fast track the realization of the African Union agenda 2063, through harmonized research efforts, and resources within the context of the Science, Technology and Innovation Strategy for Africa (STISA-2024). In addition, we can help establish, at the continental level, a critical mass of African scientists, interested in doing research that will lead to results that address socio-economic developments. Within the context of this program, institutions have been empowered, student capacity built, and livelihood of local communities greatly improved.

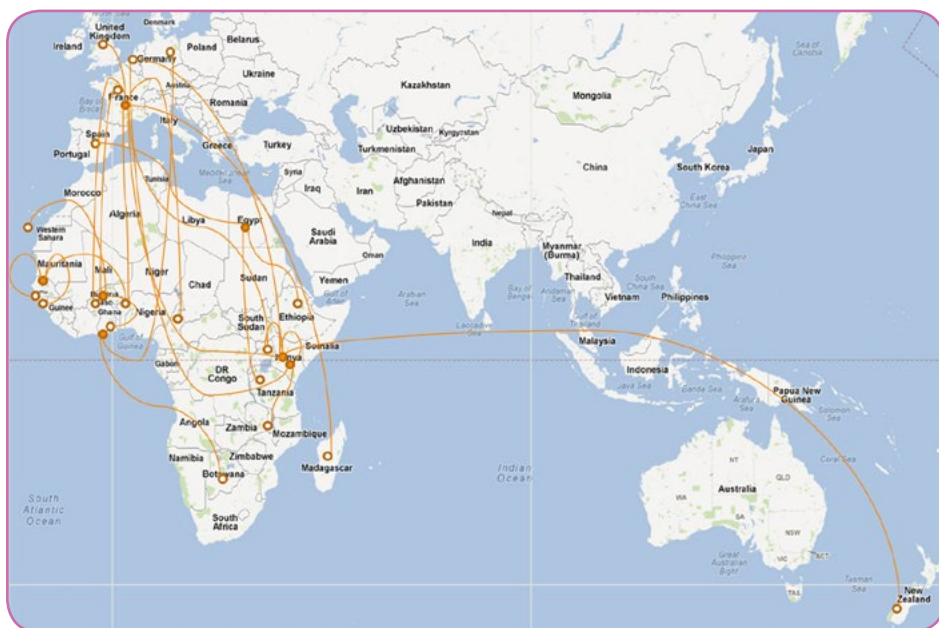


Figure 2: Partnership Networks formed between the AU Grant Beneficiary Research Institutions

Monitoring and Project Site Visits

To ensure credibility, the Commission embarked on regular monitoring of awarded projects. These visits ensured the extent to which activities planned follows the proposed timeline. It also checks if activities are carried out by appropriate personnel, and that project partners are actively in-

involved to justify the call criteria for consortia of scientist. In addition, monitoring visits verifies that projects are being implemented inline with their initial proposal, and the project is moving towards the anticipated goals and objectives of the project. All the projects were visited and this helped many to further understand some of the rules and procedures governing the grants.



Field visit during a Monitoring and evaluation mission of project no AURG-1-094 in Senegal

African Union Research Grant Science-Forum

The Program Management Unit (PMU) of the African Union Research Grant Program organized two annual science forums, bringing together grant beneficiaries from both the 2011 and 2012 calls for proposals, as well as relevant stakeholders in the industry. The first science forum was organized as part of the year-long activities of



African Union Research Grant

the 50th Anniversary of the OAU/AU. The objective of this forum was to engage researchers, development partners, and relevant stakeholders in a discussion on raising the profile of Science, Technology and Innovation by paying special attention on partnerships and engaging in collaborative research.

The 2nd African Union Research Grant Forum was held during “Science, Technology and Innovation (STI) Week” under the theme “Raising awareness on STI” from the

9th to the 31st of October, 2014. The forum focused on the progress of research activities funded by the AU Grant Programme, as well as their overall impact, future prospects, and their roles and contributions towards creating a conducive environment for establishing partnerships and collaborative research.

Although the forum established that partnership is key for research in Africa, however there are challenges to cope with.



Figure 3: 2nd African Union Research Grant Forum Participants

Impact prospects of funded research projects

It is expected that through this program, the Africa Union Commission and its partners would have contributed positively to Africa's heart beat to achieving the following:

- Enhanced African - Partnership Framework for joint research, development and exchange of information
- Establish a credible and competitive system of grants management as an innovative way to involve African

citizens to work together on common development priorities

- Fast track the realization of some MDGs in Africa.
- Harmonized Research efforts and Resources
- Provide African farmers and policy makers decision support tools (DSTs), based on scientifically validated indigenous/traditional knowledge (ITK)
- In-depth evidence-based multi-level and interdisciplinary know-how to sustainably manage and resolve conflicts
- Boost in Africa Research capacity and cooperation for increased innovation in Science and Technology to Increase productivity and food security, Decrease dependence on imported energy, Increased knowledge of Water Resource and Capacity building through training of Post graduates

Policy Conclusion and Way forward

The implementation of the African Union Research Grant programme offered a first-hand evidence and clear picture of the state of affairs with regards to R&D in some institutions and based on the experiences gathered, we therefore draw the following conclusions.

1. Institutional and Country level bureaucracies is more of bottlenecks for Research in Africa than enhancement, some of the bureaucracies could halt research and lead to loss in opportunity. Consequently, this calls for a clear paradigm shift from business as usual attitude to the importance of research for development

2. It is evident that Research and development could contribute to regional integration with emphasizes on intra and inter collaboration across countries, this is apparent as working together across countries helps bridge research gaps, building each other's capacity, enhancing information and technology flow resulting to joint scientific publications within Africa against language barriers. There could be more benefits if Individual African countries can engage in regional collaborative research.
3. Monitoring and evaluation of projects is key to successful implementation of funded projects to avoid miss appropriation and allocation of funds and unduly delay of completion of projects.
4. Research in Africa should emphasis more on actions that are impactful on livelihoods and can bring about visible changes in communities, with the clear relevance of some of the projects impact on the society; some governments have shown interest to upscale the outcome of these projects to other communities. This is one sure way of increasing governments funding to R&D in addition to the insistence of a percentage contribution of the institutions in any externally funded project.
5. There is need to build capacity of African researchers on proposal writing to enhance access to competitive funding.
6. South – North collaboration in R&D is essential in capacity building of African researchers and transfer of technology. This configuration in the context of this programme has also contributed to setting improved standards for research.

Monitoring Action Locations



Summary of AU Grant Projects

No	Beneficiary name	Amount (Euro) & Title of Action	Partners
Post Harvest and Agriculture			
1	International Centre of Insect Physiology and Ecology (ICIPE) Kenya	Validation and dissemination of bio intensive eco-friendly management strategies for thrips – a critical constraint to cowpea production in Africa 746,451.04	<ul style="list-style-type: none"> - Kenya Agricultural Research Institute (KARI) Kenya - Makerere University, Uganda - Stichting Dienst Landbouwkundig Onderzoek, Netherlands - The New Zealand Institute for Plant and Food Research, New Zealand
2	Egerton University (EGU) Kenya	Improving Indigenous Chicken Productivity for Enhanced Livelihood and Food Security in Sub-Saharan Africa 749,096.35	<ul style="list-style-type: none"> - University of Malawi, Malawi - Wageningen University, Netherlands - Kenya Agricultural Research Institute - Ministry of Livestock Development Kenya - International Livestock research Institute - Department of Agriculture Research Malawi
3	Institut Sénégalais de Recherches Agricoles (ISRA) Senegal	Contribution à la relance de la productivité agricole en zones post-conflit et alentours (Sénégal, Gambie et Guinée Bissau) 545,049.2	<ul style="list-style-type: none"> - National Agricultural Research Institute (NARI) The Gambia - Instituto Nacional de Pesquisa Agraria, Guinée Bissau
4	Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) France	Enhancing food security and well-being of rural African households through improved synergy between Agro-Forestry Systems and Food-crops (AFS 4 Food) 748,711.71	<ul style="list-style-type: none"> - Institut de Recherche Agricole pour le Développement, Cameroon - International Centre for Research in Agroforestry, Kenya - Coffee Research Foundation, Kenya - Centre Technique Horticole de Tamatave, Madagascar - Centre intern. d'études supérieures en sciences agronomiques, France - University of Yaoundé I, Cameroon - University of Dschang, Cameroon
5	Durban University of Technology, South Africa	Developing decision support simulation tools based on scientifically validated indigenous/traditional and conventional knowledge for increasing agricultural production and food security in Africa 550,000	<ul style="list-style-type: none"> - University of Mauritius, Mauritius, - Botswana College of Agriculture, - Kenyatta University, Kenya, 1985, University, Kenya

No	Beneficiary name	Amount (Euro) & Title of Action	Partners
6	University of Greenwich, Natural Resources Institute, United Kingdom	Limiting the impact of Cassava Brown Streak Disease on smallholders, women and the cassava value chain (LimitCBSD) 620,893.96	<ul style="list-style-type: none"> - Naliendele Agricultural Research Institute (NARI), Tanzania - Tanzania Food and Nutrition Centre (TFNC), Tanzania - Egerton University, Kenya - Department for Agricultural Research and Technical Services (DARS), Malawi
7	Centre de Coopération Internationale en recherche Agronomique pour le Développement, France	Amélioration de l'après récolte et valorisation du fonio en Afrique (Aval Fonio) 749,466.35	<ul style="list-style-type: none"> - Institut de Recherche Agronomique de Guinée (IRAG), Guinée Conakry - Institut d'Economie Rurale (IER), Mali - Institut de Recherche en Sciences Appliquées et Technologies (IRSAT/CNRST), Bourkina Faso - Ecole Supérieure Polytechnique / Université Cheikh Anta Diop (ESP-UCAD), Senegal
8	Department of Agricultural Research Services, Malawi	Improvement of Crop-Livestock Integrated Farming Productivity and Market Access through Smallholder Lead Farmer Concept 508,320.83	<ul style="list-style-type: none"> - Zambia Agriculture Research Institute, Zambia - Mzuzu Agricultural Development Division, Malawi - Mzuzu University, Malawi - Department of Agribusiness and Marketing, Zambia
9	National Institute of Oceanography and Fisheries (NIOF) Egypt	Improved management and technological innovation in African tilapia farms and hatcheries. 748496.32	<ul style="list-style-type: none"> - Institut Sénégalaise de Recherche Agricole – Centre de Recherches Oceanographiques de Dakar- Senegal - Institut de Recerca i Tecnologia Agroalimentàries (IRTA), Spain
10	FIFAMANOR (Centre de développement rural et de recherche appliquée en agriculture et en élevage); Madagascar	Recyclage des BIOmasses Végétales et Animales dans les systèmes d'agriculture élevage (BIOVA) 733,508.23	<ul style="list-style-type: none"> - Laboratoire des Radiosotopes (LRI) de l'université d'Antananarivo, Madagascar; - Département de Recherches Zootechnique et Vétérinaire du Centre National de Recherche Appliquée au Développement Rural (FOFIFA DRZV), Madagascar; - Département Elevage de l'Ecole Supérieure des Sciences Agronomiques (ESSA), université d'Antananarivo, Madagascar - Institut de Recherche Agronomique du Mozambique, - Centre Universitaire de Changalane, université Eduardo Mondlane (UEM), Mozambique - Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), France - Institut de Recherche pour le Développement (IRD Eco&Sols), France; - Association Réunionnaise de Pastoralisme (ARP), France; - Département Valorisation des Productions, Centre Wallon de Recherches Agronomiques, (CRA-W), Belgique,

Summary of AU Grant Projects

No	Beneficiary name	Amount (Euro) & Title of Action	Partners
Renewable and Sustainable Energy			
11	Egypt National Cleaner Production Centre (EN-CPC) Egypt	FOstering ReneWable and Sustainable Energy in Africa through R&D 721,366.38	- Cleaner Production Centre of Tanzania - Ethiopia Standards Agency- Ethiopia Cleaner Production Centre (ECPC), Ethiopia - Andalusian Institute of Technology (IAT),Spain
12	Institut International d'Ingénierie de l'Eau et l'Environnement, 2iE, Burkina Faso	Development of a Cost-effective, modular and Dry Concentrating Solar Power for Africa: Design and Test of Components 743,096.38	- The Energy Center, Kwame Nkrumah University of Science and Technology, Ghana - ECOWAS Regional Centre for Renewable Energy and Energy Efficiency (ECREEE), Cape Verde - SIREA, France
13	École Nationale Supérieure d'Agriculture (ENSA)/Université de Thiès (UT), Senegal	Mise au point de technologies de production et d'utilisation durables de biocarburant de Jatropha curcas pour une réduction de la pauvreté rurale en Afrique de l'Ouest 697,781.31	- Institut Sénégalais de Recherches Agricoles (ISRA) ; nationalité : Sénégal - Université Gaston Berger de Saint-Louis, Senegal - Centre des Recherches Agricoles du Centre (CRAC)/Institut National des Recherches Agricoles du Bénin, Benin - Centre d'Etudes et de Recherches sur les Energies Renouvelables (CERER)/Université Cheikh Anta Diop, Senegal - Université de Ouagadougou, Burkina Faso
14	Kwame Nkrumah University of Science and Technology, College of Engineering (KNUST-CoE), Ghana	Potential of distributed grid-connected solar Photovoltaic (PV) systems in rural electrification in Africa 747,245.30	- Centre of Study in Renewable and Sustainable Energy, University of Botswana, Botswana - International Institute of Management, University of Flensburg, Germany
15	Institut International d'Ingénierie de l'Eau et l'Environnement, 2iE, Burkina Faso	Vers une production durable et innovante de biocarburants en adéquation avec les potentiels et les besoins de l'Afrique : PRONOVABIO 748,896.68	- Centre de Coopération Internationale en Recherche Agronomique pour le Développement, CIRAD, France - Ecole Polytechnique Abomey Calvi (EPAC), Bénin; - Ecole Nationale d'Ingénieur Abderrahmane Baba Touré Mali, - Université de Ouagadougou(UO), Burkina Faso
16	Makerere University, Kampala, Uganda	Adaptation of small-scale biogas digesters for use in rural households in Sub-Saharan Africa 748,865.00	- Jo Smith, University of Aberdeen (UA), Britain; - Assefa Abegaz, Addis Ababa University (AAU), Ethiopia; - Robin Matthews, James Hutton Institute (JHI), Scotland - Kenneth Yongabi, Catholic University Cameroon (CUC), Cameroon - Charles Henderson, Climate Futures (CF), Britain - Sue Edwards, Institute for Sustainable Development (ISD), Ethiopia - Vianney Tumwesige, Green Heat (U) Ltd (GHU), Uganda - Kenneth Yongabi, Phytobiotechnology Research Foundation (PRF), Cameroon - Bob Orskov, Orskov Foundation (ORS), Scotland

No	Beneficiary name	Amount (Euro) & Title of Action	Partners
Water and Sanitation			
17	Institut de Recherche pour le Développement, IRD, France	Groundwater Resource in Basement rocks of Africa (GRIBA) 749,726.25	- University of Abomey Calavi, Benin - Institut International d'ingénierie pour l'eau et l'environnement Fondation 2iE, Burkina Faso, - Directorate of Water Resource Management DWRM, Uganda - Queen's University of Belfast, QUB, Britain
18	NEIKER-Tecnalia, Spain	ICT tools for the enhancement of irrigation efficiency in West Africa 748,636.36	- CSIR Water Research Institute Ghana; - West & Central Africa Council for Agricultural Research and Development
19	Council for Scientific and Industrial Research (CSIR), South Africa	Using IWRM best practices to develop Appropriate Capacity and Training for the benefit of Sub-Saharan Africa Water Security [ACT4SSAWS] 651,279.01	- University of Botswana, Botswana - University of Malawi, Malawi - Eduardo Mondlane University, Mozambique - University Cheikh Anta Diop, Senegal; - University of Western Cape, South Africa - University of Zambia, Zambia
20	University of Khartoum, Development Studies and Research Institute (DSRI) Sudan	Mapping of water conflicts and best management practices in pastoralist areas in the Sahel region- create in-depth knowledge, develop an interdisciplinary research methodology and transfer the know-how to all relevant stakeholders 548,000.00	- Ethiopia: New Generation University College Ethiopia - Germany: EcoDevelopment - Society for International Development Research and Planning Ltd; - IGAD; - Niger: Abdou Moumouni University Niger; - Somaliland: Amoud University Somalia; - The Sudan: YabConsult Khartoum;



Enhancing food security and wellbeing of rural African households through improved synergy between agroforestry systems (AFS) and food-crops



Background

The project is born from the recognition that current research on food safety has paid little attention to the role of agroforestry systems (AFS) at the plot, farm and landscape levels. Based on the results of research conducted by the project partners in the three target areas, our hypothesis is that the AFS can help improve food security and well-being of farmers:

- directly through various types of edible plants, medicinal, wood and other non-timber products,
- indirectly through the sustainable provision of environmental services.

This hypothesis is tested by accurate assessment of the synergy between food crops and AFS on increasing the level of food security and well-being of rural African households.

Approach of the Project

- Analyse the independent factors which transformed the agricultural systems (food crops and AFS) and identify the most profitable and resilient systems, likely to resist the future risks.
- combine improved production and environmental services to enhance level and quality of life in rural environment.
- Consolidate the African research capacities and work in scientific networks on the subjects of tropical AFS.

Beneficiaries of the project

- Farmers and rural organisations in the regions dominated by cacao, coffee or clove. And, all the smallholders living under similar agro-ecological, demographic and market conditions.
- The research institution and local rural development working on food crops and AFS in the target areas.
- Actors and decision makers of the sectors on the local, national and regional levels...



Major Results Achieved

Cocoa - AFS: Cocoa in AFS remains the economic base of the farms in Cameroon. Shortage in locally produced food crops does not appear as a threat to food security since revenues from cocoa are high enough to allow farmers and their workers to purchase food imported from other regions.

Cocoa-AFS is as efficient as forest in terms of carbon storage, despite a lower level of tree diversity. Improved valorisation of Safou, a major product from the cocoa based AFS through enhanced post-harvest conservation and transformation.

Coffee - AFS in Kenya are well structured systems inside with trees around plots and

between neighbouring farms; production systems are highly diversified according to farmers' strategies of associating or not food crops and trees. Associated trees provide a range of services, such as timber, firewood, windbreak, biofuel, medicinal products, fodder, etc. Manure produced by cows on farm significantly improves food crops and coffee yield and final quality. Effect of altitude and associated shade trees on pests and diseases was demonstrated.

Clove - AFS Antagonisms between both uses: flowers (nails) or leaves (essential oil) are better known. Effect of harvesting periods on quality was demonstrated. Clove in AFS remains the economic base of the farms in Eastern regions. Improved oil extraction devices to save time and reduce firewood consumption (reduce deforestation) were developed.

Expected Impact

- Reinforcement of research and partnerships in target countries.
- Identification of constraints and compromises lived by the smallholders to improve their means of subsistence (food safety and incomes).
- Identification of the ways to better reconcile sustainable production and supply of environmental services to fight against poverty in rural environment.
- Role of AFS to buffer climate and market changes in order to improve households' food safety and incomes diversification.
- Document the role of the AFS in the improvement of agricultural products quality and the rural households' food regime.



Lead Institutions

- Centre for International Research and Agricultural Development (France)

Partner Institutions

- IRAD: Institut de Recherche Agricole pour le Développement (Cameroon)
- ICRAF: International Centre for Research in Agroforestry (Kenya)
- CTHT: Centre Technique Horticole de Tamatave (Madagascar)

Associate Institutions

- SupAgro (France)
- Universities of Yaoundé and Dschang (Cameroun)
- Coffee Research Foundation (Kenya)
- University of Antananarivo (Madagascar)

Project:

- Duration 3 Years
- Total Cost of the Project: 1,500,000 €
- AUC Contribution: 748,500 €



Background

The Institute of Systems Science (ISS) through a multi-disciplinary research group have developed methodologies for understanding a variety of complex questions from the sciences, engineering and management. In particular we research sustainable environmental and social systems and use mathematical and computer models to predict their dynamics.



The overarching aim of this project is to provide African farmers with decision support tools based on scientifically tested computer and mathematical models to improve agricultural production yields.

Approach of the Project

- Investigations into appropriate computer and mathematical models to enable yield predictions based on field and human data inputs.
- Investigations into the pressing needs and existing practices of African farmers.
- Development of user friendly interactive application program interface to assist farmer decision processes.

A release plan will be used to construct an overall blueprint for the project and then the assimilation of the elements will begin. The approach will involve reviewing existing agricultural modeling platforms. Once chosen this will be dissected at source level and reconstructed on a web platform. From there a user friendly mapping structure will be set up. Both soil and rainfall databases will need to be reconstructed and integrated into the solution as they are essential. This web solution will be created with Microsoft's MVC framework, meaning the incorporation of CSHTML, JavaScript, C#. The

front-end of the web solution will be built from the ground up with custom animations and personalized style sheets, with Google's mapping platform being used due to the extensive range and customizability of the API. An algorithm will be formulated to create the grid mapping of the different regions and tie in the interactions with users, using JavaScript to provide feedback from the assimilated information from the simulations. Investigations to test the usability and effectiveness of these decision support tools will be carried out.



Major Results Achieved

- The Agricultural Production Systems simulator (APSIM) program has been selected as the best resource to assist farmers.
- We have investigated the effects of varying within season daily rainfall distributions on crop yields using simulations. Results show that within season distributions can affect yields in low rainfall seasons but this is also dependent on the use of fertilizer.
- To improve our understanding of the impact of foliar diseases, we formulated a mathematical model based on data. Qualitative analyses were carried out

and methods developed to reduce the spread of foliar diseases through effective control measures with minimum cost.

- We have established that planting date, variety, and sowing density are better



Researcher measuring experimental plot of maize

predicted by the farmer, or extension personnel, especially where computer resources and expertise are stretched.

- Soil conditions are an important aspect of farming as they determine the crops suitable to grow and also offer a platform for the interaction of fertilizer, crops and water. Thus soil conditions have a bearing on yields.
- Fertilizer has a clear impact in optimal soil conditions for all the rainfall conditions tested. Applying fertilizer improves yields. The relationship between soil, rain and fertilizer is more subtle in other conditions and this is where predictive models are helpful.

Expected Impact

Farmers can use decision support tools and models to assist in pre-season and in-season management decisions on cultivation practices, fertilization, irrigation, pesticide use, etc. This is expected to result in optimizing production and hence overall food security. It should also prevent the negative environmental effects of unnecessary agricultural inputs.

Lead Institutions

- Durban University of Technology

Partner Institutions

- University of Mauritius
- Botswana College of Agriculture
- Kenyatta University

Action Locations

- South Africa
- Mauritius
- Botswana
- Kenya

Research Team:

- Professor Kevin Duffy
- Professor Sunita Facknath
- Professor Nnyaladzi Batisani
- Dr. Benjamin O. Danga

Project:

- Duration 3 Years
- Total Cost of the Project: 929,693 €
- AUC Contribution: 550,000 €



Background

In West Africa, chronic energy deficiency and poverty especially in rural areas have brought about many countries to introduce biofuel crops as new agricultural chain to diversify farmers income and stimulate the rural economy.

In Senegal, as in Burkina Faso and Benin, the political option for biofuels is based primarily on the promotion of *Jatropha curcas*. The choice of this species is justified by the fact that, it produces seeds rich in oil easily convertible into biodiesel meeting international standards. The oil can be combusted as fuel without being refined. It is found to be growing in many parts of west African countries. Many *J. curcas* plantation experiences were capitalized.

However, the sustainability of *J. curcas* cultivation programs could be compromised by the lack of scientific knowledge on this plant. The technology gap for oil processing and equipment for biofuel use is a major handicap.

In this context, the specific objective of the project is to develop sustainable production and use technologies of *J. curcas* biofuel.

Approach of the Project

- The implementation strategy is based on a multidisciplinary, participatory and multi-actor approach
- It combines research methods in social sciences, experimental sciences and modeling.
- Research activities are conducted at different scales: laboratory, research station and on-farm
- Pilot sites were selected in countries to concentrate on-farm research activities

and thus, promote synergy and sharing data particularly for the development of models

- An internal participatory monitoring /



evaluation system was adopted to analyze the progress of the project and find solutions to difficulties

Major Results Achieved

- Significant outputs that can be used in breeding programs for improvement of *J. curcas* have been obtained:
 - A collection of more than 200 local accessions from that a dozen have more than 55% seed oil content
 - 100 seed-weight that present a high heritability and significantly correlated to oil content is identified as reliable criterion for screening at the early stage of accessions with high oil content
- Genetic basis of *J. curcas* is very narrow in Senegal and need to be widened through new introductions to sustain improvement programs.
- The main pests of *J. curcas* in the growing areas have been identified and described
- Allometric equations to estimate above-

ground biomass and belowground biomass have been established and tested in order to allow reliable and quick estimation of *J. curcas* plantations carbon stocks

- An input of 5 T/ha of *J. curcas* oil cakes in the field significantly improve soil properties and allow to increase yields of maize 5 times higher to the control
- Designing and confection of a motorized mechanical oil expeller press and a manual press that can easily be used for oil extraction in rural areas
- Successful adaptation of a single cylinder diesel engine with direct injection of 10.5 kW for use of *J. curcas* oil
 - Realization of a bicarburation kit
 - Preheating dispositive is made to reduce significantly oil viscosity
- 10 scientific papers have been published

in international refereed journals

Expected Impact

- Improving access to energy in rural areas to sustain agricultural intensification and rural entrepreneurship
- Mitigation of climate change through carbon sequestration
- Strengthening the access of farmers organizations in carbon markets by valorizing *J. Curcas* plantations carbon stocks
- Promotion of gender equality and empowerment of women who are main beneficiaries of multifunctional platforms
- Strengthening the West African research capacity by training young researchers and improving the level of laboratory equipment
- MSc in IFS.

Lead Institutions

- Ecole Nationale Supérieure d'Agriculture (ENSA)/Université de Thiès (UT), Senegal

Partner Institutions

- Institut Sénégalais de Recherches Agricoles (ISRA), Senegal
- Université Gaston Berger (UGB), Senegal
- Institut de l'Environnement et des Recherches Agricoles (INERA), Burkina Faso
- Université de Ouagadougou (UO), Burkina Faso
- Institut National de Recherches Agricoles du Bénin (INRAB), Benin
- Université Cheikh Anta Diop (Ucad), Senegal
- Institut de Recherche pour le Développement (IRD), France

Research Team:

Coordinator:

Dr Ibrahimia DIEDHIOU, ENSA/UT, Senegal

Institutional leaders:

- Pr Victor HIEN, INERA, Burkina Faso
- Dr Pape Madiallacké DIEDHIOU, UGB, Senegal
- Dr Djiby DIA, ISRA, Senegal
- Pr Issakha YOUM, UCAD, Senegal

Action Locations

- **Senegal** : regions of Kaffrine and Tambacounda
- **Burkina Faso**: Regions of Bobo Dioulasso and Bagré
- **Benin**: regions of Centre and North

Project:

- Duration 3 Years
- Total Cost of the Project: 876,732.22 €
- AUC Contribution: 697,781.31 €



Groundwater Resources In Basement rocks of Africa

Background

More than 50% of Africans still do not have access to safe water. Increasing reliable water supplies is an urgent need, and expanding irrigation to enhance food security is also a growing necessity. The ability to increase reliable water supplies depends on the development of groundwater which is generally the only perennial water sources in arid and semi-arid areas. Moreover, increasing appropriate groundwater supplies can significantly increase the resilience of rural communities to climatic variability and changes. However, about 40% of boreholes drilled in a large variety of ancient compact rocks (basement rocks) do not deliver enough water to address the people needs. Basement rocks are of major concern since they outcrop on more than 40% of Africa surface area. They are usually poor groundwater reservoirs but their overall properties are not well known. Thus, GRIBA project aims at improving the knowledge on groundwater in basement rocks of Africa.



Major Results Achieved

4 PhD are in progress and tens of masters have been trained in Benin, Burkina Faso and Uganda. With their support, we developed a new approach to quantify the amount of groundwater stored in basement rocks of Benin [1]. We found that 200 to 1,000 litres of water per square meter of surface area are stored on average in the different rock types [2]. We also estimated the amount of water that is discharging every year from the groundwater storage: the human abstraction (that is the pumping to supply domestic needs) is far less than the natural discharge (that is mainly the evapotranspiration of the vegetation).

Thus, an increased abstraction due to population growth will probably have a smaller impact on storage than already observed land-use changes.

We also found that the capacity of the groundwater storage to supply human and natural discharges is 6 years on average, which confirms groundwater's ability to buffer changes [2]. Our first estimate of the amount of groundwater renewed every year indicates that about 20% of the rainfall reaches the rock reservoir and that about half of the groundwater storage is renewed every year.

Approach of the Project

- GRIBA aims at improving the knowledge on groundwater resources in basement rocks of Africa.
- Work package 1: to quantify the amount of water stored and the productivity of the main types of basement rocks. A new approach based on the use of an innovative geophysical method named Magnetic Resonance Sounding (MRS) is developed.
- Work package 2: to develop scenarios for sustainable groundwater management based on groundwater modeling.
- Work package 3: to support the setup of a research consortium from 3 African countries and 2 European institutions.

Expected Impact

- The networking effort already allows regular exchanges between scientists and students, and future development of the project are planned.
- The research results of GRIBA will improve the practice of the actors of development to locate the best sites to drill boreholes and to manage groundwater in basement rocks..

[1] Vouillamoz, J.M., Lawson, F.M.A., Yalo, N., Descloitres, M., 2014. The use of magnetic resonance sounding for quantifying specific yield and transmissivity in hard rock aquifers: The example of Benin. *Journal of Applied Geophysics* 107, 16–24. doi:10.1016/j.jappgeo.2014.05.012
 [2] Vouillamoz, J.M., Lawson, F.M.A., Yalo, N., Descloitres, M., 2015. Groundwater in hard rocks of Benin: Regional storage and buffer capacity in the face of change. *Journal of Hydrology* 520, 379–386. doi:10.1016/j.jhydrol.2014.11.024



Lead Institutions

- Institut de Recherche pour le Développement, France

Partner Institutions

- Benin: Université d'Abomey Calavi (Laboratoire d'hydrologie appliquée)
- Burkina Faso: 2iE fondation and Université de Ouagadougou (Laboratoire d'Hydrogéologie)
- Uganda: Ministry of Water and Environment (Directorate of Water Resources Management) and Makerere University
- United kingdom: Queen's University of Belfast
- France: Laboratoire d'étude des Transferts en Hydrologie et Environnement

Research Team:

- Dr Jean-Michel Jean-Michel, IRD
- Dr Nicaise Yalo, UAC
- Dr Koita Mamadou, 2iE
- Dr Angelbert Biaou, 2iE
- Dr Youssouf Koussoube, UO
- Dr Callist Tindimugaya, DWRM
- Dr Michael Owor, MU
- Dr Jean-Christophe Comte, QUB
- Dr Ulrich Ofterdinger, QUB

Action Locations

- Benin, Burkina-Faso and Uganda

Project:

- Duration 3 Years
- Total Cost of the Project: 1,109,100 €
- AUC Contribution: 750,000 €



Background

Grain legumes the second most important food crop in the region cultivated by small-holder farmers. Thrips such as Bean Flower thrips (*Megalurothrips sjostedti*) are key biotic constraints inflicting 20- 100% yield loss. Pesticides are commonly applied to manage these pests with as high as 8 – 10 applications in a cropping season.

However, in grain legumes where the grains and leaves are consumed, pesticide based management strategies is not a preferred option. Regular use of pesticides also results in development of resistance among thrips populations. These constraints necessitate the development of integrated pest management (IPM) strategies that are less reliant on chemical pesticides use for thrips management

Approach of the Project

The project aims to enhance food and nutritional security and income generation capacity of small-holder grain legume producers of eastern Africa by reducing crop damage on grain legumes due to thrips in target smallholder grain legume production systems in Kenya and Uganda through eco-friendly Integrated Thrips Management Strategies and capacity building among National Agricultural Research and Extension System partners.

The project focuses to assess the severity and impact of thrips damage on beans, cowpeas and dolichos in Eastern Africa. Further it aims to develop and validate “Lure and kill” strategies utilizing entomopathogenic fungi and kairomonal attractant, LUREM-TR for integrated management of thrips on grain legumes. Identification and field evaluation of aggregation pheromone for Bean Flower thrips (BFT) is an innovative aspect of the project new to thrips science. Capacity



building in eastern African region on eco-friendly thrips management strategies on grain legumes is a key focus of the project.

Major Results Achieved

- Dynamics of thrips infesting grain legumes assessed and Bean flower thrips (BFT) was found to be the major pest of cowpea and dolichos.
- Ecological niche models predict increased intensity of BFT over time in West and Southern Africa
- Spatial separation of thrips attractant and entomopathogens enhanced their compatibility
- Methyl Anthrinalate, an alternative thrips attractant was compatible with entomopathogenic fungi
- Spot spraying of entomopathogenic fungi with thrips attractant was equally effective as foliar cover spray and more economical
- Effective repellent plant and essential oils for Bean Flower thrips have been identified
- Presence of Aggregation pheromone and active aggregation and presence sterna

glands for pheromone production has been demonstrated for the first time

- One Postdoc, 2 PhD and 2 Masters student researchers from Africa are trained in the project
- More than 15 Agricultural extension officers in Kenya and 40 farmers have been trained on Integrated pest management strategies for grain legumes
- Large scale demonstrations of integrated thrips management strategies are planned.

Expected Impact

.. The impact of the action is likely to impact the productivity of grain legume by mitigating crop losses due to the thrips infestation which are as high as 20 – 100%. Technically, the aspects of standardization of “lure and kill” strategies and identification of aggregation pheromone for BFT are very novel to the scientific community researching on thrips and their management. Since the thrips IPM strategies to be implemented in the project are focused on less reliance to pesticides, the environmental benefits are likely to be significant especially as most of the grain legumes are consumed as fresh green leafy

vegetables.

The efforts to develop phenological models for BFT infestation thrips damage in Eastern Africa and prediction of its changes with climate change scenario’s will assist policy makers to develop adaptation strategies to the same. The project seeks to build capacity and establish linkages with other regional organizations to ensure sustainability of the project action after the end of the project phase.



Field evaluation of “Lure and kill” strategies combining visual cues, thrips attractants and entomopathogenic fungi –Photo: icipe

Lead Institutions

- icipe – International Centre of Insect Physiology and Ecology icipe – International Centre of Insect Physiology and Ecology

Partner Institutions

- Plant Research International, Wageningen UR The Netherlands
- Kenya Agricultural and Livestock Research Institute, Thika Kenya
- Makerere University, Uganda
- Plant and Food Research, New Zealand

Research Team:

icipe – Drs. Subramanian Sevgan, Saliou Niassy, Jean Kalemba Maniania, Sunday

Ekesi, Thibaud Martin

Plant Research International – Drs Willem jan deKogel, Roland Mumm and Rob van Tol.

Makerere University – Prof. Samuel Ky- amanywa

KALRO – Drs. Johnson Nyasani, Monicah WaiganjoDr Youssef Koussoube, UO

Action Locations

- Kenya, Uganda

Project:

- Duration 3 Years
- Total Cost of the Project: 944,875 €
- AUC Contribution: 749,325 €
- www.icipe.org/thrips



Improving Indigenous Chicken Productivity for Enhanced Livelihood and Food Security in Sub-Saharan Africa (INCIP)

Background

Indigenous Chicken (*Gallus domesticus*) are raised by over 75% of resource-poor rural households and are important for nutrition and income security, and play a vital gender role in terms of cash incomes and savings, food security, nutrition and socio-cultural activities in sub-Saharan Africa. For instance, indigenous chicken (IC) accounts for 82% of the estimated 34 million chickens and contribute more than 35% and 55% of total egg and meat produced annually, respectively in Kenya and almost 75-80% of animal protein (excluding fish) in rural areas of Malawi. There is continuous increase in demand for IC products due to urbanization, increasing human population, decreasing agricultural land and consumer preference for IC meat. The popularity of IC among the resource poor rural households is attributed to their low cost of production, adaptability to harsh scavenging conditions and poor nutrition, and tolerance to parasite and diseases. Rural households in sub-Saharan Africa have been characterized by low income, food insecurity and high levels of poverty and therefore engage in production enterprises that require low inputs. Indigenous chicken production therefore is a promising tool to improve their livelihoods.

Approach of the Project

- Project management through joint coordination, implementation and evaluation
- Development and packaging of performance improvement and environmental friendly production technologies along the IC product value chain
- Validation of IC technologies and Promotion of IC utilization along the IC product value chain
- Promotion of partnership in service delivery and agribusiness development
- Visibility and multiplication of the project's activities and results

Major Results Achieved

- Over eighteen (18) postgraduate and 10 undergraduate students involved in the project's research work
- Over 20 technical papers have been produced and published in internationally peer-reviewed journals and more papers presented at various local and international conferences.
- An established poultry breeding and research unit at Egerton University, Kenya and at Lilongwe University of Agriculture and Natural Resources (LUANAR), Malawi.
- Importation of parent stock of Rhode Island Red, a dualpurpose breed from Hendrix Genetics in Netherlands
- An animal feed production unit, branded "Egerton Feeds", has been established.
- Pioneered the use of Artificial Insemination in IC, which was disseminated to farmers.
- Several IC technologies have been developed and validated
- An energy-renewable system has been installed within the Poultry Breeding and Research Unit to demonstrate environmental friendly animal production
- A green house technology to demonstrate production of chicken under such technology to combat chilling challenges in cold high areas has been successfully installed.
- An SMS-based marketing and information system has been developed under the name "M-FUGO".
- Outreach programmes and short courses are being carried to facilitate dissemination of the developed technologies and information to target beneficiaries from different communities.
- An active project website (www.incip.org) has been developed

- Five issues of the project newsletter have been published
- The programme has purchased two field vehicles to strengthen national fieldwork capacity
- A high capacity (over 75,000 eggs) incubator for production of day old IC for dissemination to farmers is currently being installed.
- An agribusiness incubation centre has been developed and incubated businesses along the IC value chain, which are currently on operation.

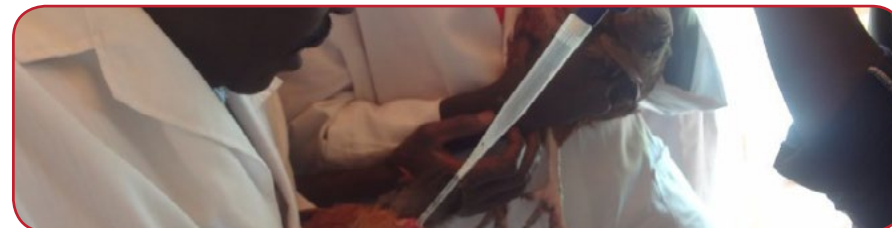
Expected Impact

- Contribute to poverty alleviation and income and food security of smallholders and disadvantaged actors in the indigenous chicken (IC) sub-sector
- Smallholder, and other disadvantaged stakeholders in Kenya and Malawi enabled to be involved in a coordinated IC sub-sector
- Promote utilization of IC by dissemination of improved IC technologies through promotion of partnerships in service delivery and agri-business development
- Adaptation of IC production to changing environmental dynamics and the effects of



climate change

- Enhance policies for IC production and facilitate the involvement of smallholders
- An African-European research and academic partnership network established for further research on IC and on strategies for adaptation to the effects of climate change
- Interdisciplinary research and academic partnership fostered to help in the development of expert knowledge in IC production and environmental management
- Private-public sector partnerships that equip smallholder farmers and specialists to sustain quality IC production established



Lead Institutions

- Egerton University, Kenya

Partner Institutions

- Lilongwe University of Agriculture and Natural Resources, Malawi
- Wageningen University - UR, The Netherlands

Action Locations

- Kenya:- Western, North-Rift and South-Rift
- Malawi:- Northern and Central Regions

Research Team:

Prof. Alexander K. Kahi, Egerton University, Kenya, Prof. Thomas N.P. Gondwe, LUANAR, Malawi, Prof. J.A.M. van Arendonk, Wageningen University-UR, The Netherlands

Project:

- Duration 3 Years
- Total Cost of the Project: 1,041,859.00 €
- AUC Contribution: 749, 096.62 €



Background

The armed conflict that prevailed in southern Senegal for nearly 30 years has upset the social and economic life in this region and in the border areas with Gambia and Guinea Bissau: thousands of people were displaced, social infrastructure were destroyed, farming areas were polluted by mines, many victims among the civilian population were noted. The people most affected by the conflict are mostly farmers, who can no longer use their land, and thus were forced to abandon their villages and often, in the process, have lost all means of production.

Since early 2000, the security situation has gradually improved and producers are engaged in a process of returning to their villages. Thus, the Government of Senegal has launched a vast program of reconstruction and revival of economic and social activities in Casamance (PRAESC). The revival of agricultural production is a very important component of this program.

This action aims to improve the productivity of agricultural activities in resettled villages to consolidate peace.

Approach of the Project

Quality seeds, appropriate crop management and committed producers are the essential elements of an efficient agriculture. To bring together these elements, the action will put in place a mechanism that will allow for producers to have seeds in due time. This mechanism includes steps : (1) Research produces the first seeds levels (foundation seeds), (2) certified seed producers continue the process in order to ensure availability of seed at the producers' level. Furthermore, the production constraints will be identified and solutions sought to overcome them. Once the technology needed to overcome the constraints are developed or adapted,

they are shown to producers through demonstration plots, which will also serve as training field for capacity building for producers (for the application of the technologies). Producers thus trained will be more efficient in their production activities.

In addition, the study of sectors, such as field crops, particularly cereals, and forest fruits, will lead to understanding how they are organized and propose improvements for better functioning. The produces will be better valorized, and the producers' incomes will be improved.

Major Results Achieved

- Foundation seeds of cereals are produced by research (rice : 3,354.4 kg for 17 varieties; maize : 570.5 kg for 4 varieties; sorghum : 73.5 kg for 2 varieties)



Record production of sweet potato by a farmer (Guinée Bissau)

- Certified rice seed are produced and made available to producers (4,063 kg)
- Baseline situation of family farms in Casamance established
- Establishment of 0.5 ha of Rhizophora mangrove propagules to participate to the mangrove ecosystem rehabilitation
- 5,000 plants of Detarium senegalensis and 5,000 plants of Saba senegalensis produced for forest fruits

species conservation

- Establishment of 6 hectares of assorted multipurpose tree species, in 5 communities, for regeneration/enrichment
- Training of 137 farmers and technicians to good agricultural practices

EXPECTED IMPACT

- Returned farmers stay in their villages and produce, on a regular and sustainable basis, their food needs (and more);
- Agricultural productivity is greatly improved



Returned farmers receiving rice seeds from the project team members

Lead Institutions

- Institut Sénégalais de Recherches Agricoles (ISRA)

Partner Institutions

- National Agricultural Research Institute (NARI)
- Instituto Nacional Pesquisa Agraria (INPA)

Action Locations

- Sénégal : Régions de Ziguinchor, Sédhiou et Kolda
- Gambie : North Bank Region
- Guinée-Bissau : Région de Bafatá e Gabú

Project:

- Duration 3 Years
- Total Cost of the Project: : 749,442.65 €
- AUC Contribution: 545,049.21 €

Research Team

- Saliou Djiba, Entomologie
- Dr. Katim Touré, Agro-économie
- Dr. Djiby Dia, Géographie
- Moussa Sall, Agro-économie
- Joachim Diouf, Suivi-Evaluation
- Youga Niang, Agronomie maraîchage
- Dr. Diénaba Sall Sy, Entomologie maraîchage
- Dr. Bothié Koïta, Agroforesterie
- Souleye Badiane, Agroforesterie
- Ansumana Jarju, Agroforesterie
- Simon Gomes, Agro-économie
- Elisio Pereira Barreto, Agro-économie
- Joao Aruth, Agronomie



Development of a cost effective, modular and dry concentrating solar power for Africa: design and test of components



Background

- Low electricity access rate in sub-Saharan Africa (30%), especially in rural areas where about 70% of people actually live
- Sahelian counties belong to the solar belt: this geographical position is very attractive for CSP plants implementation
- Concentrating Solar Power (CSP) could be locally manufactured (most components) but not PV up to now
- So far, CSP have been shown to be economically attractive only for high power plants (several MWel)

General Objectives

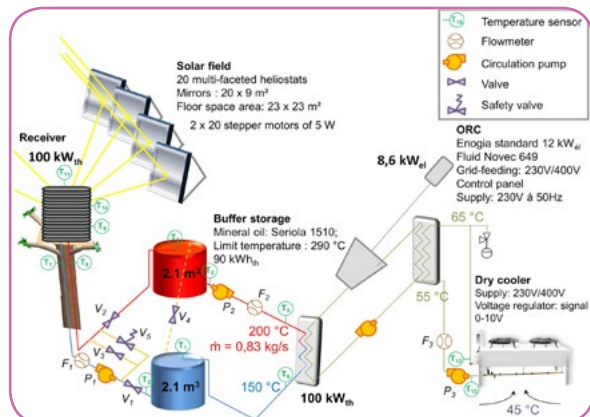
- Increasing access to energy services for rural and peri-urban populations in Africa
- Improve security of energy supply in peri-urban and rural areas, through electricity generation by solar energy
- Reduce the environmental impacts of energy services by providing clean and sustainable solutions (reduction of greenhouse gas, etc.)

Specific Objectives

- Develop a pilot cost-effective concentrating solar power plant for electricity generation by designing and experimenting their components using local low cost materials

Approach Of The Project

- Multi-scale design optimization from a multi-faceted heliostat level to a whole solar field for a 100kWth CSP (central tower)
- Implementation and testing of an optimal multi-faceted heliostat in Burkina and Ghana in order to cover several aspects of West Africa region
- Research on turbine: development of Tesla turbine (it could use several types of fluids: vapor, air, organic fluids, etc...)
- Design, implementation and testing of an optimal Tesla turbine for a 100kWth CSP
- Implementation of 100kWth central tower using the above components.



Layout of the power plant under construction at 2iE.

Expected Impact

- Technical capacity building across participating countries to implement CSP technologies in Africa and to be able to participate more fully and reverse the trend of dependence on foreign support for equipment, installation, maintenance, etc.
- Local mankind valorization
- Valorization of locally available materials
- Support for local industry / communities / national Departments of Energy/ Rural Electrification in in construction of CSP power plants
- Raising CSP technologies and bring them to the fore as viable options for electrification and thermal energy provision.
- Reinforcement of intra-regional scientific research collaboration

Major Results Achieved

"Human scale" multifaceted heliostat built at 2iE



(a).Receiver built at 2iE (b) Receiver during test (c) Tower



Lead Institutions

- International Institute for Water and Environmental Engineering

Partner Institutions

- The Energy Center, Kwame Nkrumah University of Science and Technology (KNUST)
- SIREA
- ECOWAS Regional Centre for Renewable Energy and Energy Efficiency (ECREEE)

Action Locations

- 2iE Kamboinsé, Ouagadougou (Burkina Faso)
- Wa Polytechnic, Wa (Ghana)

Research Team

- 2iE / Laboratory for Solar Energy and Energy Savings (LESEE): Dr K.E. N'Tsoukpoe, E. Clerc, J. Zmuda, M. Gaye, M.K. Sani, Y.M. Seshie, S.E. Kenda Nitedem, G.K. Ko, Prof. P. Neveu
- KNUST / The Energy Center: Dr E. Ramde, Dr Y.A.K. Fiagbe
- SIREA: Dr A. Jourdan, B. Bouteille

Project:

- Duration 3 Years
- Total Cost of the Project: 1,004,184 €
- AUC Contribution: 743,096 €



Fostering Renewable and Sustainable Energy in Africa through R&D



dependence on imported energy and fostering science, technology and policy supporting research in the field of Renewable and Sustainable Energy. This would be achieved through †enhancing †networking† at national and regional level among key institutions in the renewable and sustainable energy and promotion of †best adapted Renewable Energy Technologies† (BRETs). In addition of supporting policy makers to develop national †Renewable Energy Strategies.

Major Results Achieved

- Analysis of the Production by Source
- Analysis of the current state of distribution networks
- Estimations on energy demand and consumption
- Evaluation of technologies for using renewable energies in four African countries was achieved
- Characterization of the renewable energy sector in the target countries was achieved
- Analysis of trends in renewable energy industry growth in the target countries was achieved
- Identifying barriers to entry for renewable energy technologies was achieved



Background

FORWARD is a 24-month project financed through the financing agreement between the European Commission and de African, Caribbean and Pacific (ACP) Group of States, under the African Component of the ACP Research Pro-gramme for Sustainable Development Pro-gram, of the 10th European Development Fund.

The Overall objectives of this Programme are to improve science and technology research to contribute to African sustainable development through:

- innovatively and sustainably building Africa's research capacities through direct funding of the AU Science and Technology Policy, particularly the implementation of the Consolidated Plan of Action (CPA) and its light-house projects; and
- enhancing intra-regional scientific research collaboration and cooperation that contributes to Africa's sustainable development

Approach of the Project

The approach of project is a holistic approach by †contributing to the African sustainable development by decreasing

- Mapping of R&D activities in participating countries & stakeholders mapping was achieved
- Raising awareness on RE applications and networking was achieved
- National working groups for RE was established in participating countries

Expected Impact

- System of indicators for the evaluation and follow-up of renewable

energy technologies

- Country-specific Best Adapted Renewable Energy Technologies (BRET) reports
- Tailored policy recommendations for the promotion of the use of energy from renewable sources and the development of country-specific Renewable Energy Strategies
- Sustainability Strategy to ensure mainstreaming of results.

Lead Institutions

- Egypt National Cleaner production Centre

Partner Institutions

- Uganda Cleaner Production centre
- Cleaner Production Centre of Tanzania
- Ethiopian Standards Agency Cleaner Production Centre
- Andalusian Institute of Technology

Action Locations

- Egypt, Tanzania, Uganda, Ethiopia, Spain

Research Team

- Mr Ali Abo-Sena, ENCPC, Egypt
- Mr Tamer Samir, ENCPC, Egypt
- Eng. Juan Pablo, IAT, Spain
- Mr Antonio B-ez, IAT, Spain
- Mr Silver Ssebagala, UCPC, Uganda
- Ms Happy Asingwire, UCPC, Uganda
- Ms Anne N. Magashi, TCPC, Tanzania
- Mr Cleophas Migiro, TPCT, Tanzania
- Mr Ketema Tolosa, ECPC, Ethiopia

Project

- Duration - 2 Years
- Total cost: 901,707.98 Euro
- AUC contribution: 721,366.38 Euro
- <http://www.forward-project.com/forward/index.html>





Adaptation of small-scale biogas digesters for use in rural households in Sub-Saharan Africa



Major Results Achieved

- 2 Msc's and 3 PhDs trained in Ethiopia, Uganda & Cameroon.

WP1: Socio-economic assessment of factors limiting uptake of biogas digesters in SSA compared to other parts of the world

- Analysis of uptake of biogas digesters in different farming systems
- Financial and economic analyses of biogas digesters

WP2: Quantification of resource flows in farming systems with different digester types (fixed dome; floating drum; flexible balloon)

- Energy villages selected in the 3 countries and digester installation done
- Quantified energy use, carbon and nutrient sources, measured indoor air quality

WP3: Adaptation of designs of digester and farming systems to minimise barriers to uptake and optimise efficiency of resource use and feedstock treatment

- Developed Computer software for concept and detailed design of installation within the household system
- 3D models of digesters developed for adaptation



Key Components of a Biogas System

Background

The Afri-Flame project is a biogas research and implementation programme. It aims to adapt existing biogas digester and gasifier stove technology and develop local approaches for rural households in Sub-Saharan Africa. Initially, trials are being run in villages in Cameroon, Ethiopia and Uganda.

Approach of the Project

The bulk of the research work is done by Masters and PhD students under supervision of the research team. Project work is divided into work packages

- **WP1:** Socio-economic assessment of factors limiting uptake of biogas digesters in SSA compared to other parts of the world
- **WP2:** Quantification of inputs, outputs and flows of energy, finance, nutrients, carbon and pathogens in farming systems designed around different types of small scale biogas digester
- **WP3:** Adaptation of designs of biogas digester and farming systems to minimise barriers to uptake and optimise efficiency of resource use and feedstock treatment in SSA
- **WP4:** Development of a toolkit to support promotion, selection, installation and long term use by rural households of small-scale biogas digesters
- **WP5:** Management.

- Household layouts developed to guide the placement of digesters

WP4: Develop a toolkit to support promotion, selection, installation and long term use by rural households of small-scale biogas digesters

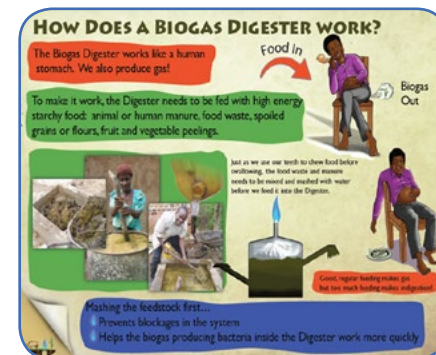
- Trainings conducted on use of the digesters in the villages of the project operations
- Created a universal brand- "Afriflame"
- Made printed education material and interactive digester models.
- Created website -www.afri-flame.net
- Step-By-Step Construction Manuals
- Biogas Digester User Guides for all 3 types of digester

Expected Impact

- Increased and long term use of small

scale biogas digester in SSA

- Increased sustainable usage of resource like water, slurry
- Adaptation of digester designs to SSA for increased functionality
- Increased awareness of digester use and maintenance among rural households for durability of digesters.



Lead Institutions

- Makerere University

Partner Institutions

- Addis Ababa University
- Institute of Sustainable Development
- Catholic University Cameroon
- Phytobiotechnology Research Foundation (PRF)
- University of Aberdeen
- The James Hutton Institute
- Climate Futures
- Oskrov Foundation
- Green Heat Uganda

Action Locations

- Uganda
- Ethiopia
- Cameroon

Research Team:

- Prof. Johnny Mugisha, Makerere University
- Prof. Jo Smith, University of Aberdeen
- Dr. Assefa Abegaz, Addis Ababa University
- Dr. Lisa Avery, The James Hutton institute
- Dr. Kenneth Yongabi, Catholic University & PRF
- Charles Henderson, Climate Futures
- Sue Edwards, Institute for Sustainable Development
- Gabriel Okello, Green Heat Uganda
- Dr. Robert Orskov, Orskov Foundation

Project:

- Duration 3 Years
- Total Cost of the Project: 957,527 €
- AUC Contribution: 748,865 €

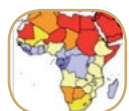


Background

Pastoralists are migrating cattle herders. In Africa, ca. 18-20 Mio pastoralists produce ca. 60% of the meat and ca. 30% of the GDP. During history they have been relegated to the drylands where they are affected by climate



Pastoralists UNDP



Water Stress (IPCC)

change, degradation of natural resources and limited social and economic infrastructure. According to UNEP almost all Sahel countries face increasing water vulnerability, water scarcity or even water stress. In line with UNDP the SUNARPA team is convinced that one of the major causes of the water crisis is a crisis of governance. The increased number and intensity of water conflicts are indicators.



Violent Conflicts (google.de)

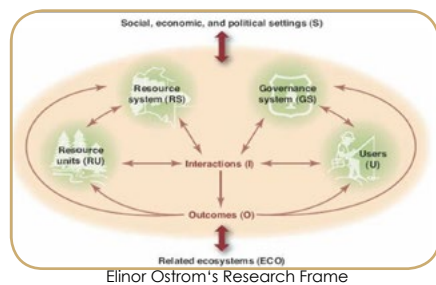
Approach of the Project

Social, economic, political, ecological science provides the know-how for introducing any sustainable innovation & technology. Peace is the underlying condition for any development. Aiming at making use of water in pastoralist areas sustainable & peaceful the project uses the interdisciplinary research frame of Nobel Prize winner for economy Elinor Ostrom. It focuses on analysing the Socio-Ecological Systems and serves the SUNARPA Team to analyse conflicts and options of conflict resolution and peaceful water

management. The Team aims at designing ways out of the pastoralist crisis by creating evidence-based know-how for decision-makers and pastoralists.

The team conducts studies on water governance and conflicts in pastoralist areas using literature reviews, regional /transboundary field research, stakeholder and conflict analyses, workshops, conferences, publications.

The SUNARPA Team represents the disciplines: Agriculture & Livestock, Economy, Environment & Pastoralism, Gender Studies, Geography, International & Development Studies, Law, Literature & Communication Science, Management of Natural Resources, Peace & Conflict Studies, Political & Social Science, Soil Science/Pedology, Water Engineering.



Major Results Achieved

The interdisciplinary research methodology, State-of-the-Art reports on water governance have been drafted and stakeholders mapped. An online literature bank to be handed over to the partner universities has been established. Joint field research has been undertaken. Scientific colloquia, stakeholder meetings & conference have been held. Member universities have established master studies on pastoralism & environment and research teams.

Following research results have been developed so far:

1. Changes in land use accelerated desertification processes and reduced water retention capacity of soil. Chronic water scarcity leads to acute water crisis.
2. Regional water governance needs more integration of local people and their needs;
3. National water governance needs stronger enforcement on the local ground; rules need to refer to pastoralist's water needs;



(IGAD CEWARN)

4. Local water governance: There is competing demand for limited water resources and increasing differentiation of tenure & management regimes; exclusion appears as new concept. Capacity of local communities to manage water conflicts is declining.
5. Ostrom's approach needs adaptation to the African context by including broader conflict systems affecting the countries; weak security & law enforcement; layers of different tenure systems; different conflict & identity patterns.

Expected Impact

1. Scientific research /interdisciplinary and regional research capacities strengthened;
2. Science sustainable development strengthened: evidence-based know-how used by decision-makers;
3. Sustainable use of natural resources and peace

Lead Institutions

- University of Khartoum - The Sudan

Partner Institutions

- Amoud University, Somaliland; Abdou Moumouni
- University & Réseau International d'Etudes Stratégiques sur les Conflits en Afrique, Niger
- Ethiopian Civil Service University
- Intergovernmental Authority on Development (IGAD)
- New Generation University College, Ethiopia
- Technical University of Berlin and EcoDevelopment – Society for International Development Research & Planning Ltd., Germany
- Yabconsult, Sudan

Action Locations

- Djibouti, Ethiopia, Germany, Niger, Somaliland, Sudan

Research Team:

- Assoc. Prof. Dr. Musa Adam Abdul-Jalil
- Mohamed Heban Awale, BA
- Dr. Peter Ay; Dr. Debalkew Berhe
- Prof. Dr. Amadou Boureima
- Assoc. Prof. Dr. Boubacar Daouda Diallo
- Prof. Dr. Brigitte Fahrenhorst
- Associate Prof. Dr. Hussein Abubakr Ibrahim
- Matthew Gichile (pres.)
- Assoc. Prof. Dr. Tilahun Goshu
- Prof. Suleiman Guleid (pres.)
- Dr. Mounkaila Harouna
- Assoc. Prof. Dr. Mohamed Khadam
- Tesfaselassie Mezgebe, MA
- Yufnalis Okubo, LLM
- Dr. Abdalbasit Saeed
- Dr. Mesfin Tilaye
- Assoc. Prof. Dr. Gabriele Zdunnek
- Frank Zelazny, MA.

Project:

- Duration 3 Years
- Total Cost of the Project: 1,100,000 €
- AUC Contribution: 548,000 €



Background

Improvement of crop-livestock integrated farming productivity and market access through smallholder lead farmer concept project is been implemented in Malawi and Zambia with an aim of identifying, testing and promoting effective strategies/ technologies in integrated farming system (IFS) among smallholder farmers. This is to address the challenges of low productivity and profitability of agricultural activities in mixed crop and livestock farming systems dominant in the two countries among smallholder farmers. The three year project commenced in January, 2013 with bench marking of present crop livestock integration level in Mzimba and Mchinji districts in Malawi and Chipata district in Zambia. Lead farmers were selected to test the interventions identified through farmer group and expert panel discussions and modelling. The lead farmers are further to pioneer adoption and promotion of the appropriate interventions.

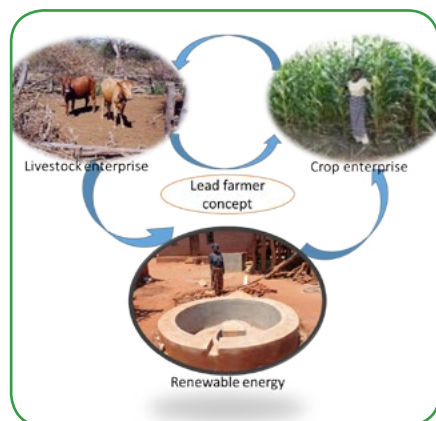
Relevance to Call

The project contributes to food security and reduction of poverty amongst smallholder farmers in Malawi and Zambia through identification and promotion of cost-effective and sustainable interventions for crop-livestock Integrated Farming System (IFS), creation of market linkages thereby contributing to availability of diverse crops and livestock and livestock products on the markets in the two countries. The project also aims at contributing to protection of the environment through biogas digesting animal waste for energy production using biogas digesters at smallholder farmer level before integrate the manure into crop production.

Approach of the Project

The project is implemented through four research steps, (1) surveying and benchmark-

ing present crop livestock integrated farming system (IFS); secondly developing and parameterizing desktop simulation/tools; thirdly identifying interventions/strategies;



and lastly testing effectiveness of interventions/ strategies in IFS with lead farmers. Further the project selected lead farmers in the project sites to participate in testing of the identified interventions and promote in their localities. The project engages lead farmers as stakeholder and provide resources in implementation of the interventions e.g. labour, land among others. Other project supporting activities include training of farmers in construction and utilization of biogas plant, promotion of simple biogas digesters through lead farmers, training of smallholder farmers in agri-business, facilitating and coordinating establishment of IFS lead farmers associations and linking the associations to farmer unions and capacity building at post and under graduate levels.

Major Results Achieved

- Benchmarking of current mixed farming system through baseline survey.

- Identification of 5 potential interventions to enhance integration of crops and livestock at smallholder level through farmer group and expert panel discussions and modeling..
- Selection of 60 project lead farmers in project sites.
- Mounting of 11 on-farm demonstrations on dual purpose crops, 11 demonstrations on maize-legume intercropping.
- Setting out and construction of 12 first phase biogas digesters at lead farmer home-steads.
- Crop residue sampling from 60 smallholder farms for nutritive analysis

Expected Impact

- Improved productivity of crops and livestock of at least 60% of smallholder farmers in the project area motivated

by the lead farmers through adoption of effective IFS strategies/ technologies;

- At least 70% increase on the annual smallholder household income from crops and livestock in integrated farming system;
- At least 80% reduction of fuel wood usage through use of biogas from small biogas digesters demonstrated under lead farmers;
- Capacity building through knowledge exchange of experts of different fields from both local and international institutions involved in research and networking;
- Improved marketing system of smallholder farmers through associations;
- Capacity building of 2 local scientists at MSc in IFS.

Lead Institutions

- Department of Agricultural Research Services (DARS)

Partner Institutions

- Zambia Research Institute, Msekera Research Station (ZARI)
- Mzuzu Agricultural Development Division (MZADD)
- Mzuzu University (MZUNI)
- Department of Agribusiness and Marketing

Research Team:

- M. C. Banda, DARS
- K. Kanenga, ZARI
- J. Munthali, MZADD
- C. Njombwa, DARS
- Dr. C. Mubamba, DVLD
- K. Gondwe, MZUNI.
- H. Malwa, ZARI
- D. Siyeni, DARS

Action Locations

Malawi:

- Mzimba District: Mpherembe, Bwengu, Mbawa and Bulala Extension Planning Areas
- Mchinji District: Mlonyeni, Mikundi, Chioshya and Mkanda Extension Planning Areas

Zambia:

- Chipata District: Katondo, Mwami, Chiparamba and Mafuta Extension Camps.

Project:

- Duration 3 Years
- Total Cost of the Project: 635,401.04 €
- AUC Contribution: 508,320.83 €



Using IWRM best practices to develop Appropriate Capacity and Training to benefit of Sub-Saharan Africa Water Security

Background

Access to sufficient and safe water is one of the major challenges Africa faces which has resulted in the continent's underdevelopment and increasing economic decline. International development policy makers are recognizing climate change and desertification as fundamental obstacles to the social economic development in the third world. Sub-Saharan Africa has been severely affected since the early 70's by the compounding effects of drought, deforestation and desertification. Climate change predictions suggest decreased rainfall, runoff and recharge, especially in large river. Predicted climate variability with its associated prolonged drought periods will have major implications on the sustainability and availability of water (resources). The overall aim is improving awareness of and access to knowledge that can provide more adequate water quantity of suitable quality throughout Sub-Saharan Africa.

Approach of the Project

The project framework consist of six primary research activities using three Umbrella themes with four cross-cutting and closely linked sub-project issues.

Activity 1: Understanding how transdisciplinary approaches achieve better water quantity, quality and more wise use;

Activity 2: Work with pilot area communities and water managers to scope locally pertinent and feasible alternative and practical solutions to specific water and waste stream management issues, identify capacity gaps and fill needs;

Activity 3: Create toolkits broadly applicable to Sub-Saharan Africa from existing and new knowledge gained;



Activity 4: Develop courses and material to help educate and train at higher education and community levels;

Activity 5: Update web-based portals by sharing IWRM knowledge gained especially applicable for Africa;

Activity 6: Identify implementation means and potential funding sources for pilot areas' agreed-to solutions.

Project Umbrella Themes:

U1: Water security in the context of Integrated Water Resource Management (IWRM);

U2: Effective Knowledge Sharing /Dissemination;

U3: Capacity Building (Society/ Water managers).

Cross-Cutting Sub-Project Issues:

SP1: Value of water; SP2: Water Quality

SP3: Water Quantity SP4: Climate Change

Major Results Achieved

In South Africa, hydrochemical and hydrograph analyses confirmed that the upper Berg River remains a groundwater dependent system. In Botswana, the need for new strategies to prevent excessive water diversions into small upstream dams, thereby improving flows into Gaborone dam, was evident. Livelihoods of local communities in the Senegal Delta are negatively impacted by invasive aquatic plant species (*Typha* sp.) which link to diminishing fish numbers and waterborne disease. A hydrometric monitoring network was installed in Malawi to help monitor rain-

fall, runoff to Lake Malombe and river water quality and quantity in an area of changing climate and resources stress. In Zambia, while water quality data suggests no acid drainage is occurring near the Munali Nickel mine, groundwater resources are not likely reliable to sustain future anticipated increased mining activities. The socio-economic value of water in Mozambique's Sabie area of the Inkomati River is being assessed looking at society's willingness to pay for water. Water policies are being analysed and recommendations from communities and other stakeholder are being used as key inputs to promote more logical and efficient water uses.

Expected Impact

New knowledge, policy briefs and agreed-to feasible technical interventions are being developed for and by stakeholders for each Pilot area. Governments and local communities can co-share the benefits. Transdisciplinarity is proving useful to get buy-in for solution-driven results. IWRM principles/best practices, aligned to stakeholder key inputs, seem to increase awareness of the need to act to increase their water security locally. This approach and engagement processes may help solve similar water security issues occurring elsewhere in Sub-Saharan Africa.



Lead Institutions

- CSIR (Council for Scientific and Industrial Research), South Africa

Partner Institutions

- University of Botswana (UB)
- University Cheikh Anta Diop (UCAD), Senegal
- Eduardo Mondlane University (UEM), Mozambique
- University of Malawi (UNIMA)
- University of Zambia (UNZA)
- University of the Western Cape (UWC), ZA

Research Team:

- CSIR: Dr. K. Kennedy; Dr. P. Oberholster

Botswana: Dr. P. Kenabatho; Prof. B.P. Parida

Malawi: Prof. S. Sajidu; Dr. M. Monjerezi

Mozambique: Prof. F.G. Mucavele; Prof. J. Mutondo

Senegal: Prof. A. Kane; Prof. S. Faye

South Africa: Dr P Oberholster, Dr. T. Kanyererer,

Zambia: Dr. H. Sichingabula; Mr. J. Kabika

Action Locations

- Botswana, Malawi, Mozambique, Senegal, South Africa, Zambia

Project:

- Duration 3 Years
- Total Cost of the Project: 937,469 €
- AUC Contribution: 749,975 €



ICT Tools for enhancement of irrigation efficiency in West Africa



Background

The most constraining factors that hamper growth in cereals and vegetables productivity in West Africa include inadequate use of fertiliser, insufficient access to improved seeds and markets, inadequate credit, low capacity, lack of processing/utilisation equipment, the need for irrigation facilities and production technology. Particularly the major gaps the action is aimed at bridging are: (i) excessive reliance on rain feed agriculture; (ii) lack of adequate irrigation support services and (iii) weak access to technology.

Informal irrigation schemes, which represent the vast majority of irrigation in most West African countries, are characterized by limited knowledge and skills in irrigation farming, and lack of sufficient support services from extension services and other advisory systems so as to realize its full potential. Thus irrigation scheduling, which concerns the farmers' decision on "how much" water to apply and "when" to irrigate so as to maximize crop profit, is not properly conducted, since it a very complex decision making process requiring specific knowledge on crop water requirements and irrigation methods and equipments.

The development of the proposed ICT-based irrigation advisory service will advice farmers on their crop irrigation needs and irrigation scheduling, as well as on the most suitable irrigation technologies.

Approach of the Project

At least 6 pilot fields will be selected through a participatory process involving researchers, extension, meteorological services and benefi-

ciaries. A sensor network capable of monitoring key environmental parameters at the pilot fields of Ghana and Senegal in an accurate and reliable way will be implemented, in order to use the obtained environmental data for determining crops' water needs based on water balance models. These water balance models will be adjusted in the 6 pilot fields, during the two first years of the project based on field observations. An ICT-based irrigation advisory service will be implemented in the pilot fields of Ghana and Senegal. The implementation will embrace the integration of the sensor networks and the ICT-platform, and testing of communication and data transmission between the sen-



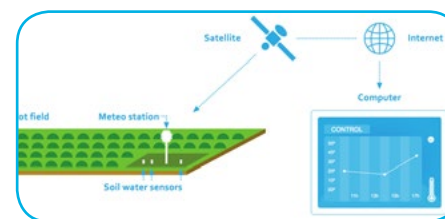
sor networks deployed at the pilot fields and the ICT platform. The results obtained during the implementation and testing at the different pilot fields of Ghana and Senegal will be used to assess the benefits derived from the ICT-based irrigation advisory service. The assessment of results will include the quantification of the improvements in irrigation efficiency, the assessment of environmental, social and economic benefits of the system and the technical and economic feasibility of the system. Different dissemination events and training sessions for farmers will be conducted. Dissemination activities will include, workshops, training sessions

with farmers, in order to strengthen African stakeholders' capacities towards irrigation advisory services and ICT tools for agricultural sustainability, and ensure replicability to other regions of Africa.

Major Results Achieved

The research activities conducted will be aimed at enhancing irrigation efficiency and increase cereal and vegetable crops productivity in West Africa, through the testing and transfer of ICT and innovative irrigation advisory services. The research activities include:

- (i) Develop and adjust a soil water balance model for determining irrigation requirements of crops such as rice and vegetables;
- (ii) Design, development and implementation of a sensor network for monitoring environmental parameters;
- (iii) Design, development, implementation and testing of an ICT-based irrigation advisory



Lead Institutions

- Neiker (Basque Institute for Agricultural Research and Development), Spain

Partner Institutions

- CORAF/WECARD (West and Central African Council for Agricultural Research and Development), Senegal.
- CSIR-WRI (Council for Scientific and Industrial Research-Water Research Institute), Ghana.

Action Locations

- Weija (Ghana), Bontanga (Ghana), Akumadan (Ghana), Kpong (Ghana), Fanaye (Senegal), Vital (Senegal)

service.

(iv) Build on target stakeholders' capacities in irrigation and ICT technologies and foster replicability to other African regions through wide spread dissemination of the project outcomes.

Expected Impact

The execution of the action will allow for the creation of research alliances between African and European research institutions (CSIR, WECARD/CORAF and NEIKER) and African rice and vegetable smallholder farmers, which will collaborate in the execution, monitoring and evaluation of the action.

Another added-value element of the action is related to the implementation and testing of innovative irrigation technologies and advisory services that will enable to enhance irrigation efficiency and water resources management in the African agricultural sector. This will bring considerable environmental and social benefits related to water savings and increased food security. At the same time, the implementation of ICT tools and innovative irrigation technologies in close cooperation with target stakeholders will result in capacity building, overcoming one of the main barriers of smallholders that is, weak access to technology.

Research Team:

- NEIKER (Spain): Dr. Gorka Landeras (Neiker); Mr. Ernesto Ortiz (Neiker),
- CSIR (Ghana): Dr. Joseph Ampofo; Dr. Emmanuel Obeng Bekoe; Dr. Emmanuel Obuobie; Mr. Frederick Logah; Ms Deborah Ofori.
- CORAF-WECARD (Senegal): Dr. Ernest Asiedu; Dr. Ousmane Ndoye
- ISRA (Senegal): Dr. Mbaye Diop,

Project:

- Duration 3 Years
- Total Cost of the Project: 1,069,480 €
- AUC Contribution: 748.636,36 €



Improved management and technological innovation in African tilapia farms and hatcheries

AURG-2-139

Background



Tilapia production and its importance both to the economy and to social welfare varies largely among African countries. Despite some cases of success, such as Egypt (one of the top five producers of tilapia in the world) aquaculture production has not made much progress in Africa, which is the region in the world with the lowest level of productivity. In Senegal, natural fisheries resources are currently overexploited whilst the country misses the opportunity of fully developing its high aquaculture capacity.

Furthermore, in spite of the different stages of development of the tilapia production in African countries, common issues are shared by most of the countries: a) poor management and lack of technological innovation, which hinders the productivity, the intensification of the culture and the professionalization of the sector; b) high environmental impacts, mostly related to water pollution, high water and electric consumption; and c) high socioeconomic impacts, mainly related to food safety and human health issues.

Approach of the Project

ITACA project uses a multi-pronged strategy focused on three main levels of intervention. The first level will bring as result the assessment and improvement of the economic, social and environmental sustainability of tilapia farms. To obtain this result, the action will analyse the key management factors determining the economic, social and environmental sustainability in at least 6 African tilapia farms. This will permit to define and implement in the selected fish farms management plans aimed at improving their sus-

tainability. After the implementation of the management plans, the variations in the sustainability indicators will be assessed so as to evaluate the cost-effectiveness, the efficiency and the replicability of the different management practices.

The second level deals with the transferring and testing of improved technologies for enhanced fry and fingerling production in African hatcheries. The action will focus on the development, implementation and testing in two tilapia hatcheries of Automated Monitoring and Control Systems for key environmen-



tal and production parameters due to its cost-effectiveness and the associated economic, social and environmental benefits.

The third level is aimed at reinforcing the research capacities through the sharing of experiences among partners and the execution of technical visits to relevant aquaculture research organizations and facilities both in Africa and in Europe.

Major Results Achieved

A set of 20 sustainability indicators defined for the assessment of Egyptian and Senegalese farms' sustainability.

Development of a 'Sustainability Barometer' for tilapia farms with 5 sustainability diagnosis scales.

Definition of 21 Management Plans for the improvement of sustainability in the pilot tilapia farms.

Design of an Automated Monitoring and Control System for the 2 pilot tilapia hatcheries.

Technical visits to relevant aquaculture organizations & facilities conducted in Spain and Senegal.

Development of Video Tutorials on Best Management Practices for sustainable tilapia production.

2 Project Workshops held with more 80 attendees.

Expected Impact

At least 70% of the selected indicators of social, economic and environmental sustain-

ability are improved in the pilot tilapia farms selected.

Management plans for improving sustainability put in practice in the 6 pilot tilapia farms selected.

At least 20 management practices for improving sustainability assessed.

An Automated Monitoring and Control System implemented and tested in 2 tilapia hatcheries.

Fry/fingerling production increased by 15% in the selected pilot hatcheries.

At least 200 relevant stakeholders identified and informed about ITACA Project.

Over 2,500 African tilapia farms and hatcheries reached by the action.



Lead Institutions

- National Institute of Oceanography and Fisheries of Egypt (NIOF)

Partner Institutions

- Institut Sénégalais de Recherche Agricole – Centre de Recherches Oceanographiques de Dakar-Thiaroye (ISRA-CRODT)
- Institut de Recerca i Tecnologia Agroalimentaries (IRTA).

Action Locations

- Egypt
- Senegal
- Spain

Research Team:

- Mohamed Abdel-Razik Essa (NIOF)
- Ashraf Mohamed Abdelsamee Goda (NIOF)
- Abdul Hakim El-Said El-Alfy (NIOF)
- Hamet Diaw Diadihou (ISRA-CRODT)
- Anis Diallo (ISRA-CRODT)
- Moustapha Dème (ISRA-CRODT)
- Alicia Estevez García (IRTA)
- Cristóbal Aguilera Jiménez (IRTA)
- Ricard Carbo Bacaicoa (IRTA)

Project:

- Duration 3 Years
- Total Cost of the Project: 1,069,280.46
- AUC Contribution: 748,496.32 €



Background

There is a general low access to electricity in Africa, and furthermore, most deprived households cannot afford electricity connectivity. To address these issue, Africa's abundant sunshine must be exploited for the benefit of its people.

This research project seeks to assess the potential of distributed grid-connected solar PV systems in rural electrification schemes and provide a strategy for meeting electricity deficit in rural Africa.

Approach of the Project

YEAR 1:

Installation of demonstration grid-connected solar PV plants in target rural communities in both Ghana and Botswana

Installation of weather station in target rural communities in both Ghana and Botswana

Study of Low-voltage distribution grid in rural communities

YEAR 2:

Power quality measurement and study of Protection, Safety and Operational requirements

Dynamic simulations and analysis of Low-voltage network

YEAR 3:

Economic analysis of grid-connected PV plants in low-voltage network as distributed generation source

Estimate distributed grid-connected solar PV potential as a strategy for meeting electricity deficit in rural Africa

Major Results Achieved

Kick-off meeting involving implementing institutions and project associates and stakeholders — August 2012

Selection of location of Walewale (Ghana) and Mokolodi (Botswana) as sites for implementing the Action — February 2013

Installation of Automatic Weather Station in Walewale (Ghana) - December 2013

Paper presentation at International Conference on Solar Energy Technology in Development Cooperation in Frankfurt, Germany — November 2014

Walewale (Ghana) LV distribution grid modeled using Paladin DesignBase and preliminary simulations done— January 2015

From preliminary simulation results, 2 abstracts on impacts of increasing PV penetration on distribution system voltage, total harmonic distortion (THD), and energy losses to be sent to International Conference on Clean Energy to be held in Botswana in September 2015



First phase of installation of 5 out of 7 solar PV systems at Walewale Project Site in Ghana completed — March 2015

Similar solar PV installations at the Mmokolodi Project Site in Botswana ready to take off and be completed in July 2015.

Public electric utilities, Independent Power Producers, Policy and regulatory agencies will develop requisite technical know-how and skills regarding distributed utility grid-connected solar PV technology

Expected Impact

Public electric utilities, Independent Power Producers, Policy and regulatory agencies will develop requisite technical know-how and skills regarding distributed utility grid-connected solar PV technology

This project will inform other AU member countries in their quest to develop national action plan to provide affordable and sustainable energy access to meet the United Nations SE4ALL goal of universal energy access by 2030

End-users will have improved quality of service in electric power supply

End-users will have reduced electricity bills which will translate into money savings

Utility company will experience less electrical transmission losses

Carbon emissions from thermal plants will be reduced which will translate into a clean environment

Rural communities will be exposed to modern energy services such as solar PV systems and smart/net-metering



Lead Institutions

- The Energy Center (TEC), Kwame Nkrumah University of Science and Technology (KNUST)

Partner Institutions

- Clean Energy Research Center (CERC) University of Botswana
- Department of Energy and Environmental Management (EEM), Europa-Universitat Flensburg

Action Locations

- Walewale, Ghana
- Mokolodi Village, Botswana

Research Team:

- Mr. Emmanuel Kwaku Anto
- Mr. Ebenezer Nyarko Kumi
- Dr. Emmanuel Akowuah

Project:

- Duration 3 Years
- Total Cost of the Project: 934,056.60
- AUC Contribution: 747,245.30 €



Limiting the impact of Cassava Brown Streak Disease on smallholders, women and the cassava value chain

Background



The main aim of LimitCBSD is to minimize the impact of the devastating cassava brown streak virus disease (CBSD) on

poor farmers in eastern Africa.

Cassava is a subsistence crop that provides more than half of daily dietary requirement for over 200 million Africans. In the last decade, cassava is severely affected by an epidemic of CBSD in Kenya, Tanzania, Uganda, Malawi, Mozambique Rwanda, Burundi, DR Congo and southern Somalia. The disease causes rotting of affected tubers making them unfit for consumption or marketing, and thus affecting food security as well as economic development. This project was set up to understand the impact of the disease on the poor, identify novel sources of resistance, use the latest technologies such as tissue culturing and next generation sequencing to identify resistance genes, and finally to increase the capacity of local partners by transferring the technologies developed.

Approach of the Project

We've six interlinked work packages (WP) in this project, where each key partner has taken the responsibility to lead at least one WP, and thus sharing responsibility as well as project ownership.

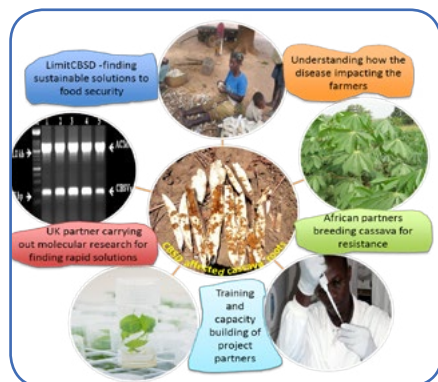
- WP1: Assessing economic and social impact of CBSD on smallholder cassava farmers, especially on women in affected communities—NARI Tanzania is the lead.
- WP2: Measuring the impact of CBSD on cassava end-uses, and identification of

alternative markets for affected cassava roots— TFNC Tanzania.

- WP3: Screen landraces for new sources of CBSD resistance, and develop breeding populations—DARS Malawi.
- WP4: Mine for CBSD resistance genes using next generation sequencing and develop molecular markers— NRI UK.
- WP5: Transfer molecular marker and tissue culture technologies to regional partners— NRI UK., and
- WP6: Coordination, monitoring and evaluation—All partners.

Major Results Achieved

WP1: We've conducted surveys in five major cassava growing regions of Kenya, Tanzania and Malawi and found that the disease has virtually caused the extinction of susceptible cassava varieties. This is a major loss of cassava germplasm. In areas where the disease is prevalent for some time, farmers have adapted to the situation by growing tolerant varieties (Hillocks et al., 2015, Journal of Phytopathology, in press). The disease, however, still causes direct yield losses in the



region of 3-7% which is equivalent to \$290-632 million per annum. WP2: CBSD negatively affects cassava root and flour quality. Infected roots with a severity scores of 1 (no disease symptoms) and 2 (mild symptoms) were still acceptable for human consumption and marketing as well as for preparing the high quality cassava flour (HQCF). Roots with scores 3, 4 and 5 (medium to severe and very severe symptoms) were unfit for human consumption or for HQCF (Hillocks and Maruthi, 2015, Food Chain, in press). WP3: We've screened over 100 land races and advanced breeding lines in Kenya, Tanzania and Malawi, and found about half a dozen lines showing high levels of resistance. WP4: Some of these lines are used for identifying resistance genes by Illumina sequencing of cassava transcripts (Maruthi et al., 2014, PLoS ONE 9(5): e96642). Over 700 genes were found to be uniquely upregulated in the resistant variety Kaleso

which will be further investigated. WP5: A training program on molecular diagnostics and tissue culturing was conducted in Kenya in April 2014, and a molecular laboratory was set up in Tanzania in March 2015. In addition, we're training one PhD student from Kenya in the UK on virus diagnosis, tissue culture and marker development. One MSc student is also trained in Tanzania on the effect of damaged cassava roots on poultry diet. WP6: All partners share the responsibility hence the project is progressing well.

Expected Impact

Our research is expected to minimize the impact of CBSD on smallholders in affected countries, and can save 100s of millions of dollars that would be otherwise lost due to disease. Reducing disease severity will greatly reduce the hard labor and drudgery on women who would spend much time peeling affected cassava roots.

Action Locations

- Kenya, Tanzania, Malawi

Research Team:

- Dr Maruthi MN Gowda, NRI, UK
- Dr Rory Hillocks, NRI, UK
- Dr Sophie Bouvaine, NRI, UK
- Dr Geoffrey Mkamillo, NARI, Tanzania
- Ms Bernadetha Kimata, NARI, Tanzania
- Dr Grace Mahende, TFNC, Tanzania
- Mr Mohammed Chando, TFNC, Tanzania
- Dr Ibrahim Benesi, DARS, Malawi
- Dr Albert Mohne, DARS, Malawi
- Prof Joshua Ogendo, Egerton University, Kenya
- Ms Emily Masinde, Egerton University, Kenya

Project:

- Duration 3 Years
- Total Cost of the Project: 776,116 €
- AUC Contribution: 620,893 €



Lead Institutions

- Natural Resources Institute, University of Greenwich, UK

Partner Institutions

- Naliendele Agricultural Research Institute (NARI), Tanzania
- Tanzania Food and Nutrition Centre (TFNC), Tanzania
- Egerton University, Kenya
- Department for Agricultural Research and Technical Services (DARS)
- Associate partner—Lake Zone Agricultural Research & Development Centre, Tanzania



Improvement of post-harvest and enhancement of fonio in Africa

AURG-2-163

Background



Small grains, long neglected, play an important role in the food security of some of the poorest populations. Fonio

is a very small African cereal that has long been the staple food of many rural families in West Africa.

Fonio is today rediscovered by urban consumers for its taste and nutritional qualities. Better enhancement of this cereal requires the mechanization of post-harvest operations.



Ears of fonio (© J-F. Cruz, Cirad)

Approach of the Project

The project develops the main following components:

- Research activities: design and experiments for technological innovations and achievements of surveys at the level of producers and small businesses.
- Activities of validation and transfer of postharvest equipment at the level of pilot units.
- Support and advice to craftsmen and manufacturers for the production of equipment.
- Publication of the research results and dissemination of simplified information

(demonstration, leaflets...) to the final beneficiaries. Strengthening the capacities of partners: training and support of innovation processes.

Major Results Achieved

1. Analysis of production and post-harvest systems in Guinea

The surveys conducted in Foutah Djallon (Guinea) showed that fonio was quoted as the main crop by 80% of producers, followed by rice (20%).

Producers wish to have equipment for harvest and a better dissemination of threshing, cleaning and hulling equipment developed by research over the past decade

2. Mechanisation of post-harvest techniques

Mechanization of harvesting remains difficult and the motor mowers tested should still be subject to news improvements.

The ASSI thresher was adapted to the fonio in the past, and the rice thresher, Vortex type, always being adapted shows promising results. The winnowing channel and the rotary sieve properly clean the fonio.

3. Processing and stabilisation techniques improvement

Washing – desanding (sand removal)

The washing of fonio after hulling and whitening can be achieved effectively through a small rotary washer.



Pre-cooked fonio (© J-F. Cruz, Cirad)

A prototype of "hydrolift" desander was designed and realized by Cirad to be tested in a SME in Bamako (Mali).

Drying

A cross flow dryer (CSec-T) and a 'solar greenhouse' dryer (CSec-S) were tested successfully at the ESP-UCAD, Dakar (Senegal). Their implementation in real conditions is scheduled in Kedougou in Eastern Senegal.

4. The innovation process in small processing plants.

The surveys carried out in Burkina Faso helped identify the main craftsmen and manufacturers of Ouagadougou and Bobo Dioulasso. A

survey was conducted in Mali to characterize SME of fonio processing in Bamako. A study is underway in cooperation with the NGO "Afrique verte", to study the process of dissemination of the GMBF fonio dehuller.

Expected Impact

- Boosting and enhancement of the fonio sector in West Africa by producing post-harvest equipment that fit the needs of village groups and fonio small businesses holders.
- Strengthening the network of promoters of the fonio sector (researchers, processors, SME, producers, manufacturers, NGO...).



"Solar greenhouse" dryer (© M. Rivier, Cirad)

Lead Institutions

- Cirad, France

Partner Institutions

- IRAG, Guinea
- IER, Mali
- IRSAT, Burkina Faso
- ESP-UCAD, Senegal

Action Locations

- Cirad, Montpellier, France
- IRAG, Conakry and Labé, Guinea
- IER, Bamako, Mali
- IRSAT, Ouagadougou, Burkina Faso
- ESP-UCAD, Dakar, Senegal

Research Team:

- Cruz J.-F., Cirad, France (Coordination)
- Béavogui F., IRAG, Guinea (WP1)
- Diallo T.A. IRAG, Guinea (WP2)
- Thauhay P., Cirad, France (WP2)
- Kébé C. M. F., ESP-UCAD, Senegal (WP3)
- Goli T., Cirad, France (WP3)
- Coulibaly S. & Guindo F., IER, Mali (WP3)
- Medah I., IRSAT, Burkina Faso (WP4)
- Ferré T., Cirad, France (WP4)

Project:

- Duration 3 Years
- Total Cost of the Project: 997,427 €
- AUC Contribution: 749,466 €



Recycling of plant and animal biomasses in crop-livestock system

Background



The project had its origin in the strong partnership between the FIFAMANOR and teaching and research organizations in Madagascar, and international research centers (CIRAD, IRD, ARP and CRA-W).

During a seminar, contacts occurred with partners in Mozambique and enabled to initiate a joint reflection on issues related to crop-livestock farming systems. Also, in the Indian Ocean region, the collaboration "North-South" is longstanding. In contrary, the examples of regional collaboration between "South-South" are few in number. The positive experiences of collaborations with Reunion Island (France) lead us to expand the "South-South" partnership while consolidating North-South partnerships already in place. Thus, the project was developed to optimize the management of the recycling of plant and animal biomass produced on the farm and to strengthen the scientific collaborations.

Approach of the Project

- Improve laboratories capabilities by the acquisition of needed materials and equipment.
- Characterize the biomass and soil resources by the validation of tools/methods low cost.
- Improve the synergy between crop and livestock systems by the recycling and the conservation of biomass and nutrients.
- Increase agricultural productions (rice, milk, etc.) by the promotion of innovative

agro-ecological techniques.

- Constitute a single and shared database by standardize collected data entry and aggregation modes at different levels (farmer, farm) and in each field.
- Develop scientific collaboration by structuring and animation of a scientific research network.

Major Results Achieved

- Technical training on tools/methods for resources monitoring.
- Calibration and prediction models from infrared spectrometers (raw materials, forage species and organic matter).
- Ring test between laboratories.
- Characterizations of crop livestock production systems.
- Project's database developed.
- On-station two trial rounds achieved on innovative agro-ecological techniques (conservation agriculture, silage, manure management).
- PhD works initialized and several student's thesis published.
- Several regional and international expertise missions and exchanges accomplished.



Expected Impact

- Agricultural productivity secured and better autonomy of farming systems.
- Synergy among crop and livestock improved (recycling & conservation of biomass/nutrients).
- Farmers dependence against external inputs (feed concentrates, mineral fertilizers, etc.) reduced.
- Farm's incomes and standard of living of farmers improved.
- Knowledge and skills of scientists, engineers, technicians strengthened.
- Supervision/training capacities of agricultural organizations improved.
- Capabilities of national institutions to manage international contracts enhanced.
- Continental and regional scientific research network established and functional.



Lead Institutions

- Center of Rural Development and Applied Research (FIFAMANOR)

Partner Institutions

- Reunion Island Pastoralism Association (ARP)
- Center of International Cooperation in Agronomic Research for Development (CIRAD)
- Walloon Agricultural Research Center (CRA-W)
- Antananarivo University / Livestock Department (ESSA)
- National Center of Agricultural Research (FOFIFA)
- Agricultural Research Institute of Mozambique (IIAM)
- Institute of Research for Development (IRD)
- Radioisotope Laboratory (LRI)
- Eduardo Mondlane University (UEM)

Action Locations

- Mozambique
- Madagascar

Research Team:

- ARP: 1 researcher
- CIRAD: 7 researchers
- CRA-W: 1 researcher
- ESSA: 3 research professors
- FIFAMANOR: 5 researchers
- FOFIFA: 5 researchers
- IIAM: 2 research professors
- IRD: 2 researchers
- LRI: 4 researchers
- UEM: 3 researchers

Project:

- Duration 3 Years
- Total Cost of the Project: 973,578.07 €
- AUC Contribution: 733,508.23 €



Towards an Innovative and Sustainable Production of Biofuels Related to African Potentials and Needs

Background

In western Africa, the initiatives for biofuels concentrate essentially on the production of fuels from oil seeds plants.

From a technical point of view, several possibilities of energy valuation of vegetable oils (VO) are possible : the use of 100% raw vegetable oil, the use of mixtures of vegetable oils with diesel oil, or the preliminary trans-

esterification of oil to obtain a fuel (biodiesel) with characteristics close to diesel oil.

The project focuses on two ways of production of biofuels : the mixture of vegetable oil with gasoil on one hand and the trans-esterification of vegetable oils on the other hand.

Major Results Achieved

New latex plant and seeds from oleaginous plants have been investigated and new en-

zymes which are active in oil transesterification have been identified.

Charcoal-based catalysts have been produced and characterized, and proved to be effective in the catalysis of transesterification of oils.

Stable mixes of diesel oil and cashew nut shell liquids have been formulated and shows interesting properties as biofuels. Preliminary combustion tests in diesel engines have been performed with satisfactory results in terms of combustion quality.

Expected Impact

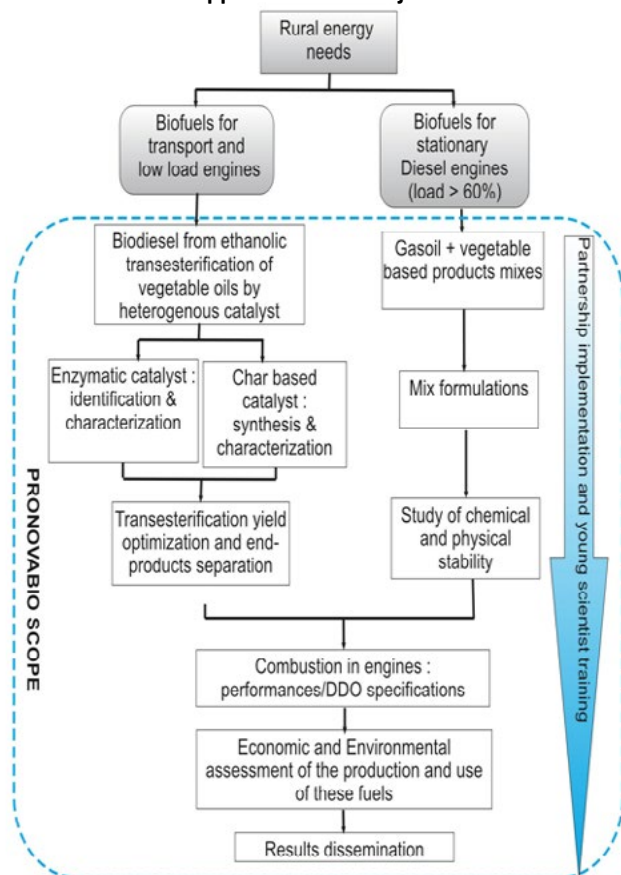
Propose simple solutions to implement for a substitution of the diesel oil by a biofuel or

mixture biofuel-diesel oil. This would enable to limit the share of energy in production costs while limiting the impacts on the environment, in particular the greenhouse gases. Operators of engines for food-processing products (husking machines, mills, pumps, press) and other processing of raw materials, as well as operators of generating sets for electricity production are concerned.

Create new markets for seeds and oil producers (e.g. Jatropha).

Provide a locally produced biofuel for transport application, so as to lower oil dependency, mitigate greenhouse gas effects and reduce air pollution from vehicle exhaust gas.

Approach of the Project



Lead Institutions

- Foundation 2iE, International Institute for Water and Environmental Engineering, Laboratory Bioenergy and Biofuel.

Partner Institutions

- EPAC, Abomey Calavi Polytechnic School Research Unit «and food Engineering» in Benin,
- ENI-ABT, Abderrahmane Baba Touré's National School of Engineer, Laboratory of Applied Thermic in Mali,
- The University of Ouagadougou, Laboratory of Analytic, Environmental and Bio-organic Chemistry, in Burkina Faso,
- CIRAD, International Cooperation Centre in Agronomic Research for the Development , Research Unit "Biomass, Wood, Bioenergy, Bioproducts " and Reseach Unit

“Agro-polymers and merging technologies”, in France

Action Locations


Benin, Burkina Faso, Mali

Research Team:

Dr Sayon Sidibé, Dr Igor Ouédraogo, Aristide Dejean, Apul Alain Kouteu, 2iE
 Prof. Mohamed Soumanou, Dr Fidèle Tchobo, Jospin Djossou and Mamouine Mazou, EPAC
 Prof; Yvonne Bonzi, Dr Issa Tapsoba, Nomamba Ouéda, UO
 Dr Joël Blin, Dr Sylvie Mouras, CIRAD

Project:

- Duration 4 Years
- Total Cost of the Project: 1,101,319 €
- AUC Contribution: 748,897 €



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