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Strengthening Capacity For Agricultural Research In Africa

As part of follow-on activities to SCARDA, RUFORUM is helping to document experiences from the SCARDA project. This issue describes experiences and lessons from some of the SCARDA trained graduates and the impact of the MSc training on their professional careers and institutions.

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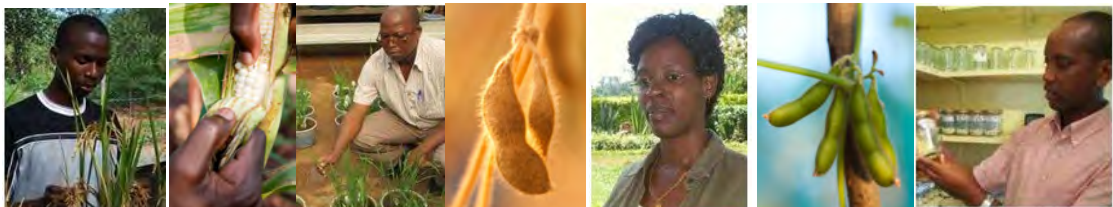
Contact: The **Newsletter Editor**, RUFORUM Secretariat, Plot 151 Garden Hill, Makerere University Main Campus, P.O. Box 7062, Kampala, Uganda.
Fax: +256 414 534153;
Tel: +256 414 535939;
E-mail: Secretariat@ruforum.org;



SCARDA Case Studies and Commentary

The project Strengthening Capacity in Agricultural Research and Development in Africa (SCARDA) aimed to enhance the performance of selected research and educational organizations in ten countries in sub-Saharan Africa. Particular emphasis was placed on strengthening linkages between these organizations and their key research and development partners to help foster agricultural innovation. One of the major components of the project was strengthening the quality of science in the target organizations and support for postgraduate studentships in priority topics was the key activity in this. A total of 78 students received training in topics as diverse as plant breeding, rangeland management and agricultural information and communica-

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tion management.

The SCARDA project was a continental initiative and was coordinated by the Forum for Agricultural Research in Africa (FARA), with technical support from the Natural Resources Institute of the University of Greenwich in the United Kingdom. SCARDA was



implemented by the three sub-regional organizations in sub-Saharan Africa that include Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), Conseil Ouest et Centre Africain pour Recherché et le Développement/West and Central African Council for Agricultural Research and Development (CORAF/WECARD), and Southern Africa Development Community-Food, Agriculture and Natural Resources (SADC-FANR), with assistance from three recognised educational organizations, namely, the Regional Universities Forum for Capacity Building in Agriculture ((RUFORUM), Centre Regional de Formation et d'Application en Agrométéorologie et Hydrologie Opérationnelle (AGRHYMET) and the African Network of Agricultural, Agro-forestry and Natural Resource Education (ANAFE). These educational organizations were responsible for matching the training needs of the target organizations to the most suitable service providers and for assuring the quality of the training that was given. This role was especially important in facilitating the process of Masters training.



As part of follow-on activities to SCARDA, RUFORUM is helping to document experiences from the SCARDA project. This issue highlights some of the experiences and lessons from some of the SCARDA trained graduates and the impact of the MSc training on their professional careers and institutions.

Mayada Mamoun Beshir, (Sudan), Agricultural Research Council, Sorghum Breeder,



Ms. Beshir has studied the development of molecular markers for introgression of resistance to Turicum leaf blight in sorghum. She had worked for the Agricultural Research Corporation (ARC) in Sudan in the biosafety and biotechnology research centre since 2006, and was nominated for a SCARDA scholarship in 2008. She graduated in August 2011 and is undertaking a PhD at Makerere under the regional plant breeding programme. Her work is contributing to knowledge of the inheritance of resistance to Turicum leaf blight in sorghum breeding materials relevant to central and eastern Africa.

She appreciated the chance to work full time on her studies (which was facilitated by her studying at Makerere rather than working and studying at her home station). This also served to enable her to finish on time. The experience at Makerere provided additional skills such as improved mas-

tery of English, learning to present findings and ideas in public, and sharing information with and learning from class mates, as well as African scientists at SCARDA and RUFORUM meetings. She won a competitive research grant from the RUFORUM Field Attachment Program Award (FAPA) and has published her results in conference proceeding and scientific journals.

The immediate impact of her work has been to identify the inheritance of Turicum leaf blight in sorghum (a disease of major economic importance) and to develop a mapping population which could be used for disease screening and QTL mapping. This population has promising lines for yield and for disease resistance. This work will be further developed under her proposed PhD programme. She will continue as a research scientist in the Biotechnology and Biosafety Research Centre.

She supports expanding RUFORUM to enable a much larger number of students to be trained and comments: "In Africa we have very many



Above: Mayada Mamoun receiving an award for the Best resource poor research during the 10th ACSS 2011 Conference in Maputo

younger people who are very much eager to learn but waiting for the chance."

Yaw Danso, (Ghana) CSIR-Crops Research Institute, Plant breeder.

Mr Danso did his MSc at the Kwame

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Nkrumah University of Science and Technology, Kumasi, in Ghana under a SCARDA scholarship awarded by CSIR. This study was conducted to screen tomato germplasm for root-knot nematode resistance. The work had several interrelated components. One involved a field trial on land heavily infested with root-knot nematodes. A second experiment was conducted in a plant house at CSIR-Crops Research Institute, and finally molecular screening was undertaken to identify the markers for the resistance genes. The six resistant cultivars identified in the molecular screening correlated well with the resistant phenotypes in the field and pot experiments. This study is



Above: Mr. Yawa Danso at the 10th ACSS 2011 Conference in Maputo

the first molecular screening of tomato germplasm for root-knot nematode resistant genes in Ghana.

Mr. Danso is now an Assistant Research Scientist at CSIR-Crops Research Institute, Ghana. He has published several papers from his MSc study. His current work is cocoyam germplasm for resistance to parasitic nematodes under field conditions, field evaluation of sweet potato elite cultivars for resistance to parasitic nematodes, and screening water yam varieties for resistance to parasitic nematodes in two agro-ecological zones of Ghana. He plans to pursue further studies in plant nematology, probably at the University of Reading in the United Kingdom. He comments

that all his schooling has been in Ghana and he would benefit from international experience. His proposed PhD study would be to introgress root-knot nematode resistant genes into elite susceptible tomato cultivars. His career objective is to be a plant breeder with a speciality in breeding for plant parasitic nematode resistance or tolerance in food crops.

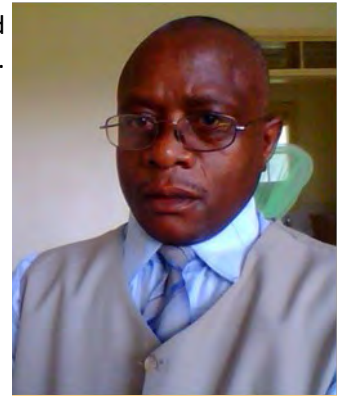
The Benefits from the RUFORUM programme included timely monthly payment of the stipend, a good annual book allowance, financial support for field work. The provision of a laptop was very valuable (although, in his case, it arrived somewhat late). His MSc was completed on time. The programme also paid the publication cost of one manuscript, and there was a very useful mentoring and integration programme organized for graduates. He was supported to present his work at an International Conference in Maputo, Mozambique in 2011.

Leonidas Dusengemungu, (Rwanda) ISAR, Responsible for the interface between research and end users.

Mr. Dusengemungu's thesis (which has been defended) was titled "Capacity for sustaining agricultural innovation platforms in Rwanda: a case study of Research into Use project." His hypothesis was that deliberate strategies are needed for agricultural innovation platforms to transition from being donor supported to being self-sustaining. These strategies must clearly identify the motivations of the key actors in the platforms, and address their training needs.

This case is particularly interesting as it involves a mature student who missed out on earlier scholarship opportunities and then his education was totally disrupted by the Rwanda genocide in 1994. He was exiled to Congo and lived in a refugee camp until 1996; the camp was destroyed and he took refuge in the forest, returning to Rwanda in 1998. He re-

sumed his B.Sc.



Above: Leonidas Dusengemungu

(Sociology) and graduated in 2002. In February 2005, he joined ISAR as a socio-economist researcher at ISAR. Although scholarships were available to ISAR staff, he was not selected, possibly because of his age (he was born in 1960) and abandoned ambitions for further studies. However, in 2008, he was awarded a SCARDA scholarship to study Agriculture Extension and Education at Makerere. He completed his course work in 2010 and will graduate in 2012, the only extensionist funded by SCARDA. He has published material from his thesis, including a book chapter contributed to a Wageningen University study.

As a mature student, he observes that *"this training is making Africa a better place for students. Of course they are not uprooted from their society and are better able to reintegrate quickly their into jobs. Many of African countries experienced war and social conflicts which do not allow students to finish up as quickly as they can at an earlier age. Now, old and young students were financed under RUFORUM/SCARDA. To me, as an old student, now 51 years old, I was happy to study near my family and to grow intellectually nearby my citizens. With RUFORUM/SCARDA I was not deprived of my roots. This is a first success of the program: putting students in African Universities rather than bringing them abroad and never come back."*

He was Head of the Outreach Pro-

Yazan Ahmed Mohamed Elhadi, (Sudan), Dryland Range Management



Mr Elhadi is from Sudan and graduated with a first class BSc honours degree. He was selected as a SCARDA student to study dryland management at the University of

Nairobi. His thesis subject was to investigate the links between seasonal climatic variability and poverty through a case study of pastoral and agro-pastoral communities in Baringo District, Kenya. This study was motivated by the need to ascertain whether poverty incidence, gap and severity can vary with seasonal climatic variability, and to identify determinants of poverty in sedentary agro-pastoral and semi-nomadic pastoral households. Data was collected through formal interviews using a structured questionnaire in the Njemps Flats, a semi-arid rangeland in the larger Baringo District (now Marigat and East Pokot Districts) of Kenya. The findings revealed that, unlike semi-nomadic pastoralists, sedentary agro-pastoralists tend to diversify their sources of income by utilizing the available resources for different economic activities. The analysis indicated that poverty was higher during the dry season, and that poverty levels were different between the semi-nomadic pastoralists and sedentary agropastoralists. The number of livelihood sources, household size, distance to the nearest market, ownership of enclosures and household herd size were the most important determinants of poverty in the study area. Counter intuitively, a negative relationship was observed between per capita daily income and household size in both

sedentary agro-pastoral households and semi-nomadic ones. Access to extension services and remittances were found to be the most significant determinants of poverty incidence under semi-nomadic pastoral land use system. Under sedentary agro-pastoral land use system, however, it was the number of livelihood sources followed by the education of the household head that had the highest effect on poverty incidence.

Diversification of household livelihoods through off-farm activities can therefore be recommended as a way of reducing poverty in semi-arid rangelands. This will reduce over-reliance on livestock and land as the primary sources of livelihood. Furthermore, the study recommends family planning and birth control to reduce the number of people directly dependent on pastoral livelihood. The evidence shows that poverty can be alleviated by focusing on income diversification in the short run and by education and formal employment in the longer term. Climate variability plays a major role in creating transient poverty, so seasonality effects need to be accounted for in planning interventions. Drylands can be significantly more productive with improved planning and sound intervention.

Mr. Elhadi completed his MSc on time and is now a self-sponsored PhD student at the University of Nairobi, Department of Land Resource Management and Agricultural Technology. He comments that the University of Nairobi has excellent professors in dryland environment and economics, and that supervision was accessible and friendly. The university has a wide range of scientific materials, a conducive learning environment, and helpful colleagues. He plans to develop his work in the arid areas of East Africa (with field work in North Eastern Kenya). The proposed focus will be on the effect of climate variability and role of gender in the camel products value chain. He has started the proc-

ess of developing papers from his MSc research to be published in peer-reviewed journals.

His career ambition is to become a senior research professional of a dryland management programme in Africa. He observes:

"I hope to rise to a position where I can authoritatively and confidently influence dryland resource management in the region for optimum use and improved livelihood. The rural communities in the drylands need to access safe and sustainable resources, which will end their struggle with poverty."

Guy Romain Aimé Kombo (Republic of Congo), Programme for the Protection and Conservation of Plant Genetic Resources



Cassava is an important both as a food and cash crop in the Republic of Congo. To evaluate varietal diversity and understand its

management on-farm in Bouenza department, 21 villages were surveyed in two agroecological zones (one forest, the other savannah). Individual surveys on 411 households revealed great varietal diversity and some 86 cultivated varieties were found. The mean count of varieties at village level was about 13 varieties. Most households grew between 2 and 5 varieties, with greater diversity typically in the forest zone. The mean value of diversity loss was 37.04% and the survey indicated that 66 varieties had disappeared.

Varietal preference criteria by farmers varied between groups but high productivity was the most common. Farmer's management of pests and diseases helped to maintain or mini-

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mize diversity loss. The main source of new materials is through introduction or exchange with other farmers. Knowledge of diversity will facilitate the implementation of participatory breeding program. Mr. Kombo graduated in 2010 and since then has been involved in two major activities:

- collection of local varieties of cassava and yams as well as participating in a number of workshops and seminars on cassava, and,
- the introduction, evaluation and dissemination of new varieties of beans under the auspices of the Pan African Bean Research Alliance (PABRA) in Congo-Brazzaville.

With respect to beans, 103 new bean varieties have been introduced since April 2010 and were launched on two sites (Boko-Songho and Madingou). Four new sites were introduced in 2010/2011. Mr Kombo has also been involved in research planning and developing gender awareness in research programmes.

Abubakari Mutari, (Ghana), Research Officer, Savanna Agricultural Research Institute



Mr. Mutari was nominated by his institute to undertake a study on the effects of post-harvest handling and 1-MCP application on the quality and shelf life of tomatoes. The research was carried out as a one year masters programme at the University of Greenwich in the UK. Two experiments were conducted between August



Above: Abubakari Mutari, during one of experiments at the research Institute

and September in 2009 at the laboratories of the Natural Resources Institute (NRI) of the University of Greenwich in the UK to assess the effects of physical impact and 1 – MCP application on ethylene production and quality of tomatoes. In the first experiment, ethylene production, respiration, ripening and weight loss increased significantly with temperature but there was no significant effect of temperature on fruit firmness. In the second experiment, there was a significant effect of 1-MCP treatment on total soluble solids but colour and firmness were not significantly affected.

After graduating, Mr. Mutari was promoted to Research Scientist. He has worked on a study to assess the effects of fertilization and stage of harvesting on the storability and shelf life of tomato. Another study is on the effect of integrated soil fertility and nutrient management on the quality of chilli and tomato in the Northern part of Ghana. He is the focal person for the Food for Life (F4L) project with the Community Life Improvement Programme (CLIP), an NGO in Tamale, Ghana. As such, he was awarded a

small grant to train and demonstrate to farmers the use of non-chemical methods of controlling storage pests of cowpea and maize, employing solarisation and triple bagging technology. I am also a secretary to the think tank of the F4L, with the responsibility for handling correspondence, organizing meetings, trainings, workshops and conferences.

The focus of his future work will be on the safety of horticultural produce. In Ghana, the horticulture industry is expanding and getting more attention from government and the private sector. Field observations show that the use of agrochemicals is rising sharply but farmers are not well informed on the use and safety of these products. He plans to address this critical need so that farmers can produce quality products without danger to themselves, their community, and the consuming public.

Michael Kwabena Osei (Ghana) CSIR-Crops Research Institute, Plant breeder

Mr. Osei's study was an evaluation of tomato germplasm for resistance to tomato yellow leafcurl virus (TYLCV)

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disease in Ghana and was undertaken at Kwame Nkrumah University of Science and Technology, Kumasi,

Ghana where he graduated in 2010. Tomato leaf curl disease is reported to be widespread in Ghana causing severe yield losses. The disease, caused by a whitefly-transmitted geminivirus, is of economic importance and has become a problem on tomato farms in Ghana. The study addressed this problem by firstly conducting a survey in five major tomato growing areas in the Ashanti region to find out farmers' perception of the disease. The field work involved taking samples of plants with TYLCV-like symptoms disease and then a separate farmer survey to identify disease hotspots.

Fifteen tomato accessions from the AVRDC and CSIR-CRI were initially screened in the greenhouse. This was repeated in farmers' field earlier on identified as a hot spot. The screening involved exposing the plants to whiteflies infected with tomato leaf curl disease in the greenhouse. To acquire the virus for successful screening of the accessions, the whiteflies were first reared and made to feed on infected plants with the disease symptom. These were repeated on a disease 'hot spot' in the field for further evaluation. Scoring for disease incidence and severity were done when plants were 30, 45 and 60 days after transplanting. Other important data such as fruit weights, plant height, and number of fruits per plant were also taken. In the next year, the fifteen tomato accessions were again planted in the field together with another 15 set of tomato accessions from Burkina

Faso, USA, Holland, France and Ghana for screening TYLCV-Resistance. PCR analyses were done on the 30 accessions to confirm the phenotypic screening. The farmer survey showed that farmers were familiar with tomato leaf curl disease but ascribed the causes to other factors such as lack of fertilizer, and pest (flies). The incidence was high at around 75% of plants infected. Their interventions were mainly spraying pesticides but this was to no avail.

Three begomoviruses were identified which were found to constitute two distinct begomovirus species. This was based on DNA-A sequence comparisons and the International Committee on Taxonomy of Viruses proposed species demarcation of 89% sequence identity. The names Tomato leaf curl Ghana virus for isolate GH5-3 and Tomato leaf curl Kumasi virus for isolate BOTB2-2 are proposed, respectively.

From the greenhouse and field screening of accessions from AVRDC and CSIR-CRI, there were no significant differences among accessions on the incidence of the disease and in terms of their ability to resist the disease. However, tomato accessions A1, A2 and A3 showed mild symptoms of TYLCV infection. In general, based on both phenotypic and molecular evaluations, four categories of accessions were identified, accession with symptoms and presence of viral DNA, accessions with moderate symptoms but relatively low concentrations of viral DNA, accessions with mild or weak symptoms but high levels of TYLCV concentration and accessions with weak or mild symptoms and no viral concentrations. During the study, all the accessions except B24 showed TYLCV DNA amplification in the PCR assay. However, all the accessions showed symptoms of TYLCV in the field. As such, no resistant accession was identified in this study. A number of refereed publications have resulted from this study.

Modise Rammika, (Botswana), Analytical Chemist in Soil and Plant Laboratory, Department of Agricultural Research

Mr Rammika works for the Department of Agricultural Research in Botswana as an Analytical Chemist in Soil and Plant Laboratory.



His job requires that he analyse soil and plant samples in order to advise farmers on fertilizer recommendations and specific soil problems and issues. His thesis involved developing an ion imprinted polymer for the determination of Ni(II) ions from mine tailings. This has given him exposure to sample preparation methods; in particular metal analysis. The methodology which he has developed enables pretreatment of plant and soil samples prior to analysis especially when testing for metal concentrations. His degree was taken at Rhodes University in South Africa and he graduated in 2011.

The research report is highly technical but the summary is repeated here. A Ni(II)- dimethylglyoxime ion imprinted polymer {Ni(II)-DMG IIP} was synthesized by the trapping method using the bulk polymerization format. The structures of the imprinted and nonimprinted polymer were evaluated by infrared spectroscopy and the morphology was observed by scanning electron microscopy. The Ni(II)-DMG IIP was optimized for pH, mass, time and by the uniform design experimental method for the molar ratios of monomer to crosslinker to porogen and template to ligands as well as keeping these parameters constant and varying the quantities of initiator, 2,2'-zobisiso-

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butyronitrile (AIBN).

The optimum pH was 8.5, optimum mass was 50 mg, optimum time was 1 min and the optimum molar ratios of crosslinker to monomer, monomer to template and nickel(II) sulfate-hexahydrate (NiSO₄·6H₂O) to 4-vinylpyridine to dimethylglyoxime were found to be 3.3:1.0, 0.6:1.0 and 1.0:0.6:3.6 respectively with 30 mg and 8 mL as the optimum amounts of initiator and porogen respectively. Through this optimization, recovery of Ni(II) was increased from 98 to 100%.

Selectivity of the ion imprinted polymer was evaluated by analysing, using an inductively coupled plasma-optical emission spectrometer, for Ni(II) ions that were spiked with varying concentrations of Co(II), Cu(II), Zn(II), Pd(II), Fe(II), Ca(II), Mg(II), Na(I) and K(I) in aqueous samples. Selectivity studies also confirmed that the ion imprinted polymer had very good selectivity characterized by %RSD of less than 5%. Co(II) was the only ion found to slightly interfere with the determination of Ni(II). The limits of detection and quantification were

found to be 3x10⁻⁴µg/mL and 9x10⁻⁴ µg/mL respectively.

His scholarship was awarded through his department and delivered everything he needed during the course of the work (although the stipend was low for South African costs). The ion imprinted polymer has never been developed before. It is an effective method which has excellent performance, selectivity and the simplicity while using cheap reagents. He comments: "This study indirectly demonstrates that at Master's level, a student can do a marvellous job".

The thesis is to be published as a book by Lambert Academic Publishing and he has a number of papers published in refereed journals.

"So this funding has really transformed my life and the future looks bright unlike before. So I am very very grateful for the funding and believe it can contribute to other young up and coming scientists in the future. In the future I will like to continue where I left and do more wonders in the world of research. I want to study in the United States so that I can study where technology is high so that my skills can match the current level of

understanding. I also want to get exposure to the latest technology and also to learn to adapt to different cultures as I understand a lot of people from all over the world go to the USA. I want to start collaborating with other scientists from the USA as I have now built a network of scientists in Africa while at Rhodes."

Mr Rammika would like students to have more control over the allocation of funds (and to account directly for their decisions). This would increase their understanding of managing resources. The sponsorship should also include funding for conferences as it is vital for scientists to travel and share experiences with other scientists. For example, in his case, the idea of using dimethylglyoxime as a ligand was the result of attending a SEANAC conference (his professor sponsored him). Mr Rammika had a poster presentation and another scientist, looking at his poster, advised that he try dimethylglyoxime. Finally he recommends that RUFORUM scholarships should be highly selective so that only the best applicants benefit, and that the programme extend to PhD and post-doctoral positions as well.

The overall story is one of competence, enthusiasm, and a real concern to make a contribution to African development. The students have been well supervised and finished their degree programmes on time. They have started developing professional networks and are confident with their new skills and knowledge. All have returned to their national institutions and are helping to rebuild research capacity. There is however an underlying concern of 'what next?'. They were well supported through their degrees in terms of resources and access to information and advice. In several cases, the graduates are returning to empty labs and facilities where they will be unable to exploit the new potential they have gained. This is possibly put most starkly in the Botswana case:

"...currently I am not active in the research world due to the fact that our government funding is continuing to dwindle every year due to global recession and we hear another recession coming so there won't be any research I will be doing while at work..."

Africa cannot afford to lose the talent that these cases expose. The SCARDA programme (through collaboration with RUFORUM and its counterpart organisations in other regions) has done a remarkable job in creating high quality masters level study opportunities for African students to do demand-led research in Africa. Young Africans are showing they can respond effectively to the chances they are being given. The next stage, which seems clearly illustrated by these cases, is to create post-masters employment experiences (using both the private and public sectors) through which these students can build an engaging career path. That may not be the job of RUFORUM. But the need to partner with organisation (s) that can help take these graduates to the next level is a critical piece in the human capacity development puzzle that RUFORUM is working so hard to solve.



These stories are based on a case study of students funded by SCARDA in ASARECA , CORAF and SADC region.

The study was done by Dr. Malcolm Blackie of bT-Associates: Smallholder Agricultural Development, UK.

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