

bt-Associates: Smallholder Agricultural Development



SCARDA funded graduates: Case studies and commentary

A report to RUFORUM

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Introduction

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 communication management (see Annexes).

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 (Association for Strengthening Agricultural Research in Eastern and Central Africa-ASARECA), Counsel Ouest et Centre Africain pour Recherche et le Development/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 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 report describes experiences and lessons from some of the SCARDA trained graduates and the impact of the MSc training on their professional careers and institutions.

Approach and methodology

The RUFORUM Secretariat provided a list of graduates from the programme which had been funded through the SCARDA programme (see Annexes). This list included basic details of the student research projects as well as individual contact details (including email addresses). A total of sixteen graduates were contacted and were asked whether they were prepared to participate in the study. It was made clear that participation was entirely voluntary and the study was intended to help RUFORUM and other Higher Education Networks enhance their activities in future years. Each graduate was asked to comment specifically on the following:

- How did each student gain their scholarship,
- what were the really good things (and the less good things) that happened as they developed their study,
- they were asked to highlight special or exciting elements from the research, and finally,

- they were asked if they had any ideas on the direct impacts of their work (say, increased area planted, improved food security) and some of the indirect ones (being a role model for younger scientists; showing that agriculture is an attractive professional career to school children).

In addition, they were also invited to provide their perspectives on their future career development and how they felt participating in the SCARDA programme had contributed to their career objectives. They should also suggest ways in which the RUFORUM and Other Higher Education initiatives in Agriculture could be improved in the future.

Case studies

Mayada Mamoun Beshir, (Sudan), Agricultural Research Council, sorghum breeder, Agricultural Research Corporation

Ms. Beshir has studied the development of molecular markers for introgression of resistance to Turcicum 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 now plans to take a PhD at Makerere under the regional plant breeding programme. Her work is contributing to knowledge of the inheritance of resistance to Turcicum 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 at her home station). This also served to enable her to finish on time. The experience at Makerere provided additional skills such as improved mastery 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 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 Turcicum 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 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 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 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 study¹. 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.

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 work at an International Conference in Maputo, Mozambique in 2011.

¹ Osei, K., Moss, R., Nafeo, A., Addico, R., Agyeman, A., Danso, Y., & Asante, J.S. 2011. Management of plant parasitic nematodes with antagonistic plants in the forest – savanna transitional zone of Ghana. Journal of Applied Biosciences 37: 2491-2494.

Osei, K., Addico, R., Nafeo, A., Agyeman, A., Edu-Kwarteng A., Danso Y. & Sackey-Asante J. 2011. Effect of some organic waste extracts on hatching of *Meloidogyne incognita* eggs. African Journal of Agricultural Research 6(10): 2255-2259.

Danso, Y., Akromah., & Osei., K. 2011. Molecular marker screening of tomato (*Solanum lycopersicum*) germplasm for root-knot nematodes resistance. African Journal of Biotechnology 10(9): 1511-1515.

Danso, Y., Akromah (In press). Phenotypic evaluation of tomato (*Solanum lycopersicum*) germplasm for root-knot nematode (*Meloidogyne incognita*) resistance. Ghana Journal of Horticulture.

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 resumed his B.Sc. (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 study².

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 jobs. Many of African countries experienced war and social conflicts which do not allow students to finish up as quick as they can at 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 Outreach Program/Technology Transfer Unit/ISAR(2010-2011), and is now the Socio-Economist Researcher for the Crop Unit in Rwanda Agriculture Board, Western Zone.

² L. Dusengemungu, P. Kibwika, and F. Kyazze Birungi, (2011), "The Case study of the Maize Innovation Platforms in the Research Into Use Project in Rwanda", *Innovation platforms: perspectives and practice from Sub-Saharan Africa*, (in draft)

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 were 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 agro-pastoralists. 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 process of developing papers from his MSc research to be published in peer-reviewed journals³

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 agro-ecological 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 minimize 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.

³ Yazan A. M. Elhadi, D. M. Nyariki, V. O. Wasonga1 and W. N. Ekaya, 2011. Transient Poverty among Pastoral Households in the Semi-Arid Lowland of Baringo District, Kenya. *Ozean Journal of Social Sciences*. Forthcoming. Yazan A. M. Elhadi, D. M. Nyariki, V. O. Wasonga1 and W. N. Ekaya, 2011. Factors influencing transient poverty among Agro-pastoralists in semi-arid areas of Kenya. *African Crop Science Journal*. Forthcoming.

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

Mr Mutari was nominated by his institute to undertake a study on the effects of postharvest 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 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 affected⁴.

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, and another 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) 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

⁴ Mutari A and Debbie R, 2011. The effects of postharvest handling and storage temperature on the quality and shelf of tomato. *African Journal of Food Science* 5(7): 446 - 452



find out farmers' perception of the disease. The field work involved taken 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 farmer's 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, drought, high temperatures 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 study⁵.

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 non-imprinted 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'-azobisisobutyronitrile (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) sulfatehexahydrate (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%.

⁵ M.K.Osei, R.Akromah, S.L.Shilh, S.K.Green. 2010. Evaluation of some tomato germplasm for resistance to Tomato Yellow Leafcurl Virus disease (TYLCV) in Ghana. *Aspects of Applied Biology* 96: 315-323

M.K.Osei, R.Akromah, S.L.Shilh, L.M.Lee and S.K.Green.,2008. First Report and Molecular Characterization of DNA A of Three Distinct Begomoviruses Associated with Tomato Leaf Curl Disease in Ghana. *APS-Plant Disease* 92 (11),1585.

S.L.Shilh, M.K.Osei, R.Akromah, L.M.Lee, S.K.Green. Tomato leaf curl Ghana virus: EU350585 Dec.17, 2007(submission date) Feb. 5, 2008 (release date) Tomato leaf curl Kumasi virus: EU847739 Jun. 23, 2008 (submission date) Jul. 29, 2008 (release date) Tomato yellow leaf curl Mali virus: EU847740 Jun. 23, 2008 (submission date) Jul 29, 2008 (release date) Genbank database at the National Center for Biotechnology Information (<http://www.ncbi.nlm.nih.gov>)

M.K.Osei, R.Akromah, S.L.Shilh, S.K.Green, C.K.Osei . 2008. Baseline survey of Farmers perception of TYLCV disease and their control measures in the Ashanti region of Ghana. Proceedings of the 1st All Africa Congress on Biotechnology, 22-26th September 2008 pp 334, Nairobi-Kenya

M.K.Osei, R. Akromah, J.N.L. Lamptey and M.D.Quain ,Phenotypic and Molecular Screening of Some tomato germplasm for Resistance to Tomato Yellow Leaf Curl Virus (TYLCV) Disease in Ghana (in press_AJAR)

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 3×10^{-4} $\mu\text{g/mL}$ and 9×10^{-4} $\mu\text{g/mL}$ 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 a 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 journals⁶.

"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 postdoctoral positions as well.

⁶ Rammika M, 2011. An ion imprinted polymer for the determination of Ni(II) ions from mine tailings. Stuttgart: Lambert Academic Publishing

Modise Rammika, Godfred Darko, Zenixole Tshentu, Joyce Sewry and Nelson Torto, 2011. Dimethylglyoxime based ion-imprinted polymer for the determination of Ni(II) ions from aqueous samples. Water SA 37: 3

Modise Rammika, Godfred Darko and Nelson Torto, 2011. Incorporation of Ni(II)-dimethylglyoxime ion-imprinted polymer into electrospun polysulphone nanofibre for the determination of Ni(II) ions from aqueous samples. Water SA 37: 3

Analysis

The case studies reported here are based on information provided by graduates. The data have not been independently verified but the reported publication record of the majority of graduates is impressive. Almost all have one or more papers in refereed journals and the summaries provided of the work undertaken shows a clear grasp of the science involved. The enthusiasm and competence of the graduates is evident, as well as the difficulty of many of the projects undertaken. That said, there are two important caveats. First, of the students contacted, only the cases where sufficient information was provided to enable a case study to be developed were followed up. Second and this is important, of those that responded, only one was female. But the study does capture a case of a graduate from a conflict zone and a sole Francophone. With the exception of the Francophone, whose studies were in French, all students from non-English speaking countries gained evident competence in spoken and written English.

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 continue 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.

Annex: List of the trained graduates and their whereabouts**Annex 1: Master's thesis research topics of students sponsored under SCARDA in the ASARECA region**

No	Student Names	Country	Masters Programme	Research Topic	Institution where they are Currently employed after the MSc training
1	Lado M. Moga	Sudan	Plant Breeding	Inheritance of resistance to rice yellow mottle virus disease in selected rice cultivars in Uganda	Agriculture Research Cooperation (ARC) Sudan
2	Mayada M. Bashir	Sudan	Plant Breeding	Introgressing resistance to <i>Turcicum</i> leaf blight and mapping of associated quantitative trait loci in sorghum	PhD student at Makerere University in Uganda – on leave of absence at Agriculture Research Cooperation (ARC) Sudan
3	Luka O. O. Awata	Sudan	Plant Breeding	Heterosis and combining abilities for multiple resistance to <i>Turcicum</i> leaf blight and maize streak virus	Agriculture Research Cooperation (ARC) Sudan
4	Micheline Inamahoro	Burundi	Plant Breeding	Characterization and mapping of root development in a segregating diploid banana population for resistance to <i>Radopholus similis</i>	Agricultural Research Institute of Burundi (ISABU)

No	Student Names	Country	Masters Programme	Research Topic	Institution where they are Currently employed after the MSc training
5	Gafishi Kanyamasoro	Rwanda	Plant Breeding	Inheritance of resistance to maize weevil <i>Sitophilus zeamais</i> (Motschulsky) in maize inbred lines and determination of their heterotic groups	Institute for Science and Agricultural Research (ISAR)
6	Fulgence Niyangabo	Burundi	Soil Science	Genetic studies of resistance to rice blast in upland rice	ISABU
7	Uwizerwa Mathilde	Rwanda	Soil Microbiology	Optimisation of rhizobium and arbuscular mycorrhizal fungi benefits for grain legume production in acid soils	Institute for Science and Agricultural Research (ISAR)
8	Cyamweshi Rasangamwa	Rwanda	Soil Science	Strategy for improving bush bean production on a phosphorus fixing Andosol with aquatic moisture regime	Institute for Science and Agricultural Research (ISAR)
9	Leonidas Dusengemungu	Rwanda	Agricultural Extension	Capacity for sustaining agricultural innovation platforms in Rwanda: A case study of research into use project	Institute for Science and Agricultural Research (ISAR)

No	Student Names	Country	Masters Programme	Research Topic	Institution where they are Currently employed after the MSc training
10	Musa N. S. Abdalla	Sudan	AICM	Challenges facing research institutions in using information and communication technologies to disseminate agricultural information to farmers in Gezira State, Sudan	Agriculture Research Cooperation (ARC) Sudan
11	Umenezero Olive	Rwanda	Animal Science	Effects of supplementing napier grass with ram press sunflower cake on intake, digestibility, milk yield and composition in dairy cows	Institute for Science and Agricultural Research (ISAR)
12	Wilson Dufitumukiza	Rwanda	Soil Science	Effect of lime and NPK fertilizer formulations on soil chemical properties, tea yield and total leaf polyphenols in Gisovu, Rwanda	Institute for Science and Agricultural Research (ISAR)
13	Sibomana I. Caroline	DRC	AICM	Growth and physiological changes of tomato as influenced by soil moisture levels	Congolese Ministry of Agriculture Improvement of

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No	Student Names	Country	Masters Programme	Research Topic	Institution where they are Currently employed after the MSc training
14	Banga Falasi Patience	DRC	AICM	land use information flow for mangroves forest conservation and rural farming in Democratic Republic of Congo	Congolese (DR Congo) Ministry of Agriculture
15	Sseguja Fred	Uganda	AICM	Factors influencing access to agricultural information by commercial urban farmers in Kampala City, Uganda	FINCA Uganda
16	Yiga Moses	Uganda	AICM	Use of information and communication technology in the dissemination of agricultural information in Public Agricultural Research Institutes in Uganda	National Agriculture Research Organization (NARO)
17	Simachew Manaye	Ethiopia	AICM	An analysis of language use and content in communicating agricultural technologies to farmers in Ethiopia	Institute of Science and Agricultural Research (ISAR)

No	Student Names	Country	Masters Programme	Research Topic	Institution where they are Currently employed after the MSc training
18	David K. Mbugua	Kenya	AICM	Information access and preference for delivery pathways by peri-urban and rural smallholder dairy farmers in Central Kenya	Kenya Agricultural Research Institute (KARI)
19	Andrew Musungu	Tanzania	AICM	Accessibility and usage of dairy cattle feeding information by small scale farmers in Morogoro urban in Tanzania	Sokoine University of Agriculture (SUA)
20	Habonayo Glorioso	Burundi	Soil Science	Comparative effect of farmyard manure, cowpea residues and NPK fertilizers on maize grain (<i>Zea mays</i> L.) yield in Morogoro	National Agricultural Institute in Burundi (ISABU)
21	Cyrille Mbonihankuye	Burundi	Horticulture	Effect of pruning on yield and quality of selected indeterminate tomato (<i>Solanum lycopersicon</i> L.) lines	National Agricultural Institute in Burundi (ISABU)

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No	Student Names	Country	Masters Programme	Research Topic	Institution where they are Currently employed after the MSc training
22	Manzi Maximilliane	Rwanda	Animal Science	Factors affecting pre and post weaning growth of crossbred cattle genotypes at Songa Research Station in Rwanda	Institute for Science and Agricultural Research (ISAR)
23	Yazan Elhadi M.	Sudan	Range Management	The link between seasonal climatic variability and poverty: A case study of pastoral and agro-pastoral communities in Baringo District, Kenya	University of Gezira (Currently a PHD Student at University of Nairobi)
24	Ntukamazina Nepomuscene	Burundi	Research Methods	Improving research methods on bean breeding at Burundi Agronomic Sciences Research Institute	National Agricultural Institute in Burundi (ISABU)
25	Sufian Mohamed Suilman	Sudan	Plant Breeding	Genetic diversity among Sudanese Sorghum accessions using molecular markers and phenotypic characterizations	Agriculture Research Cooperation - Sudan

No	Student Names	Country	Masters Programme	Research Topic	Institution where they are Currently employed after the MSc training
26	Atif Ahmend Mohamed Musa	Sudan	Plant Breeding	Study of combining and heterosis of grain sorghum (<i>Sorghum bicolor</i> L.) using (line x tester) analysis	Agriculture Research Cooperation (ARC)- Sudan
27	Izz Eldin Ahmed Banaga	Sudan	Soil Science	Effect of Nitrogen and Phosphorus rates and sources on grain and forage yield of maize in the River Nile State	Agriculture Research Cooperation (ARC)- Sudan
28	Mohmed Yousif Balla	Sudan	Plant Breeding	Genetic variability of soybean for yield and yield components under irrigation conditions of Gezira, Sudan	Agriculture Research Cooperation (ARC)- Sudan
29	Ali Elkhazin Ali Yousif	Sudan	Soil Science	Effects of chicken and cattle manure on wheat production and soil properties in the high terrace and Karu soils in River Nile State	Agriculture Research Cooperation (ARC)- Sudan
30	Khalid Hamdan Mohamed	Sudan	Soil Science	Effect of different types of organic fertilizers on growth, quality and yield of tomatoes in sandy soil	Agriculture Research Cooperation (ARC)- Sudan

No	Student Names	Country	Masters Programme	Research Topic	Institution where they are Currently employed after the MSc training
31	Amel Osman Ahmed	Sudan	Soil and Water Management	Phosphorus sorption, desorption and buffering capacity as a guide for Phosphorus availability of some selected soil series	Agriculture Research Cooperation (ARC)- Sudan
32	Amel Ahmed Ali Sidahmed	Sudan	Soil and Water Management	The effects of water stress on yield and productivity of two newly released wheat varieties	Agriculture Research Cooperation (ARC)- Sudan
33	Mariam Abdalla Mohamed	Sudan	Horticulture	Evaluation of micro and macro propagation techniques of Gerbera (<i>Gerbera jamesonii</i>) under different conditions	Agriculture Research Cooperation (ARC)- Sudan
34	Ahmed Babiker Ahmed Khalifa	Sudan	Horticulture	Effect of drip irrigation system and fertigation on growth, yield and quality of banana cv. Grand Nain (Musa AAA)	Agriculture Research Cooperation (ARC)- Sudan

Annex 2: Masters thesis research topics of students sponsored under SCARDA in the SADC region

No	Student Names	Nationality	Masters Programme	Research Topic	Institution where they are Currently employed
1	Francis Khoalenyane	Lesotho	Monitoring and Evaluation	Analysis of Lesotho's subsistence maize farmers' adaptive capacity to climate change and variability; an innovation systems approach	Department of Agriculture and Research , Lesotho
2	Joseph Pharudi	Botswana	Agronomy	Effect of phosphate rock solubilizing microorganisms on phosphorus uptake and yield of annual crops in phosphorus deficient soils in Botswana	Department of Agriculture and Research, Botswana
3	Kelebonye Bareeleng	Botswana	Agronomy	Enhancement of phosphorus availability for crop production using organic manure	Department of Agriculture and Research, Botswana
4	Rammika Modise	Botswana	Soil Science	Development of ion imprinted polymers for copper , cobalt and nickel ions from mine tallings samples	Department of Agriculture and Research, Botswana
5	Edwin Lesang Monamodi	Botswana	Plant Breeding	Morpho-physiological characteristics determining yield in tomato (<i>Lycopersicum esculentum</i>)	Department of Agriculture and Research, Botswana

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No	Student Names	Nationality	Masters Programme	Research Topic	Institution where they are Currently employed
6	Nametso Baipoledi	Botswana	Agronomy	Economics of sweet sorghum production under different NPK fertilizer regimes	Department of Agriculture and Research, Botswana
7	Malefsane Mokotedi	Botswana	Range Management	Effect of a mixed cattle-goat system on animal production and vegetation condition in a mopane woodland in Botswana	Department of Agriculture and Research, Botswana
8	Lorato Lekgari	Botswana	Plant Biotechnology	Over-expressing Arabidopsis MYB transcription factors in Salvia and sugarcane	Botswana College of Agriculture
9	Thapelo Mabaka	Botswana	Instrumentation	Study of wireless instrumentation at Jwaneng Mine	Botswana College of Agriculture
10	Chanamwe Sondo	Zambia	Agric Economics and Extension	Assessment of mechanisms put in place to ensure beneficiary ownership and sustainability of participatory programmes: A case of PaViDia and ASP in four selected districts of Zambia	National Research Development Center - Zambia
11	Dominic Mambo	Zambia	Monitoring and Evaluation	The potential contribution of agricultural colleges to national	National Research Development Center, Zambia

No	Student Names	Nationality	Masters Programme	Research Topic	Institution where they are Currently employed
				agricultural innovation systems: Institutional analysis of the curriculum development implications for NRDC	
12	Blackson Jeke	Zambia	Horticulture	Challenges of tomato production and postharvest handling in Zambia: A case study of Chipata district	National Research Development Center, Zambia
13	Boas Nkhuwa	Zambia	Forestry	Evaluation of the perceptions of communities on benefits derived from community based natural resources management (CBNRM) programmes: The case study of Mumbwa in Mumbwa district	National Research Development Center, Zambia
14	Chrispine Mapanda	Zambia	Food Science	Utilization of rind and soy protein in polony production	National Research Development Center , Zambia
15	Sandamu Bulaya	Zambia	Engineering	Computational fluid dynamics modeling of ogee spillway and energy dissipation	National Research Development Center, Zambia

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No	Student Names	Nationality	Masters Programme	Research Topic	Institution where they are Currently employed
16	Ernest C. Mulela	Zambia	Animal Science	The use of caterpillars as a protein source in broiler rations	National Research Development Center, Zambia
17	Simon Zimba	Zambia	Soil Science	Validation of Aquacrop model for sunflower under Zambian conditions	National Research Development Center
18	Mabengwa Mutumpike	Zambia	Agronomy	Growth response of greenhouse grown tomato in different production media	National Research Development Center - Zambia

Annex 3: Master's Thesis research topics of students sponsored under SCARDA in the CORAF/ WECARD region

No	Name of student	Nationality	Area	MSc. Thesis Title	Institution where they are Currently employed
1	Michael Kwabena OSEI	Ghana	Plant Breeding	Evaluation of some tomato germplasm for resistance to tomato yellow leaf curl virus (TYLCV) disease in Ghana	Crop Research Institute of Ghana/ Kumasi
2	YAW DANSO	Ghana	Plant Breeding	Molecular marker screening of tomato, <i>Solanum lycopersicum</i> L. Germplasm for Root-Knot Nematodes, (<i>Meloidogyne incognita</i>) resistance	Crop Research Institute of Ghana/ Kumasi
3	Martin L.K. TENGAN	Ghana	Plant Breeding	Conversion of Okomasa- A normal pollinated maize variety to Quality Protein Maize using the backcross breeding approach	Crop Research Institute of Ghana/ Kumasi
4	Umar Sanda ISSA	Ghana	Integrated Pest Management	Susceptibility of some maize varieties to the maize storage weevil <i>Sitophilus zeamais</i> (Motschulsky) (Coleoptera: Curculionidae) and effect of some local botanical materials for the suppression of weevil populations	Crop Research Institute of Ghana/ Kumasi
5	Lawrencia AGBENYIKEY	Ghana	Library	Access to and use of information centres among scientists at Council for Scientific and Industrial	Crop Research Institute of Ghana/ Kumasi

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No	Name of student	Nationality	Area	MSc. Thesis Title	Institution where they are Currently employed
6	Abubakari MUTARI	Ghana	Postharvest Technology	The effects of postharvest handling and 1-MCP application on the quality and shelf life of tomato	Savanna Agricultural Research Institute / Tamale
7	Famara JAITEH	Gambia	Plant Breeding	Screening tomato (<i>Solanum lycopersicum</i> L.) genotypes for resistance to root-knot nematodes (Meloidogyne species)	National Agricultural Research Institute
8	Absa JAW	Gambia	Plant Breeding	Screening and molecular characterization of Near-Isogenic lines resistant to Rice Yellow Mottle Virus	National Agricultural Research Institute
9	Ramatoulaye GUISSÉ (Late)	Gambia	Postharvest Physiology	Post Harvest Losses of Rice (<i>Oryza</i> spp) from harvesting to milling. A case study in Bease and Nobewam in the Ejisu Jubang District in the Asanhti Region of Ghana	National Agricultural Research Institute
10	Ismaila MBENGA	Gambia	Integrated Pest Management	Stemborer infestation on maize plants treated with salicylic acid	National Agricultural Research Institute
11	Morro MANGA	Gambia	Seed Science and Technology	Storability of some elite maize varieties in Ghana	National Agricultural Research Institute
12	Demba NA. TRAWALLY	Gambia	Soil Physics	Irrigation of groundnut with water of different salinity levels and their effect on soil hydro-physical properties and crop performance	National Agricultural Research Institute

No	Name of student	Nationality	Area	MSc. Thesis Title	Institution where they are Currently employed
13	Matthew GOMEZ	Gambia	Agricultural Engineering	Ploughing depth and weed control effects on maize performance and soil properties	National Agricultural Research Institute
14	Lamin DIBBA	Gambia	Agricultural Economics	Estimation of NERICA adoption rates and impact on productivity and poverty of the small-scale rice farmers in the Gambia	National Agricultural Research Institute
15	Abdoulie B. MBOGE	Gambia	Fisheries and Freshwater Management	Opportunities and constraints of fish farming in Ghana: A case study of Ashanti Region	National Agricultural Research Institute
16	Mama Mariama SAHO	Gambia	Food Safety	What are the gender implications of international food safety standards on men and women milk processor in The Gambia?	National Agricultural Research Institute
17	Yoka Richard EBA	Congo	Animal Biotechnology	Effet du zinc et du sélénium surquelques parametres de reproduction chez le cobaye (<i>Cavia porcelus</i>)	Centre de Recherches Agronomiques de Loudima/ Delegation General a la Recherch Scientifique et Technologique - CRAL/DGRST
18	Malonga Junior Patrick YOMBI	Congo	Animal Biotechnology	Réponse de la chèvre naine de Guinée (<i>Capra hircus hircus</i>) au traitement de synchronisation des chaleurs par l'alfaprostol (analogue de PGF ₂ α).	Centre de Recherches Agronomiques de Loudima/ Delegation General a la Recherch Scientifique et Technologique

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No	Name of student	Nationality	Area	MSc. Thesis Title	Institution where they are Currently employed
19	Marie Françoise YEBAS	Congo	Farming systems	Evaluation agronomique et sélection participative des variétés de riz NERICA en République du Congo	Centre de Recherches Agronomiques de Loudima/ Delegation General a la Recherch Scientifique et Technologique
20	Romain KOMBO	Congo	Crops Modeling	Dynamique évolutive et critères de préférence des variétés de manioc cultivées dans le département de la Bouenza (République du Congo): Implications pour l'Utilisation et la Conservation des ressources génétiques	Centre de Recherches Agronomiques de Loudima/ Delegation General a la Recherch Scientifique et Technologique
21	Budeh NZOBADILA	Congo	Soils Sciences	Etat des unités paysannes de diversité variétale du manioc (<i>Manihot esculenta</i> Crantz) dans l'aire culturelle Tchabè (centre du Bénin)	Centre de Recherches Agronomiques de Loudima/ Delegation General a la Recherch Scientifique et Technologique
22	Dorisca SAMBA	Congo	Biometrics	Uncompleted???title?	Centre de Recherches Agronomiques de Loudima/ Delegation General a la Recherch Scientifique et Technologique

No	Name of student	Nationality	Area	MSc. Thesis Title	Institution where they are Currently employed
23	Dramane TOGOLA	Mali	Animal Biotechnology	Profil endocrinien et modifications morphométriques, physiologiques et comportementales de la chèvre naine de Guinée (<i>Capra reversa</i>) du sevrage à la puberté”	Institut d'Economie Rurale
24	Marcel DIARRA	Mali	Animal Biotechnology	Effet de l'huile de palme et de la farine des cabosses de cacao sur l'utilisation de la farine de manioc comme source d'énergie alimentaire chez les poulets de chair	Institut d'Economie Rurale
25	Mohomodou MOUSSA	Mali	Animal Biotechnology	Composition chimique et digestibilité <i>in-vitro</i> de la paille d' <i>Imperata cylindrica</i> seule et mélangée à quelques légumineuses tropicales et à <i>Moringa oleifera</i>	Institut d'Economie Rurale
26	Bréma GUINDO	Mali	Plant Genetic and Plant Protection	Criblage du riz africain (<i>Oryza glaberrima</i>) et quelques variétés prometteuses vis-à-vis du flétrissement bactérien des feuilles de riz causé par <i>Xanthomonas oryzae</i> pv <i>oryzae</i>	Institut d'Economie Rurale
27	Aba Sékou MAIGA	Mali	NRM/ Biodiversity	Impact de l'irrigation sur le développement du palmier dattier (<i>Phoenix dactylifera</i> L.) dans la région de Gao au mali	Institut d'Economie Rurale