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# Building Capacity for Science-Led Development in Africa

*Lessons from the African  
Regional Postgraduate  
Programme in Insect  
Science (ARPPIS)*

Vitalis O. Musewe and Maurice Odindo



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2009

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### Disclaimer

The views expressed in this publication are the authors' and are not necessarily shared by *icipe* or any of its donors or partners in the training programmes.

## **Building Capacity for Science-Led Development in Africa: Lessons from the African Regional Postgraduate Programme in Insect Science (ARPPIS)**

by  
Vitalis Musewe and Maurice Odindo

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## Preface

In 1983, seven African universities teamed up with the International Centre of Insect Physiology and Ecology (*icipe*) to launch a training programme that would provide young African scientists with the opportunity to study and learn in Africa, the arthropod pests and vectors that are a threat to the health and sustenance of the African people and which limit the continent's development. After 25 years of operation and with 35 universities now participating in the network, the African Regional Postgraduate Programme in Insect Science (ARPPIS) has grown to become a living proof of the viability of regional cooperation in scientific capacity development and a model that has inspired similar developments in Africa and beyond. Presently, the programme boasts an output of 202 doctoral and 165 master degree level graduates, most of them holding responsible positions in various governmental and private institutions in Africa, whose capacities they have greatly enhanced. Research by the graduates has also helped to advance *icipe's* own mandate of improving the lives of Africa's poorest people. *Building Capacity for Science-led Development in Africa: Lessons from the African Regional Postgraduate Programme in Insect Science* is a well researched effort to share the story of ARPPIS with policy makers, educators, scholars, development partners and general citizenry throughout the world.

The authors examine the social, economic and technological climate that has influenced the development and performance of ARPPIS, from Africa's adolescent scientific incapacity of the 1970s to the present electronic age and a global economy. To level the ground for fair evaluation, the authors first establish the yardsticks by reviewing the concept, context and process of scientific capacity building for development. The principles of best practice in capacity development are also discussed.

The book highlights the ingenious approach to programme development, which involved over 70 eminent scientists, personalities and development partners through at least three international conferences and planning meetings. A critical evaluation is presented of the many innovative initiatives of ARPPIS that have led to its laudable achievements. Such initiatives include the deliberate quest for gender and regional balance in training and a focus on training of agricultural practitioners and mid-level scientists through the sub-regional master's component of the programme that runs parallel with doctoral level training. In evaluating achievements of ARPPIS the authors reviewed profiles of some of the best achieving alumni which have been published elsewhere<sup>1</sup> and used some of these as case studies in the book. As part of programme performance, participation of development partners in ARPPIS has been examined at great length, with a focus on the dedication of the three main sponsors – the Rockefeller Foundation, the Netherlands Government and the German Government through DAAD programme. The book recognises the valuable contributions of functional partners, including the participating universities, international and regional organisations and national research institutes in the various African countries in ARPPIS training at various levels. The role and performance of participating universities in student registration, research supervision and hosting of the Masters programme are evaluated in great depth.

The book presents an account of historical development and current status of ARPPIS and of the new challenges and opportunities for scientific capacity development in Africa. A comparative review of the performance of similar programmes in Africa has been included to extol the prestigious position of ARPPIS as the premier model. Drawing upon the lessons learned from ARPPIS and elsewhere, the authors propose new perspectives for re-engineering the programme to suit future aspirations and needs of the continent.

Publication of this ARPPIS commemorative book was sponsored by the Rockefeller Foundation of New York to whom *icipe* is most grateful.

### I. Gordon

Chair, *icipe's* Board of Training and Postgraduate Studies (IBTPS)

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<sup>1</sup>Nurturing African Talent for Leadership in Insect Science: 25 Years of the ARPPIS Experience



# CHAPTER 1

## Introduction

### 1.1 Rationale

In 2008, the African Regional Postgraduate Programme in Insect Science (ARPPIS) marked 25 years of a historical existence that has been characterised by milestones in capacity development for insect science for Africa and beyond, and excellence in research and development. The past 25 years has seen an era in which ARPPIS has enhanced and promoted its capability to deliver relevant, quality research training that produces globally competitive graduates, who are committed and able to contribute effectively to resolving food and health insecurity in Africa. In the 25 years of the scientific endeavour during the ARPPIS journey, *icipe* and the university partners have learned many lessons, and gained first-hand experience, that is not only relevant to insect science, but to all those involved with capacity building initiatives, particularly in science and science-related enterprises.

The story of ARPPIS now needs to be shared with others, so that it informs, it inspires and above all, it mentors the younger generation of scientists and newer crop of research leaders. In addition to giving new directions in the implementation of ARPPIS, the interactive session was designed to generate ideas and develop consensus on the content and structure of this ARPPIS commemorative book. In this introductory section of the ARPPIS commemorative book, we review the research agenda of the 1970s that spearheaded the need for scientific capacity in insect science, especially in the African continent and the status of higher education in Africa, with a focus on insect science.

### 1.2 Africa's insect problems in the 1970s

The African Regional Postgraduate Programme in Insect Science traces its beginnings to the period when African insect science was at a crossroads. In the 1970s and 1980s, widespread infestations of the desert locust *Schistocerca gregaria* were common in the Sahel, and sleeping sickness and nagana were causing high morbidity and mortality to the herders along the Lambwe Valley of Kenya, Central African Republic and Ethiopian Highlands, and their cattle, due to the huge swathe of land occupied by all kinds of tsetse species, including *Glossina morsitans*, *G. pallidipes* and *G. brevipalpis*. At about this time too, *icipe* had been in existence for some 10 years and there was a general awareness among Kenyan farmers in particular and African producers in general of the importance of insects in crop production, and limitations caused by crop borers, banana weevils, sucking bugs and storage pests towards the realisation of sufficient food production. The global scenario on pest management had also just gone through an era of "Silent Spring" of the 1960s, and there was a critical need to mobilise resources, especially human, towards implementation of programmes that would lead to a safe yet effective means of pest management and would be ecologically sound, yet environmentally friendly. It was an era in which many African countries were just establishing themselves into nationhood, many of them just going through the first decades of political independence, and faced challenges of mobilising financial and human resources for nation building. It was in this period of high expectations that ARPPIS was born. This was a period of high demand of scientists to push forward the agenda considered as successful programmes which should serve as a



model solution for building human capacity in developing countries. The overall call was: An educative and knowledgeable society is an indicator of a nation's development.

### **1.3 Status of higher education in Africa in the 1980s**

Strategic investment in the development and retention of human resource capacity has been a major challenge over the last 50 years of independence of countries in sub-Saharan Africa. This need for capacity investment, which included both professional as well as institutional development, was integral to the decisions leading to the establishment of the International Centre of Insect Physiology and Ecology (*icipe*) and remains true to date.

In the 1960s and 1970s the prevalent model for training in higher education was training abroad through scholarships provided through programmes of bilateral and multilateral development agencies. One of the largest of these programmes was the USAID-funded capacity development programme in Africa, the African Graduate Fellowship Programme (AFGRAD) and the follow-on project Advanced Training for Leadership Skills (ATLAS). These programmes were managed by the African American Institute (AAI). Similar programmes were being implemented by the World Bank, Rockefeller Foundation, Ford Foundation and various European donors. Most of these capacity building programmes were funding MSc and PhD level training. The model used was similar in most aspects. Trainees undertook their graduate work in the US or Europe through the standard 'participant' training model in that students undertook all their coursework, conducted their research and wrote their theses at the foreign university. Some spent as long as four to seven years at foreign institutions before returning to their home countries. While some were accompanied by family members, many were separated for long periods of time.

There were many problems with those capacity building programmes. A study undertaken by World Learning<sup>1</sup> and sponsored by the USAID in 2003 revealed many of the problems of these past capacity building programmes. First, the long separations from their home institutions led to difficult re-entries. Many returnees became depressed and subsequently left their employment after returning to their home countries. Second, research that they undertook at the foreign institution was often irrelevant to the problems faced by Africa and/or required research equipment that was not available at their home institution. Most had to refocus research, develop more appropriate specialisations, and learn how to operate in a resource-poor environment. It was painful and often demoralising to graduates who returned home. Third, follow-up of returning graduates was limited. This affected access to funding for research, opportunity to attend professional meetings, and assistance with publications. There was definite need for follow-up through 'resettlement' grants. Fourth, the traditional capacity building programmes were 'top down' and provided for limited or no consultations with home faculties. These problems led to increasing preference for the compromise approach known as 'sandwich' model, which facilitated six to eighteen months of coursework at the foreign institution with research conducted in the home country.

### **1.4 ARPPIS — A response to inadequacy of insect scientists in Africa**

ARPPIS was created through a dire need for top level African scientists to move African development forward. In 1964, a UNESCO report projected that Africa needed 200 indigenous scientists per million inhabitants to achieve a 'critical mass' for technological and scientific development. Two decades later, the picture had hardly changed, and the 'critical mass' of indigenous scientific capability was far from being attained. In 1980, only 14% of the required 70,000 scientists in Africa were achieved (Odhiambo, 1984). It was already recognised by this time that to produce a well-trained and well-motivated graduate, postgraduate training called for an environment that provided intellectual catalysts, a

<sup>1</sup>World Learning (2003). *Regional Agricultural Sector Training and Capacity Building Needs Assessment*. START IQC EEE-1-02-00016-00, December 22.

feature that would introduce a synergistic impact to propel rapid development and change. Such an environment has as its main features highly trained manpower, well-equipped laboratory and library facilities, and a clear financing policy. Such an environment is particularly critical for scientific and technological fields. Well-trained manpower in these fields is meagre, while maintaining modern facilities which can produce graduates with the capability to compete internationally is costly and difficult to support and maintain.

The benefits to be derived from postgraduate training were considered to be many. In the first instance, postgraduate training was considered to be any institution's window to the intellectual world. It is an investment in the future, a sustainable introduction into an uncertain future. In the short-term, this may be manifested through an exchange of information and expertise across countries and by attracting international scholars who wish to spend their sabbatical leave away from their own countries. However, heavier investment is often required to ensure a continuous availability of the scientific capability for national and international programmes.

*In situ* postgraduate training in insect science was proposed for ARPPIS, for it was recognised that applied insect science would bring considerable rewards in increased crop yields and in reducing post-harvest losses (FAO, 1981). In fact, applied insect science could help alleviate the problems of hunger, malnutrition and human and livestock diseases that afflict most of the developing countries, with sub-Saharan Africa being the most vulnerable. A cost-effective postgraduate training programme in insect science located in Africa would help in curbing the 'brain-drain' of highly trained indigenous scientific manpower, in increasing food production and in improving human and animal health. It was already recognised that a country is able to benefit from the wide range of possibilities offered by science and technology only when its local scientific and technological personnel is trained to a high level, and are conversant with research and development needs of their countries.

For example, already in those early days it was recognised that although the Kenya Government deeply appreciated the assistance and contribution made by Governments of the UK, USA, Canada and others in manpower development, and the scientists received an excellent education; their training had several major disadvantages. Their teaching will have been in a different cultural context; their research will often have been on an insect pest of the temperate region and not relevant to the problems of the home country; the philosophy of applied insect research and pest management in Europe or North America is to maximise farmers' profits whereas that appropriate for subsistence farmers should be to minimise risks, and secure enough food; the cost of training outside Africa is excessive and requires access to large amounts of foreign exchange; and finally, the future sustainability of such scholarships is uncertain, with the developed countries also experiencing economic hardships. It was noted that it was important for Africa to work out her own development strategies in the light of its specific conditions, requirements and traditions. Africa must remain ultimately responsible for its own development; and to lose sight of her needs would be to invite disaster for the continent.

Right from the time of *icipe's* establishment it was quite clear to her architects and planners that African countries lacked the necessary critical mass of scientists and institutions with capacity to undertake the relevant R&D work to provide the needed knowledge-based solutions to the development constraints. This was more apparent in the field of insect science. It was also clear that sustained long-term investments in capacity building would be necessary to improve endogenous capability at all levels, and develop the required institutional capability to optimally utilise that capacity in Africa. It was on this basis that *icipe's* major training programme, the African Regional Postgraduate Programme in Insect Science (ARPPIS), was designed and developed to provide young African scientists with the opportunity to study and learn in Africa, the arthropod pests and vectors that are a threat to the health and sustenance of the African people and which limit the continent's development. In 1983, seven African universities teamed up with *icipe* to launch ARPPIS.

According to Dabrowski (1991), the establishment of ARPPIS became necessary due to the following reasons:

- Some 85% of Africa's population worked in the agricultural sector and such was the population that had to grapple with the havoc caused by pests.
- Africa lacked the requisite human resources that would tackle the many pest problems that afflicted the continent.
- While the solution to Africa's pest problems required high level research training, only first degree holders were available for this assignment.
- Africa's resources were limited, yet the problems were common and similar on the continent hence the need for cooperation among institutions to raise the critical mass of indigenous scientists to tackle the problems.

Since *icipe's* research programmes are consistently focused on solving Africa's problems within the 4H paradigm, the projects allocated to graduate students are automatically relevant to the continent. However, an in-house evaluation of the programme in 1990 recommended that, wherever possible, ARPPIS scholars should carry out their field research in their own countries to help fill data gaps in such areas. This approach has helped the ARPPIS scholar-turned scientist to identify areas of research need in their countries, and helped them to rapidly fit into national programmes once they return home at the end of their PhD course.

In subsequent chapters of this book, we discuss the genesis of the ARPPIS programme, the ARPPIS model and its unique features, outputs and impacts of the ARPPIS programme, we recognise some key individuals in the life of ARPPIS, we examine the contribution of the ARPPIS alumni to national, regional and international research and development, the academia, science and administration and even politics. The ARPPIS scholars have been the greatest ambassadors of the programme. Through hard work and determination, many of them overcame great odds to reach their goals in science, and many of them now occupy positions of honour around the world. We review some of the positions held by the ARPPIS alumni in the final chapters, and finally we examine the future role of ARPPIS in insect science education in Africa.

# CHAPTER 2

## Genesis of ARPPIS

### 2.1 The vision

The ARPPIS Programme was a vision of the late Prof. Thomas R. Odhiambo, former Dean of the Faculty of Agriculture and Professor of Entomology at the University of Nairobi and later the first Director of the International Centre of Insect Physiology and Ecology (*icipe*). He identified the need to provide opportunity for advanced training of African students within Africa. In justification for starting ARPPIS, Odhiambo (1989) was to write

*“The central challenge of scientific research in Africa is how to mobilise and build-up the home grown human capacities in the continent so as to make common sensible personal, family and national development decisions on a sustained basis”.*

Professor Odhiambo’s vision about a regional postgraduate course in insect science was realised through the individual efforts of African and other associates of international repute in science and development. The process, which was spearheaded by *icipe* and African universities, involved several successive meetings that considered in great depth the status of scientific human resource development in Africa, especially in the field of insect science, a term which was steadily replacing the traditional science of entomology.

In this Chapter we examine the international effort that led to the establishment of ARPPIS, including the role played by institutions and individuals. Successes and disappointments are noted and subsequent initiatives to strengthen the ARPPIS Network captured.

### 2.2 *icipe's steering role*

ARPPIS benefited from the already available system that was in place at the *icipe*. Following the establishment of *icipe*, several advisory organs had been set up, each provided with specific duties based on specific problem areas. Two key organs were the International Committee and the African Committee.

The International Committee, comprising of several academies of science throughout the world, had the major responsibility of monitoring the quality of *icipe's* research effort and to assure *icipe's* participation in international networking. The International Committee later transformed itself into the *icipe* Foundation. Among its first responsibilities, the *icipe* Foundation sponsored a meeting on scientific institution building in Africa at a symposium held at Bellagio, Italy from 14th to 18th March 1981. The symposium ended with a remarkable convergence of views that were summarised in the following statement:

*“It became apparent that all participants, from widely differing perspectives and experiences, found they shared a remarkably common perception of the evolution of science and technology (S&T) institutional capacity in Africa. Although no particular information was especially new or unexpected, the very fact of this convergence of perceptions, shared by African scholars and donor agency representatives, at a time when many donors are evaluating*

*the effectiveness of their programmes and projects, is believed to signal the opening of an important new window of opportunity in African development. Because of Africa's plight, and because the window will not remain open long, it is urgent to re-emphasise the importance of African scientific institutions to the future of economic and social development, and in particular to reorient all levels of education towards creating a science-based African culture".*

The *icipe* Foundation observed that Africans and African scientists were facing difficulties, mostly due to global political and economic forces beyond their control, and more so as a result of their willingness to accept foreign ideas, institutions, and development objectives, which left them stranded midway between traditions to which they could not wholly return, and a modern, science-based society at which they had not yet arrived. It was noted that the international community had specific roles to play in providing careful sustained support for reorienting African education and for strengthening scientific and technological institutions and capacities.

## **2.3 Establishment of the doctoral programme**

### **2.3.1 Role of the Africa Committee**

Establishment of ARPPIS was first proposed by the Africa Committee of the *icipe* Governing Council. It is worth noting that the principal focus of the Africa Committee was to relate *icipe's* scientific effort with African needs, and to concern itself with the effective role of the *icipe* in providing Africa with high-level indigenous insect scientists. In the course of its successive annual meetings in several capitals in Africa, the Africa Committee had the issue of postgraduate training high on its agenda. At its 9th meeting held in Nairobi on 8th December 1978, the Committee passed a special resolution, to the effect that:

*"The icipe, in collaboration with African universities, institutes at the icipe Headquarters in Nairobi, Kenya, an International Postgraduate Course in Insect Science in Africa leading to MSc and PhD degrees. In proposing this programme, the committee was aware that postgraduate courses in entomology were available in some African universities and could be mounted in others, but it was strongly felt that the facilities at icipe were unique and would make it possible to establish a high standard of international postgraduate course in insect science under African conditions".*

### **2.3.2 Bellagio I**

The 9th meeting of *icipe's* Africa Committee followed its resolution by establishing an ad-hoc Working Group to work out, in consultation with African universities and research institutions, a curriculum for the proposed postgraduate programme, together with other questions related to this cooperative enterprise. The concern expressed by the Africa Committee culminated in a Planning Conference held at the Rockefeller Foundation Conference and Study Centre, Villa Serbelloni, Bellagio, Italy from 7th to 11th September 1981. Twenty-two participants representing nine universities and three research institutions in Africa, and institutions and donor agencies from North America, Europe and Australia attended the Planning Conference, which became known as Bellagio I. After exhaustive deliberation, and on the conclusion of the Conference, the participating African universities and research institutions resolved to establish the African Regional Postgraduate Programme in Insect Science (ARPPIS). The signatories also approved that the *icipe* should act as Manager for the Programme on behalf of participating institutions. The trust and confidence that was placed on the *icipe* to host and manage the ARPPIS was based on the fact that *icipe* had the best known scientific leadership in insect science research and human resource

development that was most relevant to the development needs of the African continent. For example, *icipe* was carrying out research relevant to crop and livestock insect pests, as well as insect vectors of tropical diseases crucial to rural health, with a view to developing sustainable pest management technologies, as well as the beneficial uses of insects and development of human resource capacities in insect science and its application through education and training (Odhiambo *et al.*, 1991).

From then on the ARPPIS would embark on its long journey towards the training of African insect scientists for Africa. At the inception, the ARPPIS network started with seven participating universities and *icipe*, and doctoral training was its focus. The partners constituted an academic board that enrolled the first eight PhD students in 1983.

## 2.4 Establishment of the MSc programme

### 2.4.1 Demand for mid level professionals

Although ARPPIS, as originally conceived was designed to produce PhD research scientists, using the excellent facilities available at *icipe*, the PhD programme had progressed so well that by 1991, it was soon realised that there was need for another facility to address the recognised shortage of middle level scientists in applied entomology. Effective development would depend on productive and appropriate research, which was oriented towards national goals. It was not surprising therefore, that the national agricultural research systems (NARS) recognised the urgent need for Masters-level training. Scientists with a MSc degree in applied entomology were required by NARS for services in crop and livestock protection and vector-borne disease control, by national extension programmes and by universities and mid-level colleges. As observed earlier in the book, relevance, appropriateness, suitability, culture and cost were among other considerations for the call for training even at the MSc level to be undertaken close to the home country. It was further felt that, while such facility could feed into the ARPPIS PhD programme, the products would also fill the critical vacuum between the first degree holders in the national systems and the higher level research scientists produced at *icipe*.

### 2.4.2 Regional Task Force on MSc programme

Several years before the final decision to establish ARPPIS Sub-Regional Centres was taken at the Jomo Kenyatta University of Agriculture and Technology (JKUAT) meeting in August 1991, the ARPPIS Academic Board that supervised the ARPPIS PhD programme set up a Task Force in 1986 to deliberate on possible mechanisms for an ARPPIS Masters degree programme. After careful debate on different options, the Task Force proposed the establishment, within the ARPPIS participating universities, of sub-regional centres to teach applied entomology at masters level. The ARPPIS Academic Board accepted this proposal. Unlike the existing PhD programme, the ARPPIS MSc degree was to be based entirely in the ARPPIS participating university. Each sub-regional centre would provide the coursework and supervise the student research (Dabrowski, 1991c). The development of sub-regional centres in universities would make the most efficient use of staff and funds, would directly support the African university system and would enable sub-regional needs of manpower training and development to be met without the duplication of effort and resources in separate national programmes. This approach was endorsed and adopted by the 21 ARPPIS participating universities at the ARPPIS Academic Board's annual meetings. ARPPIS expected that a university presenting an ARPPIS regional Masters Programme would be willing to register non-national students.

The seven-member Task Force, chaired by the late Prof. W.Z. Coker of the University of Ghana, Accra, included Dr J.M. Gopo of the University of Zimbabwe, Prof. T. Gemetchu of Addis Ababa University, the late Prof. A. Siwela of the University of Zambia, the late

Chief Planning Officer at *icipe*, Mrs R.A. Odingo and Dr M.E. Smalley, the then first ARPPIS Coordinator. The Task Force proposed the establishment of Sub-Regional Centres to be hosted by selected ARPPIS participating universities, which the ARPPIS Academic Board accepted.

### **2.4.3 JKUAT Planning Conference**

During the 1990–1991 period, six missions comprising some representatives of the ARPPIS Academic Board and the *icipe* management were sent to evaluate academic programme and facilities at universities in eastern, southern, northeast and western Africa (to Cameroon and English speaking countries) and provide their detailed observations to the planned conference on establishing sub-regional centres for the ARPPIS courses.

The recommendations of the survey teams as well the deliberations from the Bellagio II conference were endorsed by members of the “International Planning Conference on Establishing Sub-Regional Centres for the Masters Degree in Insect Science in Africa” which took place at Jomo Kenyatta University of Agriculture and Technology (JKUAT), Juja, Nairobi, from 5–7th August 1991, financially supported by the International Development and Research Centre (IDRC) and the UN Educational Scientific and Cultural Organization (UNESCO). Fifty representatives from African Universities, including 11 Vice Chancellors and 13 faculty deans or heads of postgraduate schools, representing major regions of the continent and from agencies of international cooperation and the *icipe* staff involved in education programmes were signatories to the Conference communiqué (Exhibit 1). The representatives endorsed the proposal for the establishment of sub-regional centres offering Masters Degree Programme in Insect Science at selected universities in accordance with practices of the ARPPIS Academic Board. Recognising that the universities would commit substantial resources to the programme they recommended an active policy to raise substantial funds solicited from sources within Africa and from agencies for international cooperation through the combined effort of all the participating institutions (host university, participating universities, ARPPIS and *icipe*) in the programme.

At the meeting of Vice Chancellors, Rectors, Directors-General, Principals and representatives of African universities, representatives of the African Association of Universities (AAU), the Network of Deans/Coordinators/Directors of Graduate Studies of Eastern and Southern African Universities, the Agencies for International Cooperation, *icipe* and the ARPPIS Academic Board held at Jomo Kenyatta University of Agriculture and Technology, the meeting therefore endorsed the establishment of Sub-regional centres to offer Masters degree programmes at selected universities.

The factors that influenced the decision to establish the ARPPIS Sub-regional Masters Programme were the following:

- The recognition that in spite of the efforts in postgraduate training, especially the ARPPIS PhD programme, there was still a dire need for scientific manpower on the continent.
- The need to increase and sustain the critical mass of scientists in Africa through research and training at the Masters level to fill the middle level cadre of scientists required for making any impact on the continent.
- Postgraduate training in African universities was scarce and even where present, the deteriorating economic situation on the continent in the 1980s meant resources were no longer available for postgraduate programmes.
- Postgraduate training outside the African continent was expensive and also contributed to a brain drain from the continent.
- Postgraduate training abroad was often conducted in a culturally and ecologically different environment.
- The model of fruitful relations between the host and participating universities envisaged to ensure a sustainable programme and a viable, successful Sub-Regional Centre, was one that institutionalised or concretised the following:

- Absolute commitment by both parties (i.e. the host and participating universities) to adopt the programme drawn up between them.
- Ready and adequate sources of funds for all aspects of the programme. Lack of funds would not only sour relations between these partners, but would also endanger the whole enterprise.
- Collaborating universities were to ensure an intellectual involvement of as many as possible of the requisite scientists in the sub-region, especially in the area of teaching and supervision of student projects.
- In strengthening the facilities in the host university for a successful take-off, cognisance was to be taken of similar deficiencies in participating universities. It was therefore to be ensured that the latter were also strengthened, particularly in certain specific research areas. This was very important in that registered students could then travel to collaborating and/or participating universities – after their initial coursework at the host university – to implement their research projects in their specialised areas. The obvious effect of such an approach, in strengthening a whole sub-region rather than just one university or institution, could clearly be discerned.
- For sustainability of the programme, the courses and the coursework were to be specifically designed to meet the needs of the various national research systems within the sub-region.
- Lastly, to ensure harmonious relations between the hosting and participating universities, and hence the viability of such a Centre, a Special Committee, an Advisory Consultative Group, was proposed. Its duties and functions were essentially to involve insect scientists from both the host and participating universities, and from national programmes and research institutions, in determining the needs of both the Centre and its students. Specifically, it was to be responsible for student admission and welfare, and oversee to the periodic reviews of the curriculum to accommodate developmental needs and technological advances in the field.

#### 2.4.4 *The sub-regional centres*

The JKUAT Planning Conference deliberations led to formation of four zones for implementation of the Masters programme, each with a central university, where the courses would be offered. They were delineated as follows (Ng'eny-Mengech, 1991b):

- Southern Africa: Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Zambia and Zimbabwe, based at the University of Zimbabwe, Harare;
- West Africa: Ghana, Liberia, Nigeria and Sierra Leone, based at the University of Ghana, Legon;
- French-speaking Africa: Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Côte d'Ivoire, Gabon, Guinea, Madagascar, Mali, Mauritania, Rwanda, Senegal, Togo and Zaire, based at the Dschang University Centre, Cameroon; and
- Eastern and North-Eastern Africa: Ethiopia, Kenya, Somalia, Sudan, Tanzania and Uganda (the hosting university was not identified during the Conference).

#### 2.4.5 *Rules of participation*

The programme was designed such that, even though the sub-regional centre was hosted by a selected ARPPIS participating university in the sub-region, it was to operate in collaboration with the participating universities in each sub-region. Each centre was to have a Coordinator appointed by the host university who would be assisted in the overall supervision of his operations by an Inter-University Consultative Group (IUCG) made up of representatives of the participating universities. Each sub-regional centre was also allowed to admit and register non-national students. According to Dabrowski (1991b), the ARPPIS Academic Board further recommended that there was to be a commitment from the host university



and participating universities to strengthen the ARPPIS programme and help sustain it either directly or indirectly. Furthermore, there was to be an intellectual involvement by as many as possible of the appropriate scientists of the sub-region in planning, teaching and supervision—not only those from the sub-regional host university alone.

In the light of a vision of an enduring relationship between the host university and participating institutions, aspects of the Co-operative Agreement between participating universities and the host university were to be developed. First, it was important that a host university receive a consensus by a majority of the universities or all of the participating ARPPIS universities in the sub-region, of their acceptance of the host university as the sub-regional centre. Other perspectives for an envisaged model of successful and fruitful relations between the hosting and participating universities were also developed. The Conference also defined responsibilities of the partners in creating a viable, sustainable centre. They included terms relating to commitment of the host university, institutional responsibilities of host university and responsibilities of participating universities. These aspects of the programme are discussed in a later section of this book which describes the characteristics of the programmes.

## **2.5 ARPPIS Graduate School: The stillborn idea**

### **2.5.1 Bellagio II**

At an international conference held in Bellagio, Italy in June 1991, which was later christened as 'Bellagio II', in addition to discussing the sub-regional MSc programme, also elaborated on utilisation of the scientific potential of centres of excellence for advanced training, in line with programmes elsewhere, especially in India and Venezuela. These centres were offering much broader programmes than classical science departments at the universities. Most of the conference participants were unanimous in supporting the establishment of the *icipe* Graduate School as a logical step towards strengthening postgraduate training.

The conference participants accepted and supported the recommendations of the Task Force Review Committee, chaired by Prof. Lameck K. H. Goma, Minister for Higher Education, Science and Technology, Zambia with contribution from Prof. Donald E.U. Ekong, Secretary-General of Association of African Universities that the ARPPIS enlarged network should also include the proposed *icipe* Graduate School. The participants were in agreement that the *icipe*, as a centre of excellence in insect science, should help out in establishing the *icipe* Graduate School (*icipe* GS), concentrating on the PhD programme, and would also serve as a model for other research institutions in Africa. They emphasised that the *icipe* GS should offer multidisciplinary opportunity to students and state-of-the-art courses, not only in insect science, but also in such disciplines as biostatistics and computer science, chemical ecology, molecular biology, genetics, research management and social science. The Bellagio II proceedings, "Insect Science Education in Africa: The *icipe* Graduate School" (Ng'eny-Mengech A. [Ed.] 1991a) and "Graduate Training in Insect Science at the *icipe*" (Odhiambo *et al.*, 1991), gave details of the programme and its justifications.

However, representatives of the *icipe* Governing Council that participated in the Bellagio II Conference expressed their concern about the financial burden the Graduate School might impose on the *icipe*. These reservations would come up again during discussions of subsequent consecutive meetings of the *icipe* Governing Council and, in addition to lack of enthusiasm by ARPPIS participating universities, would lead to the abandonment of the Bellagio II recommendation on the Graduate School.

## **2.6 The 'larger ARPPIS Network'**

A major development in the ARPPIS programme was to occur in 1991 after a critical evaluation of achievements and constraints during four years of the ARPPIS activities. The *icipe* and the participating universities realised that the programme must continue

to develop information and implement its education programmes, to ensure that it could build on the past achievements, and plan further to meet the needs of the next decade and beyond. It was in search of these new programme management innovations that the *icipe* management appointed a Task Force in May 1987, chaired by Prof. Lameck K.H. Goma, Minister for Higher Education, Science and Technology, in the Republic of Zambia, and including Prof. Donald Ekong, Secretary General of the Association of African Universities (AAU).

The Task Force reported in 1989 that the *icipe* offered special opportunities for multidisciplinary training, and that this included the interface between the social and biological sciences (Odhiambo *et al.*, 1991). Their recommendations had been extensively debated within *icipe* and by the ARPPIS Academic Board, and in June 1991, a conference ("Bellagio II") on "Innovative Approaches for Sustainable Capacity Building for Insect Science Leadership in Africa" was convened in the Rockefeller Foundation Bellagio Study and Conference Centre, Italy. The Bellagio II Conference recommended a broad multidisciplinary approach in curriculum development and research projects for the PhD thesis which would meet global standards. The Conference also recommended that the *icipe* PhD programme becomes a partner in an expanded ARPPIS Network embracing the newly established MSc degree-awarding Sub-Regional Centres and the ARPPIS Participating Universities (Odhiambo, 1991b).

## 2.7 From adolescence to maturity

### 2.7.1 Growth of doctoral curriculum

The 3-year ARPPIS programme was designed with the single agenda of providing Africa with the much needed scientific base for research and development. It was necessary to build a strong foundation upon which subsequent scientific knowledge would be built. The programme for each class included an initial 6-month semester of coursework, a 2-year period for research and final 6 months for the preparation and submission of the thesis. The six-month multidisciplinary coursework had two purposes: to improve the scholars' knowledge since they had different educational and professional backgrounds, some having not studied biological sciences at all; and introducing the students to a community approach to development issues. The coursework was unique to ARPPIS because doctoral programmes for almost all universities in Africa had no coursework. However, this uniqueness brought with it a major problem of recognition of the coursework by participating universities. The problem always came to the fore whenever ARPPIS had to withdraw from the programme any student who failed coursework.

The early days were therefore a struggle for ARPPIS. Although an ARPPIS student was registered at a university that did not expect or need a pass in the coursework, if he or she failed that compulsory coursework then the student could not begin his or her ARPPIS research project. Although this only affected a minimal number of students, those were difficult discussions for the affected students and the registering universities but in the end, all succeeded in understanding and accepting the standards set by ARPPIS. In the end both students and universities saw the need for building a strong foundation that included a proper understanding of basics of science, and to show this through passing the set examinations and courses.

During initial years of programme implementation all these activities were carried out at the *icipe*. The coursework was compulsory and examined and included firstly 6 and later 7 basic courses and 3 supplementary courses on students' request. The coursework was introduced because ARPPIS students came from a variety of academic and cultural backgrounds and the courses were intended to set a uniform level of understanding in core areas of entomology, and to orientate the students to possible areas of research. First, ARPPIS found that most students had a poor background in taxonomy, physiology and biochemistry, and biostatistics. The course coordinators and lecturers were drawn from participating university faculty and from the *icipe* scientific staff (Smalley, 1987).

### 2.7.2 The coming of age

Towards the end of the 1980s, ARPPIS had entrenched itself as a premier programme for training of African insect scientists, and the scholars had found bases in various institutions throughout Africa where they were contributing greatly in national development. A participatory evaluation of the impact of ARPPIS on national programmes in insect science research and education and follow-up of former DAAD scholarship holders' meeting (Duduville, Nairobi, 3–6 December 1990) and supported by the German Academic Exchange Service (DAAD), Africa Office brought together 25 ARPPIS graduates, 26 actual scholars, 12 members of the ARPPIS Academic Board, 13 guests and visiting international scientists and 7 representatives of the *icipe* management and staff responsible for the *icipe* education programmes who participated in the evaluation conference. Prof. T.R. Odhiambo in his 'Introduction' to the Conference summarised the ARPPIS achievements as follows (Odhiambo, 1991a):

*"The ARPPIS programme has steadily garnered an impact in Africa over the last 9 years. ARPPIS graduates are in popular demand for employment as lecturers in universities, researchers and research managers in national and regional R&D systems, and in international scientific organizations. The icipe is particularly gratified and proud to note that all ARPPIS graduates work in Africa. It is this background of achievement on the one hand, and being on the threshold of the establishment of sub-regional centres in insect science at the M.Sc. level and the proposed establishment of an icipe Graduate School on other hand, that the icipe and its partner universities as well as the ARPPIS graduates themselves, decided to assess the impact of the programme in the continent so far – its successes, its areas of concern, as well as its deficiencies".*

The meeting objectives included four topics as follows: establishment of an enabling scientific information exchange environment for all ARPPIS graduates located in different countries; fostering an effective continental collaboration and interaction among the ARPPIS graduates through the establishment of the proposed scientific network; using the experience so far gained in the field to improve and enhance the structure and course content of the ARPPIS programme, and recognise the ARPPIS alumni, as a part of the ARPPIS scientific network.

A testimony of the key positions of authority in science-led development already occupied by ARPPIS scholars can be drawn from the following presentations during the evaluation workshop, which paid tribute to the ARPPIS programme and shed light on the experiences of the scholars and their tutors.

- **H. Mahamat Hassane**, Postdoctoral Research Fellow, Locusts Research Programme, *icipe*—The importance of ARPPIS in capacity building in insect science in Africa: Perspectives and experience of ARPPIS graduates.
- **John W. Bahana**, Scientist, IRLCO, Zambia—Evaluation of the ARPPIS training programme in meeting scientific and managerial needs of pan-African organisations with particular reference to the International Red Locust Control Organisation for Central and Southern Africa.
- **Esther N. Mwangi**, Scientific Officer, Livestock Ticks Research Programme, *icipe*—Strengthening the role of women in education and research in Africa through ARPPIS.
- **J.H.P. Nyeko**, Tsetse Control Department, Uganda—Meeting needs of national programmes in advanced training in integrated management of tsetse in Uganda.
- **G. Tikubet**, PESTNET Resident Scientist, Ethiopia—Contribution of the ARPPIS research project to tsetse control in Ethiopia.
- **D.A. Gomez**, Department of Biology, Food and Agriculture, Ghana Atomic Energy Commission—Potential for adopting the *icipe* tsetse control components in Ghana.

- **Wadeeda S. Forawi**, Lecturer, Islamic University of Omdurman and Coordinator of Friedrich Ebert Foundation, Sudan—Situation report on field experience and evaluation of the impact of ARPPIS in Sudan.
- **B.A. Rapuoda**, ARPPIS, *icipe*—Strengthening national research on medical vectors in Kenya through ARPPIS (representing 11 ARPPIS graduates employed by national research institutions in Kenya).
- **J.B. Okeyo-Owuor**, PESTNET Resident Scientist, Research Directorate, Somalia—Strengthening national agricultural research on crop pest control in Somalia: Experiences of an ARPPIS graduate.
- **Suleman H.O. Okech**, PESTNET Resident Scientist, Mt Makulu Research Station, Zambia—Strengthening national agricultural research on crop pest control in Zambia.
- **Ifeanyi Aniedu**, Lecturer, Department of Parasitology and Entomology, Anambra State University of Science and Technology, Nigeria—Needs of African universities for new and innovative teaching methods and curricula in insect science: The role of ARPPIS and the Nigerian experience.
- **C.B. Maranga**, Lecturer, Department of Zoology, Kenyatta University, Kenya—Needs of African universities for new and innovative teaching methods and curricula in insect science: The role of ARPPIS – Kenya experience.
- **Samuel Kyamanywa**, Lecturer, Department of Crop Science, Makerere University, Uganda—The role of ARPPIS and the Ugandan experience.
- **M.I. Mwangelwa**, Kagera Basin Organisation, Kigali, Rwanda—Post-training scientific needs of ARPPIS graduates.

The meeting also suggested various recommendations that were intended to strengthen ARPPIS and would address issues that were cropping up during implementation:

- Donors should encourage the training of scholars in their own environment so that they become aware of the problems and solutions relevant to the African continent and culture, wherever possible.
- ARPPIS should be supported and expanded in its role of partially fulfilling a need for training scientific leadership in insect science in Africa. Efforts to move into French and Portuguese speaking countries should be intensified.
- ARPPIS scholars should carry out their field research in their own country wherever possible to help fill data gaps in such area. This plan is particularly important in ecological studies.
- Collaborative linkages between ARPPIS and pan-African organisations involved in pest management should be strengthened by the establishment of academic exchange programmes.
- The ARPPIS Academic Board vigorously solicit donor support and obtain new sources of funds for small grants to enable ARPPIS graduates to carry out research on returning to their counties.
- The existing funding for small research grants be better publicised during the scholar's final year in the programme, and that the ARPPIS secretariat actively assist each graduating scholar to obtain funds if so required.
- The network of ARPPIS graduates should be formally instituted. This network can be the basis for an ARPPIS Alumni. There should be a quarterly newsletter with at least one ARPPIS graduate on the publishing committee. The content of the newsletter should include news of graduates, new frontiers of scientific research in Africa and career promotion opportunities. The network should establish a database, available to ARPPIS graduates, and the potential sources of funding of postgraduate research.
- Regular meetings of ARPPIS graduates should be institutionalised.

Financial support for ARPPIS scholars once they returned home was a thorny issue, and many of the scholars felt that their newly acquired knowledge and skills – gained through

years of hard work – would go to waste if no funds were forthcoming for gainful engagement in research once they returned home. Out of 21 graduates interviewed, 13 acknowledged lack of availability of funds for their research in their base stations, 3 expressed availability of partial support, and only 1 confirmed adequate funding for actual research project (Dabrowski, 1991a).

### 2.7.3 Initiatives for strengthening the Network

To ensure relevance and for quality assessment, ARPPIS has continuously gauged its progress vis-à-vis scientific changes in a dynamic world. Ten years following the inaugural ARPPIS conference of 1990, the ARPPIS would face another critical review, this time of the Strategic Planning Review of *icipe* in 2002, which was based on the review carried out on various capacity building activities previously. The programme included: 'Science Leadership Development', 'Knowledge and Technology Generation'; 'Technology Diffusion' and 'Post-Training Support'. The Review Team concluded that some of *icipe*'s most unique accomplishments were associated with its role in building capacity on the African continent in insect sciences. This, and the fact that majority of scientists thus trained remain active in the continent, sets *icipe* apart from other programmes being implemented elsewhere in the continent. The team, however, cautioned that *icipe* gives high priority to maintaining an appropriate balance between science and capacity building, so that an expansion of training efforts does not jeopardise staff motivation and thus the quality of science. The team recommended also that *icipe* pursues the ARPPIS programme by assigning a greater role to universities and taking full advantage of opportunities for PhD studies and supervisory capacities available within CGIAR institutes and other research centres that have competence and capability in insect and supporting biosciences. The team confirmed observations of the 1991 ARPPIS evaluation conference that the future ARPPIS and possible similar activities should reflect a more equitable geographical and gender balance, through affirmative actions.

The review team recognised the changes in needs and status of national research institutions and African universities since the ARPPIS programme was initiated in 1983 and suggested that fields in which national research and extension systems (NARES) are able to implement projects in their own right should be vacated, and that some components of ARPPIS research programme should be implemented at selected universities and at national agricultural research institutes (NARIs).

Following the recommendations that the ARPPIS Secretariat and Academic Board initiated, the programme started a close consultation process with its university network partners early in 2005, to determine strategies for strengthening and revitalising the entire network including the sub-regional MSc centres. This was aimed at strengthening the universities' role as capacity building 'agents of change'. Further it was also recognised that there was need to put ARPPIS programme within the context of contributing to meeting appropriate millennium development goals (MDGs) through implementing training programmes in insect biosciences, and meeting the challenges that were to arise from working towards attaining the MDGs. New approaches in modernisation of the ARPPIS programme were discussed in depth during the Planning Meeting of the ARPPIS sub-regional coordinators held at *icipe*'s Duduville (June 2005) and the 32nd meeting of the ARPPIS Academic Board held in October 2005.

The Board selected a sub-committee consisting of the sub-regional coordinators of the 3 ARPPIS MSc Centres (Zimbabwe, Addis Ababa and Ghana), the ARPPIS representatives from University of Pretoria and Kenyatta University (both of which have successfully established e-learning programmes), the ARPPIS Network Co-ordinator, the Chairman of the ARPPIS Scholars' Association (ASA) and a consultant on capacity building initiatives (Musewe 2005 and 2006). Both documents provided objective and realistic evaluation of constraints in the present system and gave valuable suggestion for improvement of the

ARPPIS Sub-Regional Centres curriculum by exploring potential of Open and Distance Learning. A two-day meeting of the Consultative and Planning Workshop was convened on 22nd and 23rd February 2007. A list of actions required was produced and focused on the following issues: enhancing university participation; addressing sustainability; meeting institutional needs of universities; modernising and upgrading training curricula; ensuring impact of the training programme and reviewing the cooperation agreement.

#### *2.7.4 ARPPIS in the later years*

ARPPIS has never waned in its quest to bequeath Africa with highly trained scientists to move its development agenda onwards into the future, and claim its rightful place among continents with rich scientific human resource base for enhancing food security and improved health. Presently, three sub-regional centres of the Masters programme are in operation: The Sub-regional Centre for West Africa at the University of Ghana (UG) at Legon, offering a MPhil degree; Sub-regional Centre for Eastern and North-Eastern Africa at Addis Ababa University (AAU), offering MSc Entomology degree; the Sub-regional Centre for Southern Africa at the University of Zimbabwe (UZ), the first to start operation and offering the Master of Tropical Entomology (MTE) degree. Two other possible sub-regional centres are as follows: sub-regional centre for French-speaking Africa (was approved, selected but failed to take off) and representation of Lusophone countries (was mooted but not followed up any further). For the Sub-Regional Masters Programme the universities in each sub-region are linked through an inter-university consultative group (IUCG), a relatively informal arrangement with no binding agreements. There is no formal connection between the sub-regions except through the ARPPIS Academic Board.



# CHAPTER 3

## Academic Programmes of ARPPIS

### 3.1 Introduction

ARPPIS has focused in two critical areas of training in insect science, the PhD programme and the sub-regional MSc programme. In addition, supplementary programmes and activities were created alongside ARPPIS to support the training environment. They include programmes that ease resettlement of ARPPIS alumni after they complete their doctoral training such as re-entry research grants, internships at *icipe* or at any other university, exchange visits between alumni and sponsorship of special courses. In addition, *icipe* runs her own research capacity strengthening programmes in which students and alumni can participate, such as professional development programmes (postdoctoral fellowship and visiting scientist schemes), technology diffusion courses for IPM practitioners, community training and empowerment, and production of technopacks (teaching materials, manuals, books, etc.). We will describe briefly only those activities that are implemented under ARPPIS.

### 3.2 ARPPIS PhD Programme

The objective of the ARPPIS doctoral programme is to provide young African scientists with high-level research training in insect science, undertaken at *icipe's* laboratories and field sites located in various ecological zones. Through the programme, *icipe* is able to expose the upcoming scientists to modern scientific approaches and techniques under the supervision of an internationally reputable group of scientists, backed by their counterparts in African universities. While helping to build the scientific capacity of key African universities and national research institutes, the programme also helps *icipe* to advance its own research mandate by tapping into the immense resource of young African talent. The academic programme is composed mainly of thesis research, which the trainee must successfully complete within the specified programme duration.

The programme is operated on a well set out calendar which is fairly standard from year to year and is announced to participating universities early each year. A sample of the ARPPIS Calendar is given as Exhibit 2.

#### 3.2.1 The doctoral coursework

The ARPPIS PhD coursework was a unique feature for a graduate programme in Africa. The coursework was introduced because ARPPIS students came from a variety of academic and cultural backgrounds and the courses were intended to set a uniform level of understanding in core areas of entomology, and to orientate the students to possible areas of research. Firstly, ARPPIS found that most students had a poor background in taxonomy, physiology and biochemistry, and biostatistics. The final coursework, which was developed by a team of eminent educators and researchers in insect science consisted of 7 basic and 3 supplementary course components: basic courses were Insect Taxonomy, Insect Functional Morphology, Insect Physiology and Biochemistry, Insect Pathology, Insect Ecology, Biological Control,



and Biostatistics and Experimental Design; supplementary courses were Documentation and Information Retrieval; Role of Social Science in Insect Pest Management; Project Identification, Formulation, Evaluation and Budgeting.

Lecturers for the courses were renowned experts sourced from universities in Africa and abroad and from among *icipe* scientists – experts in their own fields of research. In the early stages of ARPPIS, a student had to successfully complete the coursework before proceeding to the research project. Students who failed the coursework after a supplementary examination were discontinued from the programme.

Under funding through the Netherlands-supported project on Direct Support to Training Organisations (DSO), a special programme was implemented that developed special text books to support the coursework. Resource persons to develop the texts were sourced from *icipe* and the member universities, among others under consultancy arrangements. Three such texts were completed in the areas of Insect Functional Morphology<sup>1</sup>, Insect Physiology and Biochemistry<sup>2</sup> and Insect Population Ecology<sup>3</sup>.

The ARPPIS PhD coursework was part of the academic programme until 2001 when it became difficult to offer the course due to financial constraints. It also became apparent that universities registering the students did not consider the coursework as part of their doctoral programmes in entomology and controversy arose whenever a student was discontinued for failing to pass the coursework. The initially six-month coursework was temporarily phased out. In 2005, a modified mandatory coursework was reintroduced when the need arose to update scholars of advances and new frontiers of knowledge. Again, as in the first instance, the courses were “necessitated by the fact that scholars come from a variety of educational backgrounds and gaps had been noted when the scholars began their research work”. These courses are structured as lectures, practicals and seminars in a number of areas and are categorised in two groups: essential courses which must be taken by all newly admitted scholars and additional courses which are elective and taken based on scientific inclination of thesis research. The current ARPPIS doctoral coursework is shown in Table 1.

**Table 1. The ARPPIS PhD coursework**

Essential courses	Additional courses
Basic Taxonomy and Systematics	Chemical Ecology
Biostatistics	Principals of Integrated Pest/ Vector Management
Science writing and communication	Bioinformatics
	Functional and Population Ecology
	Project Management
	IT and Access to Online Digital Resources

### 3.2.2 Doctoral thesis research

Because of the mandatory coursework, all students admitted into the ARPPIS doctoral programme first reported to *icipe* to start their training programmes. On completion of the course the students found themselves fitting into the ongoing research programmes of *icipe*. Indeed, students are admitted on the basis of their suitability for advertised research projects which have been carved out of ongoing *icipe* programmes. In the life of the programme so far only a handful of students may have generated their own research ideas and secured funding independently of *icipe*, although the objectives of such projects still have to fall within the research mandate of *icipe*. It is no wonder, therefore, that nearly all the research activities of the doctoral students have been conducted at *icipe*.

<sup>1</sup>Dr Keith Mbata of the University of Zambia

<sup>2</sup>Dr M.F.B. Chaudhury of *icipe*

<sup>3</sup>Prof. Joseph S. Elkinton of the University of Massachusetts

### 3.2.3 Identification and evaluation of thesis projects

#### Project identification

The *icipe* Board of Training and Postgraduate Studies (IBTPS) is responsible for calling for priority proposals to be considered for award of fellowships in January of each year. Topics of proposed research originate from *icipe*'s research programmes and departments. Individual scientists are required to prepare a two-page concept statement specifying the following:

- Hypothesis of the study
- Overall and specific objectives of the project
- Project activities and time frame
- Key research methodologies to be applied
- Project location and collaborative arrangements
- Budget and funding status of the project
- Approval and/or comments by the Project Coordinator, Head of Department or Unit and Programme Leader.

#### Project evaluation

Applications for research theses projects are submitted in a standard format to the Head of the Capacity Building and Institutional Development Programme (CB&ID) – who is usually also the ARPPIS network coordinator – for tabling at a meeting of the IBTPS, after approval by the respective Heads of Programmes, Departments, Units or Projects. For urgent projects and those coming up at unscheduled times when an IBTPS meeting is not possible, the Head of CB&ID seeks approval from the chair of the IBTPS.

### 3.2.4 Procedures for scholar admission

#### Qualifications for scholar admission

Aspiring scholars must have the following qualifications:

- An undergraduate degree from an accredited university with a minimum pass level of second class upper division or equivalent;
- A Masters degree from a reputable university, taken with both coursework and research, with evidence of successful completion of graduate-level courses in insect science disciplines.

Candidates must be nationals of African or other tropical developing countries and must be, at most, 35 years of age at their next birthday when they are admitted.

#### Application procedure

Applicants must submit a written application, either in response to advertised fellowships tenable at *icipe* or as a general enquiry for graduate training opportunities. Candidates must submit the following documents:

- A full curriculum vitae which must show nationality, age, sex, educational background, work experience and scholarly work;
- Certified copies of degree certificates and course transcripts for Bachelor and Masters degrees;
- An abstract of the Masters thesis; recommendations from two academic referees;
- Letter from a university showing willingness to register the applicant for PhD.

Eligible applicants are sent formal application forms, which must be completed and returned, along with all required supporting documents and endorsements, certifying academic qualifications and all other subsidiary conditions for admission.

### **Selection of scholars**

Interested candidates submit detailed applications based on advertisement to the regional secretariat. *icipe's* Project Coordinators/Programme Leaders/Heads of Department or Unit, who made the request for graduate scholars, shortlist applicants based on merit and advise the Network Coordinator. The recommendations are considered by the *icipe* Board of Training and Postgraduate Studies (IBTPS), and which then approves admission of candidates best qualified to carry out the proposed research projects. The approvals by the IBTPS are reviewed by the next AAB, which makes appropriate recommendations to guide the future scholar selection processes.

### **Constituency and gender considerations**

Priority is given to trainees from the tropical developing world, with special consideration for nationals of African countries. Preference is also given to countries and institutions that have formalised arrangements for cooperation with *icipe* and have signed the *icipe* Charter. Although training specialisation focuses on research areas in which *icipe* has active, leading expertise, scholars are encouraged to work on research problems relevant to their home situations. Special consideration is given to disadvantaged groups, e.g. nationals of least developed countries, countries with no postgraduate training programmes, and women candidates.

### **Award of training fellowships**

Each scholar admitted to the ARPPIS PhD programme must have a training sponsorship to support the full period of study. Candidates may secure scholarships from donor agencies, their employers and governments. They can also apply for *icipe's* research and training project grants.

Each scholarship should pay for all direct scholar support costs (travel, university fees, maintenance allowance, medical insurance, supervision costs and reference materials) and programme management charges. Current schedules of the cost levels are maintained by the regional ARPPIS secretariat.

The scholar's research project is an integral part of *icipe's* research programme and the project cost is normally covered from programme funds independently of the training scholarship, unless the donor has been requested to pay for it as part of the scholarship.

## **3.2.5 Research supervision**

### **Significance of supervision**

Supervision is an important academic exercise. Although the associated paperwork can be overwhelming for both the supervisor and the scholar, it is important that attention is paid to detail so that an appropriate academic record is maintained for the scholar. *icipe* and the registering universities place a lot of emphasis on the quality of scholar research as exemplified in the thesis. Supervisory committees have considerable discretion in establishing requirements in scholar research proposals.

### **Appointment of supervisors**

- The head of department (HOD) nominates and recommends a principal supervisor to *icipe's* Board of Training and Postgraduate Studies for approval.
- Approval and appointment by the IBTPS is made within 3 months. The principal supervisor must be a regular *icipe* staff member.
- The principal supervisor recommends co-supervisors and counterpart supervisors (those from collaborating institutions) to the HOD who are all approved by the IBTPS. Appointment of co-supervisors should be effected within 3 months of the scholar's study programme.
- The registering university appoints the university supervisor.

### **The supervisory committees**

Each graduate scholar has a supervisory committee composed of at least two people: the principal supervisor (convenor), co-supervisor(s) and a counterpart supervisor (where applicable). When visiting *icipe*, the university supervisor joins the supervisory committee.

**Frequency of meetings:** Each scholar should have a formal meeting with the supervisory committee once every 3 months. The first such meeting should take place as early as possible, during proposal preparation. A departmental seminar given by a scholar and attended by members of the supervisory committee may be considered a supervisory committee meeting.

**Format of meetings:** Supervisory Committee meetings do not have any formal structure. The information to be presented and discussed is normally determined by the principal supervisor in consultation with the scholar and the other members of the committee. Scholars should take full advantage of such meetings to ensure that they receive the assistance and advice they need. At the first meeting, the committee attempts to establish any course or other requirements to be met by the scholar during the programme. During the third year of the PhD programme, the committee should discuss the projected date of thesis submission. Where a single meeting between the entire committee and the scholar is logistically unfeasible in a given quarter (e.g. when a scholar is based away from *icipe*, or when a committee member is on leave), the principal supervisor should meet with the scholar and at least one other member of the committee. The principal supervisor in these circumstances should provide a written progress report to members of the committee unable to make it to the meeting and request feedback.

**Reporting:** Following each meeting, the supervisor provides a short written summary of the meeting to the head of department and the Office for Capacity Building in a prescribed format. This summary is retained in the scholar's file.

**Appointing acting supervisor:** When a supervisory committee member intends to be absent from campus for more than 2 months, the member should designate a formal acting supervisor in writing, to the head of department. During the period of absence, the acting supervisor will assume his or her full responsibilities.

**Denial of right to supervise graduate scholars:** The right to supervise scholars may be denied a member of the scientific staff for several reasons:

- (i) Inadequate research funding or other factors leading to disapproval of the proposed project;
- (ii) History of repeated, serious conflicts with graduate scholars where it is shown that most of the fault lies with the staff member;
- (iii) Gross and repeated negligence by the staff member in administering graduate scholars' programmes to the detriment of the graduate scholars;
- (iv) Gross negligence by the staff member in offering proper supervision;
- (v) Unethical practices by the staff member when dealing with graduate scholars.

**Conflict of interest in supervision:** Personal relationships (including intimate or business) that alter or affect academic relationships may constitute conflict of interest. In the rare circumstance where scientists involved in familial or intimate relationships are proposed for the same supervisory or examining committee, written justification must be made to *icipe's* Board of Training and Postgraduate Studies for approval. Whenever a conflict of interest arises, particularly between a supervisor and the scholar, the supervisor should withdraw immediately and an appropriate supervisor found.

### 3.2.6 Trainee benefits and privileges

#### University fees

The scholarship caters for the trainee's university fees. Fees vary depending on the university selected for registration and on the nationality of the scholar.

#### Research costs

Research costs, including field travel, labour, equipment and research supplies for an ARPPIS trainee will be met by the host research project or the department hosting the scholar's project.

#### Maintenance allowances

The scholarship provides funds to pay each scholar a monthly maintenance allowance to meet the costs of accommodation and meals, books, stationery and other domestic expenses.

#### Consultation visits

Each trainee's university supervisor is provided a single return economy class air ticket once during the entire training period, to visit *icipe* to evaluate scholar research, preferably in the second year of study. The visit will be for a maximum of 7 days for which per diem and accommodation allowances will be paid. Trainees are issued with a single return economy class air ticket once during the entire training period to visit the registering university to give a seminar and interact with Faculty. The visit will be for a maximum of 7 days for which per diem and accommodation allowances will be paid at the rate stipulated for the country visited. Scholars registered in universities not in their home countries will be provided with a return economy/excursion air ticket (home–university–home) and per diem for up to 7 days. Under special circumstances not mentioned above, advice should be sought from the Head of the CB&ID Programme.

#### International travel

For all approved international travel, payable costs will include airfare, airport tax and subsistence allowance for accommodation, meals and incidental costs. The scholarship will provide funds for a one-way economy class air ticket (home – Nairobi) at the beginning of the training programme and a one-way economy class air ticket (Nairobi – home) at the end of the training programme. Unaccompanied baggage by airfreight to a maximum of 20 kg for scholars who have completed training and are returning to their home countries will be paid for.

#### Field travel

Field travel to research sites within Kenya or where the scholar is studying should be spelt out in the research project plans. The scholar will be entitled to *icipe* transport for the fieldwork, or reimbursement of transport costs on public transport (not taxi). Per diem will be paid at the local rate, but only for field visits not exceeding 14 days. A special package will be arranged for visits exceeding 14 days but less than 3 months. For visits lasting 3 months and more, the scholar will be temporarily relocated to the research site at no extra allowance for the duration of the visit.

#### Leave of absence

ARPPIS scholars are entitled to home leave, annual leave, compassionate leave and sick leave.

- *Home Leave:* The scholarship provides for one home visit (30 days) at mid-term of the programme for scholars whose training programmes exceed 24 months.
- *Annual Leave:* Scholars are entitled to 14 calendar days of leave per year. Foreign scholars may accumulate their leave for the mid-term home visit.

- **Compassionate Leave:** Compassionate leave is approved in case of death of a close member of the family (parent, wife, child, parent-in-law, and sibling) at the discretion of the programme coordinator and the *icipe* supervisor.
- **Sick Leave:** Sick leave is normally approved with full stipend up to a maximum of 2 months. Beyond 2 months, the scholar may remain on sick leave but without payment of stipend. After 6 months of sick leave, *icipe*'s Board of Training and Postgraduate Studies will review the scholar's scholarship.

### **Group medical and life insurance**

The scholarship provides medical and life insurance cover to the trainee only, under *icipe*'s group insurance schemes.

### **Assistance with accommodation on arrival and before departure**

Trainees based away from their home countries are eligible for assistance with hotel accommodation for a period not exceeding 14 days on arrival at training base and similarly just before they travel back to their countries on completion of their training programmes. Where possible, scholars are accommodated at *icipe*'s Duduville International Guest Centre (DIGC). The cost of the room will be paid directly by the programme. Where scholars have to be accommodated outside the Centre, an allowance not exceeding the approved rate for scholars will be paid. In both cases, the scholars will pay for their meals from their stipend allowances. There will be no provision for families.

### **3.2.7 Quality assurance**

#### **Preparation of proposals, reports and theses**

The scholar is expected to type (or otherwise technologically produce) the research proposals, progress reports, thesis and illustrations and undertake data analysis with minimal assistance from the host programme. Secretarial service is not provided for scholars. The cost of thesis binding is met from the scholarship, subject to the limit of the unit cost, and only if the thesis is finalised within one year after expiry of the formal training scholarship.

#### **Annual progress reports**

Trainees are required to submit to the Head of the CB&ID Programme annual reports on their progress in a prescribed format and enclosing a draft thesis, which must be endorsed by their supervisors at *icipe* and at the registering university.

#### **Duration of the training programme**

The PhD degree programme lasts 3 years. Scholars who have not completed their training within the specified period do so on their own time, without payment of any allowances.

#### **Termination of scholarship**

- **Termination by notice:** Either party may terminate the scholarship contract by giving a one months' written notice. The stipend will not be payable during the notice period if termination is initiated by the scholar.
- **Termination on academic grounds:** If the trainee's annual progress report reveals unsatisfactory performance the scholarship will be terminated by giving one months' notice.
- **Disciplinary termination:** The scholarship will be terminated without the benefit of notice when the trainee is involved in serious misconduct, such as unauthorised travel abroad, unauthorised leave, fraudulent manipulation of data and any other misdemeanour, and on the recommendation of the ARPPIS Academic Board.
- **Withdrawal of scholarship:** The scholarship will also be terminated without notice if the sponsor withdraws the scholarship and no other funds are available to support the trainee's programme.

### **Departure formalities**

All trainees who are departing from *icipe* on completion or termination of their training programmes must obtain clearance from all departments of the Centre on the Departure Clearance Form before they are formally released. All terminal provisions for departing trainees – including final stipend, air tickets, and assistance with hotel accommodation – are subject to satisfactory clearance from the Centre.

### **Certificate of completion**

An ARPPIS Certificate of Completion will be issued only to scholars who will have completed their theses and submitted final drafts to the university for assessment. A copy of the draft thesis must be deposited with the ARPPIS secretariat and with members of the supervisory committee before the certificate is released to the scholar. Issuing of the certificate is also subject to the scholar obtaining clearance from all *icipe* departments.

### **General capacity-building policies of *icipe***

All general and specific policies regulating scholar supervision and responsibilities of *icipe* departments, supervisors and scholars apply to this programme without exception.

## **3.3 Sub-regional MSc Programme**

The Masters Programme is undertaken at sub-regional level, hosted by participating universities and provides graduate research training leading to award of MSc degrees of the host universities. ARPPIS MSc Sub-Regional Centres have so far been established at three host universities.

### **3.3.1 Programme structure**

The ARPPIS Masters Programme consists of one year of taught coursework followed by one year of independent research and thesis preparation. Each Centre follows the calendar of the host university and offers its own type of degree approved by the university.

Sub-Regional Centre for Southern Africa, catering for Angola, Botswana, Lesotho, Malawi, Rwanda, Swaziland, Zambia and Zimbabwe is hosted by the University of Zimbabwe, Harare, and based in the Department of Biological Sciences. Successful students going through the programme are awarded a Master of Science in Tropical Entomology. The academic year starts in March/April.

Sub-Regional Centre for Western Africa, catering for Liberia, Nigeria, Sierra Leone and Ghana is hosted by the University of Ghana, Legon and is based in the Departments of Crop Sciences and Zoology. The university awards a Master of Philosophy (MPhil) to candidates qualifying through this programme. The academic year commences in August.

Sub-Regional Centre for Eastern Africa, hosted by the Addis Ababa University, Ethiopia caters for Kenya, Somalia, Sudan, Tanzania, Uganda and Ethiopia. The programme is based in the Department of Biological Sciences and successful candidates are awarded a Master of Science in Entomology. The academic programme begins in September of each year.

### **3.3.2 The taught coursework**

The centres provide a stimulating coursework that enhances understanding of economic entomology, especially in relation to insect pests, disease vectors of medical and veterinary importance, stored products entomology, insect morphology and systematics, taxonomy, population ecology and behaviour, integrated pest and vector management (IPVM), insecticide science, experimental design and biostatistics. The course content was agreed upon during the discussion of the JKUAT Planning Conference that endorsed the establishment of the MSc programme but host universities and sub-regional centres were

given leeway to include any other course elements in response to the changing dynamics of national and regional needs.

The content of the coursework currently offered by the three sub-regional centres is summarised in Table 2.

**Table 2. Titles of courses offered by three ARPPIS Sub-regional MSc Centres (Mark X indicates the Centre offers a course under the title shown)**

Course title	Centre		
	University of Zimbabwe	University of Ghana	Addis Ababa University
1. Biostatistics, experimental design and modelling/ biometry	X	X	X
2. Insect functional morphology and systematics	X		
3. Insect functional morphology/ Insect morphology		X	X
4. Insect taxonomy		X	X
5. Insect ecology and behaviour/ Insect ecology	X	X	X
6. Pest management	X		
7. Economic entomology	X		
8. Agricultural pests/ Agricultural entomology		X	X
9. Insecticide science/ Insecticides		X	X
10. Disease vectors of medical and veterinary importance		X	
11. Stored products entomology		X	
12. Insect pest and vector management/ Arthropod pest and vector management		X	X
13. Research methods		X	
14. Seminar		X	X
15. Current topics			X
16. Research project and thesis	X	X	X

Source: *icipe* (2005). Study report on Strengthening and Revitalising the ARPPIS Sub-regional MSc Programme. A Resource Paper prepared for the meeting of ARPPIS sub-regional centre coordinators.

### 3.3.3 Dissertation research

Research training entails independent work on a project under the supervision of university faculty, and the preparation of a thesis that is examined by the host-university in the presence of external examiners. Quality and relevance of training is assured through the oversight management of the ARPPIS Academic Board (AAB).

Attachment at *icipe* facilities based in Nairobi is offered for students wishing to undertake thesis projects that require specialised laboratory expertise, such as chemical ecology, molecular biology, biotechnology and arthropod pathology.

### 3.3.4 Student scholarships

Each student admitted into the Masters programme must have a training scholarship to cater for the full two-year period of study. The respective MSc Sub-Regional Centres offer a limited number of competitive scholarships granted by donors cooperating with ARPPIS. The total cost of training in the programme is based on the host-university's charges for postgraduate courses. Applicants are encouraged to make enquiries directly with the centre coordinators.



### 3.3.5 Links with the ARPPIS PhD Programme

Graduates from the Sub-Regional MSc programmes are well suited to join the ARPPIS PhD programme hosted by *icipe*, to advance their research careers. However, admission into the PhD programme is not automatic and students from the Sub-Regional MSc Centres have to compete with other applicants for doctoral training fellowships.

## 3.4 Complementary programmes

### 3.4.1 Dissertation Research Internship Programme (DRIP)

The Dissertation Research Internship Programme (DRIP) is a complementary programme to ARPPIS, offering PhD, and MSc degree training for students registered in universities anywhere in the world. Funding for the student's scholarship and research can come either from a sponsor or *icipe*. *icipe* provides the students with research projects and facilities as well as supervision. A highly flexible programme that has no limitation on age or nationality, DRIP also caters for social science students pursuing relevant study topics.

The objectives of the Dissertation Research Internship Programme are to:

- Contribute towards human resource development for research in tropical insect science, by enabling university scholars to conduct thesis research at *icipe* as part of the requirements for the PhD or MSc degrees of their registering universities in Africa and abroad;
- Facilitate and enhance *icipe's* collaboration with universities and other centres of excellence in developed and developing countries, for interactive technology development and exchange;
- Enhance the capacity and productivity of African universities by availing to them advanced research facilities and resources for collaborative research and training.

The DRIP complements ARPPIS by satisfying the high demand for postgraduate training by non-African scholars as well as those that may not meet the high demands of ARPPIS. By supporting this alternative programme the *icipe*, as a partner in ARPPIS, is relieved of any conflict of interest as it strives to satisfy its constituency which is wider than that of ARPPIS.

### 3.4.2 Professional development programmes

The ARPPIS has provided a platform for linkages to other *icipe's* institutional strengthening programmes. These include the Professional Development Programmes, which attracts both young and established scientists and professors from centres of excellence and academic institutions worldwide to share and contribute to the Centre's research work. For example, the Postdoctoral Fellowship Programme (PDF) enables postdoctoral scientists to take up medium-term assignments in ongoing research projects, while the Visiting Scientist and Research Associateship Schemes invite more senior scientists and research associates to help build *icipe's* capacity in research planning and evaluation. ARPPIS itself has played a key role in staff development for its own staff, and building excellence in research and development at the centre.

### 3.4.3 Technology dissemination programme

ARPPIS has stimulated the growth of technology dissemination activities, whose support runs side by side with programme funding for scholarships and other training activities. The programme runs in the form of international or national group training courses on specific subject related to student research work. ARPPIS scholars are welcome to attend these courses for exposure to field operations and techniques in IPVM. The courses last 4–6 weeks each and are usually offered at *icipe's* field research facilities and in farmers' fields. National courses may be offered within the target country.

# CHAPTER 4

## The ARPPIS Training Model

### 4.1 Objectives for model design

Until late 1900s, there were few African universities offering graduate education. Postgraduate training was mostly a preserve of universities in developed countries and was facilitated by a myriad of scholarship programmes offered either through bilateral arrangements, such as the British Council and the USAID, or by international foundations, such as the Rockefeller Foundation and the Ford Foundation. This was the preferred training model for building scientific capacity for African countries.

Unfortunately, training abroad had several shortcomings. Firstly, the students were, in most cases, trained in specialisations and on research skills that were not of immediate application to their home countries. Secondly, the training programmes exposed the students to state-of-the-art research equipment that could only be found in the developed countries at that time. Thirdly, the trainees worked among well-established scientific communities that provided all the necessary intellectual and material support to the students' work. Such conditions could not be found when the young scientists returned to their motherlands. They could not find similar research laboratories and teams that could help them establish their careers since training abroad had denied their home universities the much needed research capacity development in terms of infrastructure and human resource. Many of such young scientists retraced their way back to the developed countries where they had been trained, leading to the well documented brain drain.

When the establishment of ARPPIS was mooted in the mid 1970s the prime driving force in the minds of its founders, led by the late Professor Thomas Risley Odhiambo, was to create a postgraduate programme that would train insect scientists locally within Africa to focus their interests on problems afflicting the continent and to acquaint them with innovative approaches to doing research under conditions of limited scientific as well as material resources. Since most African universities did not have capacity for graduate training in most sciences, including insect science, ARPPIS was designed to produce well-trained scientists while at the same time help universities build their capacities in insect science research and training, by spearheading retention of trained scientists and improvement of infrastructure at the universities. This required the presence of a pool of insect scientists with ongoing research portfolios that could provide the necessary home for research mentoring and support to postgraduate students. Thus, ARPPIS was established as a regional training network of African universities collaborating closely with *icipe*, the best-known insect research power house in Africa since the early 1970s. *icipe* was to provide the international level research environment that would furnish the students with thesis projects and mentorship which the universities were lacking, while ownership by the universities would give the programme recognition as a degree-awarding initiative of which *icipe* had no legal mandate on its own.

As Professor Odhiambo declared in 1991,

*"ARPPIS motivates and trains African scientists to investigate the biology, physiology, behaviour, population and chemical ecology of pests and disease vectors that attack man, his crops or his livestock in Africa and that so often*

*devastate national development programmes. For many years, little of sustainable impact has been made in the fight against these insect pests and vectors on the continent because Africa has lacked trained manpower, particularly high level indigenous manpower. ARPPIS is uniquely equipped to meet this need because it provides relevant education and training within Africa itself, for African scientists, on the major insect pests and vectors of the African continent. It harnesses together both the quality yardsticks of the university system and the insect science expertise of the ICIPE" (Odhiambo, 1991a).*

## 4.2 Overview of the ARPPIS model

The International Centre of Insect Physiology and Ecology (*icipe*), in partnership with several African universities, established in the early 1980s, with the first intake of eight students in 1983, the African Regional Postgraduate Programme in Insect Science (ARPPIS), for training at PhD and MSc levels in insect science and related application areas. The ARPPIS Network consists of a number of selected participating universities, currently 35, working in close collaboration with *icipe*. The network has its headquarters based at *icipe*, Nairobi, where the Regional Secretariat is managed by the ARPPIS Regional Coordinator. Each participating university nominates a representative to the ARPPIS Academic Board, which is the ultimate policy-making organ on all academic matters. Each Academic Board member serves as the representative of the chief executive of the respective university. This regional network, through the ARPPIS Academic Board, directly runs the ARPPIS PhD programme.

In 1991, the ARPPIS Sub-regional MSc programme was established in three sub-regions of the continent and hosted by a selected university in each sub-region. They are: University of Zimbabwe for Southern Africa, University of Ghana, Legon, for West Africa and Addis Ababa University for Eastern and North-Eastern Africa. The sub-regional programmes have their own satellite networks of universities within each sub-region, with a sub-regional committee consisting of sub-regional members of the ARPPIS Academic Board and a Sub-regional Coordinator managing the Sub-regional Secretariat based at the host university. The Sub-regional Committee runs the MSc programme of the respective sub-region with some oversight from the ARPPIS Academic Board.

At the university level the university representative in the ARPPIS Academic Board coordinates the participation of the respective university in ARPPIS. Programme organisation and management at the university level is left to the discretion of the individual university.

The ARPPIS doctoral students are fully resident at *icipe*. The programme has a mandatory 6-month coursework offered at *icipe*, under joint coaching by specialists from both the *icipe* and the participating universities. On successful completion of the coursework, each ARPPIS doctoral student undertakes a thesis research project in the *icipe* laboratory and experimental fields; day-to-day supervision is exercised by the *icipe* scientists. However, ARPPIS also fully involves the registering university by submitting them twice-yearly progress reports and by encouraging visits between students and their university supervisors. Students visit their universities to present seminars and hold consultations with their supervisors and university supervisors travel to *icipe* to review their particular students' laboratory and field work. Students must observe the regulations of their universities throughout the 3-year programme, so that on successful submission of a thesis, the PhD degree of the registering university can be awarded.

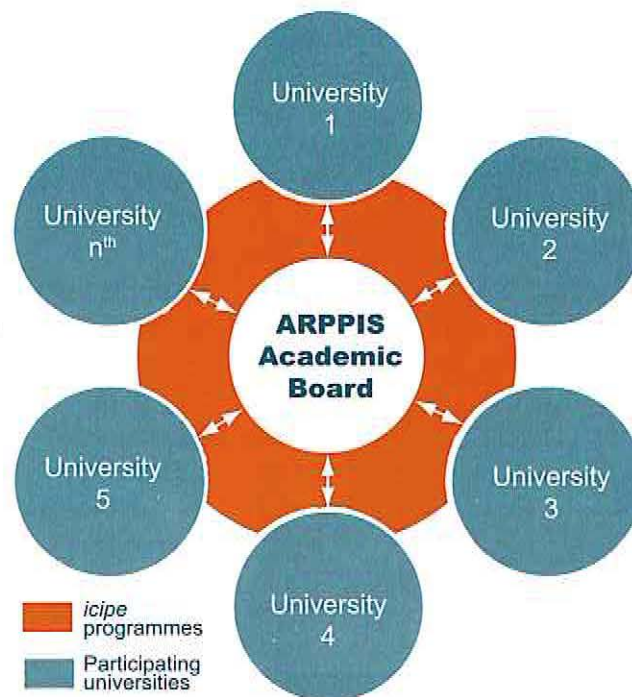
In the ARPPIS Sub-regional MSc Programme, students are fully resident at the host university during the first year when they take the ARPPIS MSc coursework approved for the sub-region. Depending on the source of their dissertation projects, students may change their residence during the second year. A few students undertake their dissertation projects at *icipe* under joint supervision with the host university, while the majority normally remain at the host university for the dissertation research. On successful completion of the course requirements the students are awarded the MSc or MPhil degree of the respective host university.

### 4.3 The ARPPIS networks

The ARPPIS network has evolved through two main stages. The original doctoral training network was created after the Bellagio I meeting which endorsed the establishment of ARPPIS. Establishment of the ARPPIS Sub-regional MSc programme followed the Bellagio II Conference and the subsequent consultation meeting at the Jomo Kenyatta University of Agriculture and Technology (see for example, Dabrowski, 1991b), which defined the structure of the ARPPIS Sub-regional MSc Programme in Insect Science. The idea of the wider ARPPIS network came up when the proposed ARPPIS Graduate School was endorsed by the Bellagio II meeting of prominent African academicians and science managers (*icipe*, 1991).

#### 4.3.1 Original doctoral network

The earlier graphical presentation of the network was in the form of a map of Africa with country boundaries and the participating universities dotted in the countries where they were located. The systems presentation was that of a wheel with spokes and no rim (Figure 1). The arrangement depicted direct collaboration between *icipe* and each participating university. Apart from the coordinative linkages through the ARPPIS Academic Board, there was no indication that participating universities had formal arrangements for mutual collaboration between or among themselves. Even though things changed for the wider network, this is the format in which the ARPPIS doctoral programme has remained organised and managed to-date.



**Figure 1.** Systems presentation of the original ARPPIS doctoral network

Under the original doctoral network, the chief executive of each participating university nominated one representative to the ARPPIS Academic Board for a period of their own choice. *icipe* was represented in the Academic Board by the chairman of *icipe* Board of Training and Postgraduate Studies (IBTPS). Other members of the Academic Board were the regional coordinator of the ARPPIS network (also known as the ARPPIS Academic Coordinator) who was secretary to the board, and sub-regional coordinators of the Masters programme. The board was chaired by the Director General of *icipe*. Students were provided with research

projects and facilities within *icipe's* research programmes. Each student was allocated a number of research supervisors from among *icipe's* scientists as determined by the nature of their thesis research projects, and at least one academic supervisor nominated by the registering university. The research and academic supervisors of each student constituted the supervisory committee for the thesis project. Research supervisors were members of the *icipe's* IBTPS, where they provided a link to ARPPIS through reports to the committee chairman. The *icipe*-based academic supervisor also linked up with the representative of the particular university through the ARPPIS Academic Board. The university representative was the link person between ARPPIS and the graduate committee of his/her university.

#### 4.3.2 The wider ARPPIS network

The aim of establishing a wider ARPPIS network, incorporating the proposed ARPPIS graduate schools at *icipe*, and sub-regional MSc centres was threefold: to promote and strengthen postgraduate studies and research in the ARPPIS sub-regional centres, the participating universities and the *icipe*; to maximise the utilisation of the resources and potential comparative advantages of member institutions; and to provide a forum for the exchange of information and experiences in postgraduate programmes within the continent.

The implementation plan for the Sub-regional Masters Degree in Insect Science in Africa, which was endorsed by the JKUAT international planning conference in August 1991, had been developed and presented at the meeting by various experts (Dabrowski, 1991c). It was envisaged that Africa should be sub-divided into sub-regions, based on

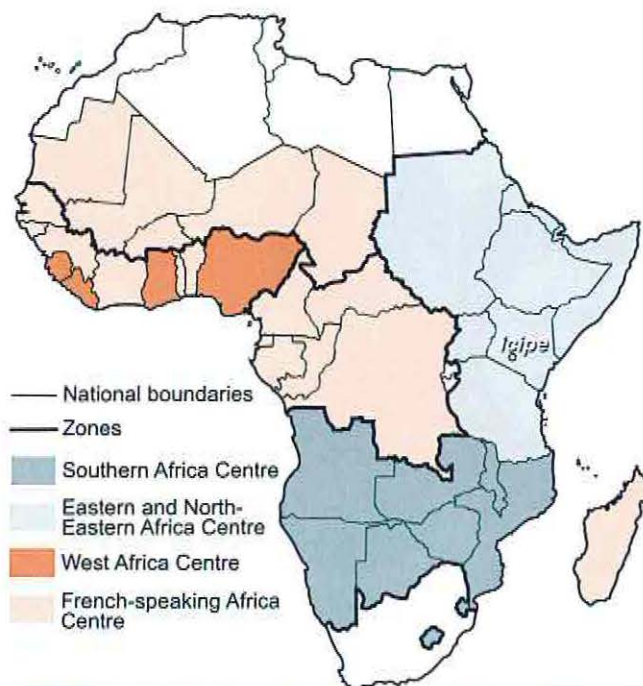


Figure 2. Sub-regions of the ARPPIS sub-regional programme

geographical and language considerations. Figure 2 depicts the 4 sub-regions recognised at the initiation of the programme. They are Southern Africa, Eastern and North-Eastern Africa, West Africa and French-speaking Africa. The plans covered network organisation and responsibilities of its organs; rationale for selecting universities to host the sub-regional centres; relations between host university and participating universities; and development of the Master's degree curriculum.

Selection of universities to host sub-regional centres was based on agreed standard criteria that included the following: existence of programmes in insect science similar to that proposed for the ARPPIS Masters degree, availability of qualified staff to constitute the

teaching core, access to quality research and teaching facilities including library, equipment and research support services, transport and communication infrastructure for international travel and field work, and suitable residential facilities for students.

Based on the above criteria, the planning conference approved the establishment of three sub-regional centres: the University of Ghana, Legon, for West Africa; the University of Zimbabwe, Harare, for Southern Africa; and Addis Ababa University, Ethiopia for Eastern and North-Eastern Africa. Later on, the Dschang University Centre in Cameroon was selected to host the sub-regional centre for French-speaking Africa but it never developed to

operational stage. Establishment of a sub-regional centre for Arabic-speaking North Africa was mooted but never followed up.

The University of Zimbabwe was selected to host the Southern Africa sub-regional centre on account of having, in addition to reasonably good infrastructure, a university-approved MSc in Tropical Entomology (MTE) programme, which other universities in the sub-region did not have at the time (Siwela, 1991). This was the first sub-regional centre to start operations, when it admitted the first class of students in 1992.

Although it did not materialise, ARPPIS was to develop into the ARPPIS Graduate School with an Academic Council. The Academic Council was intended as the policy organ for the stillborn *icipe* Graduate School and was meant to replace the ARPPIS Academic Board, which was steering the operations of the original ARPPIS doctoral programme. There was also to be established an ARPPIS General Council which was to be the forum bringing together all stakeholders of the programme.

The Council was to have a Programme Committee, chaired by somebody from the Sub-regional Centres, and charged with the responsibility of setting the business of the Council and implementing its decisions. Figure 3 is a graphic representation of how the wider ARPPIS should have been like.



**Figure 3.** Schematic representation of the wider ARPPIS network as it was envisioned during the formative years

#### 4.3.3 Membership of the ARPPIS network

The ARPPIS Network consists of *icipe* and the participating universities as the primary members. Except for the three universities hosting the Masters programme, university membership is dynamic, based on the status of signing the memorandum of agreement. Thus, there are signed up members, affiliate members whose membership lapsed or are in the process of renewing the agreement and new applicants whose membership is still under consideration. New members are normally vetted through a suitability assessment. Presently, ARPPIS has 35 fully signed up member universities including those hosting the Masters programme. A sample of the revised memorandum of agreement is shown as Exhibit 3.

The Graduate School did not materialise and also the Academic Council and the General Council. The original ARPPIS Academic Board remained the decision-making organ of the Network. More recently, the Board decided to establish a council of Vice Chancellors as the overall supervisory body.

In addition to university membership, ARPPIS has established informal collaboration with other organisations and networks operating in the region. The major ones among these partner networks and organisations are: African Academy of Sciences (AAS) ([www.aasciences.org](http://www.aasciences.org)), African Association of Insect Scientists (AAIS), African Association of Universities (AAU) ([www.aau.org](http://www.aau.org)), African Economic Research Consortium (AERC) ([www.aercafrica.org](http://www.aercafrica.org)), African Forestry Research Network (AFORNET) ([www.afornet.org](http://www.afornet.org)), African Institute for Capacity Development (AICAD) ([www.aicad.or.ke](http://www.aicad.or.ke)), African Network for Agriculture Agroforestry and Natural Resources Education (ANAFE) ([www.anafeafrica.org](http://www.anafeafrica.org)), African Network of Scientific and Technology Institutions (ANSTI) ([www.ansti.org](http://www.ansti.org)), Agricultural Information and Communication Management (AICM) ([www.asareca.org](http://www.asareca.org))

rain), ARPPIS Scholars Association (ASA) ([www.icipe.org](http://www.icipe.org)), Building Africa's Scientific and Institutional Capacity for Agriculture and Natural Resources (BASIC) ([www.natura-net.eu](http://www.natura-net.eu)), Collaborative Master of Science in Agricultural and Applied Economics (CMAAE) ([www.agricultureconomics.net](http://www.agricultureconomics.net)), East African Regional Programme and Research Network for Biotechnology, Biosafety and Biotechnology Policy Development (BIO-EARN) ([www.bio-earn.org](http://www.bio-earn.org)), International Foundation for Science (IFS) ([www.ifs.se](http://www.ifs.se)), Lake Victoria Research (VicRes) Initiative ([www.vicres.net](http://www.vicres.net)), Natural Products Network for Eastern and Central Africa (NAPRECA) ([www.napreca.net](http://www.napreca.net)) and the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) ([www.ruforum.org](http://www.ruforum.org)).

#### 4.4 Programme organisation and management

ARPPIS is organised at the regional, sub-regional and institutional levels. Figure 4 depicts interrelationships of the key officers and committees that represent the organisational structure of the wider ARPPIS. The various organisational components of the programme are discussed briefly here below.

##### 4.4.1 The Council of Vice Chancellors (CVC)

The Council of Vice Chancellors (CVC) was established during the 33rd meeting of the AAB held on 1–3 October 2007 in Accra, Ghana to take on the role of the highest decision-making organ of ARPPIS. It comprises of all Vice Chancellors or Rectors or Presidents of all member universities of the ARPPIS and the Director General of *icipe*, and provides broad policy direction and framework and support to the ARPPIS network. The CVC is also responsible for establishing, guiding and giving direction on sustainable funding of the ARPPIS network and its activities. The CVC is expected to meet at least once a year.

##### 4.4.2 ARPPIS Academic Board

As a regional programme, ARPPIS is managed by a representative board through which its member organisations contribute to the management of the programme. The ARPPIS

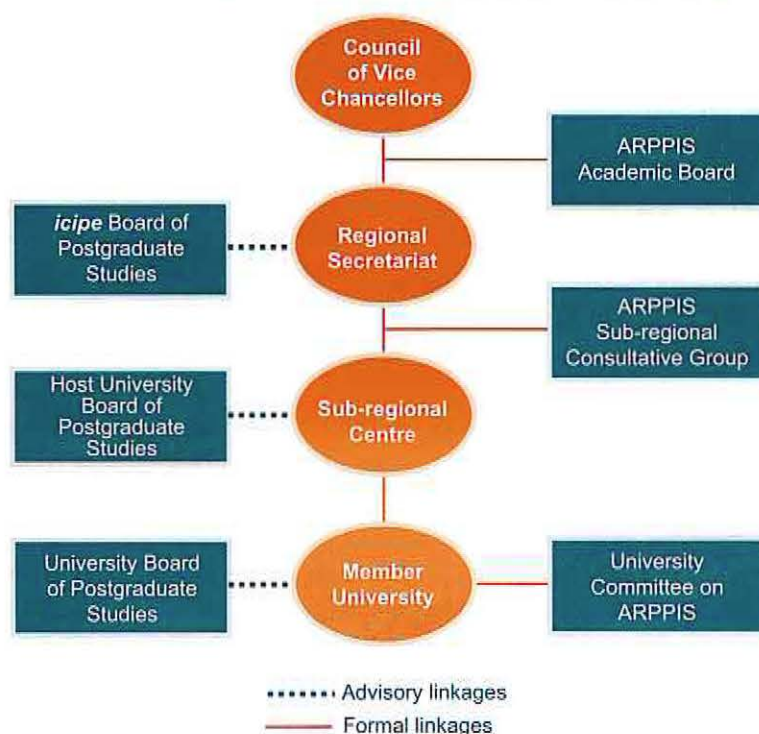


Figure 4. Organisational structure and linkages on the wider ARPPIS Network

Academic Board (AAB) is the academic organ of ARPPIS programmes and is composed of persons appointed by Vice Chancellors or Rectors of all partnering universities that have signed the ARPPIS Memorandum of Agreement (Exhibit 3). Other members of the Board are *icipe's* Director General who is its Chair, the Network Coordinator who is its Secretary, and the Chair of *icipe's* Board of Training and Postgraduate Studies.

The AAB is an advisory body. It meets once every two years. It advises *icipe* and the participating universities on academic matters relating to scholar enrolment and registration, research and thesis quality and admission of universities to the Network. In addition, the AAB ensures equitable participation of universities in the programme through sponsorship of scholars, soliciting donor support and ensuring that universities institute policies that foster meaningful collaboration in the programme as equal partners with *icipe*.

#### 4.4.3 Regional secretariat

Implementation of ARPPIS is anchored by a regional programme secretariat that has been based at *icipe* since the founding of the programme in the early 1980s. The secretariat is headed by a regional programme coordinator, whose title has changed over time, from ARPPIS Academic Coordinator in the early days, to Regional Coordinator and Network Coordinator more recently. Due to resource limitation, the Network Coordinator is essentially a member of staff of *icipe* and is responsible for many other capacity building functions, as he happens also to be the Centre's head of Capacity Building Programme. With respect to ARPPIS, the role of the Network Coordinator is to implement decisions of the AAB and coordinate the implementation of all programmes under ARPPIS.

#### 4.4.4 Sub-regional centre

The coordination of ARPPIS activities at each of the three sub-regional centres (Universities of Ghana, Zimbabwe and Addis Ababa) is the responsibility of the Sub-regional Coordinator, who is appointed by the host university, coordinates the activities of each Sub-regional Centre and informs the ARPPIS Academic Board of the progress of the Sub-regional Centre through the Sub-regional Coordinator.

#### 4.4.5 Inter-University Consultative Group

The Inter-University Consultative Group (IUCG) consists of representatives of participating institutions within a given sub-region (see for example, Morgan, 1991). The role of the IUCG is that of a facilitator for achieving an accelerated and a balanced production of insect scientists in each sub-region, of scientists who will not function in isolation but in tandem with their colleagues all over the African continent and beyond. The roles and functions include the following:

- Sensitisation of all relevant institutions, i.e., universities, national research institutes and centres of excellence in the sub-region, about the ARPPIS philosophy and programme through contact with those individuals or bodies that determine policies affecting graduate training in insect science;
- Pre-selection of candidates for consideration by the hosting institution for admission to the MSc training programme using criteria agreed on after discussion with the host institution;
- Advising the Sub-regional Coordinator on the distribution of student intake from among, and where necessary, outside the participating bodies by consultations with or on request from the participants or others; and on matters relating to students in terms of their academic and general welfare;



- Encouraging the host university to waive regulations where necessary, that would otherwise restrict home-based research being conducted as part-requirement for the MSc degree, in order to promote a sense of relevance to national problems;
- Assisting the Sub-regional Coordinator in choice of teaching staff for the programme, in order to sustain the interest of the scientific community in the programme; and with periodic reviews of the curriculum in order to accommodate expressed development needs as well as technological advances in the field;
- Seek and obtain external funds in collaboration with the hosting institution and the *icipe*, for student fellowships, provision of specialised library materials, teaching and research equipment and materials, travel of teaching staff and co-ordinators, and honoraria for teaching staff and the Sub-regional Coordinator.

#### 4.4.6 Host university

Host university is one of those hosting a sub-regional centre of the ARPPIS sub-regional Masters programme. The host university has the following institutional responsibilities: identifying qualified resource personnel from both host and participating universities, and the national research system, for teaching the requisite courses in the programme; reviewing, for purposes of eventual strengthening, the prevailing Master's courses and programmes within the requisite sub-region; identifying, specifying and organising the available manpower and their specific areas of specialisation, for purposes of supervision of research projects, theses and other academic undertakings; putting into place a more detailed description of the various approved courses, emphasising especially the practical component; and making available to all, especially participating institutions, a general list of potential researchable areas and ongoing research projects for possible collaboration and execution by students and staff.

In addition to the above responsibilities, the host university must be committed to:

- Offering teaching and research supervision for potential interested, young African insect scientists wishing to pursue higher degrees, and in conformity with the regulations of the host university;
- Promoting the growth of the scientific community of insect scientists and the advancement of an academic and intellectual culture;
- Encouraging active recruitment of potential candidates from under-represented countries in the programme, or from the countries without noticeable or viable graduate programmes in insect science;
- Providing the necessary specialised library materials, research equipment and teaching aids, in collaboration with both *icipe* and the ARPPIS programme;
- Helping in providing grants and fellowships for both students and guest lecturers;
- Committing the lecturers from the host university to take an active part in the programme, especially in teaching courses without extra remuneration;
- Registering non-national students; and lastly,
- Including as many universities in the sub-region as possible, especially those institutions not participating directly in the ARPPIS programme.

#### 4.4.7 Participating university

The Memorandum on ARPPIS which each participating university must sign with the *icipe* (on behalf of the Network), spells out the commitments which all aspiring member universities undertake to adhere to. They include sponsorship of students to the programme and their registration as candidates and award of degrees; nomination of faculty to participate in student supervision, and recognition and appointment to honorary positions of *icipe* scientists nominated to supervise the candidates; appointment of a university representative to be the focal point of communication with the university; and an understanding on cost

sharing through fee waivers and sponsorship of representatives undertaking programme activities.

In addition to the above general commitments when universities join the network, ARPPIS has defined the ingredients for fruitful relations between host and participating universities. They include:

- *Absolute commitment* of both the host university and the participating institution to uphold both the ideals and aims of the Centre.
- *Specific responsibilities* of both the host university and participating universities to be spelt out unambiguously, and accepted by all.
- *A smooth-running administrative machinery* to be put in place, to facilitate a problem-free administration of the Centre.
- *A dedication and commitment of a Coordinator* appointed during the establishment of the Sub-regional Centre is sine qua non for any successful and cordial functional relations between the host university and participating universities.
- *Clear channels of communication* between all organs concerned, namely, between host university, participating universities, secretariat of the sub-regional centre and the office of the ARPPIS Regional Coordinator.
- The assurance of regular sources of funding for the programme, especially by the early and prompt disbursement of funds and finances for the Sub-regional Centre.
- Finally, *a virile outreach programme*, under-written and supported by the host university, should be put in place to foster good relations. The outreach programme, consisting of annual research conferences and workshops, will no doubt allow donor agencies and other collaborating institutions to review, and perhaps appreciate, their investments and development efforts.

#### 4.4.8 Member of sub-regional network

Within each sub-region, the network consists of participating institutions. These include universities (mainly the ARPPIS participating universities from the sub-region) and national research institutes (NARIs) within the sub-region. Individual scientists and lecturers also participate in the sub-regional networks as resource persons and collaborators.

In addition to commitment made through the Memorandum on ARPPIS which universities sign on joining, universities also have commitment to their sub-regional networks. Members of sub-regional networks are committed to:

- Advertise the programme in its national press and media;
- Initially screen the candidates and recommend a short-list of candidates to the programme of the Centre;
- Nominate, and if eventually selected, sponsor and help those candidates to the programme at the Centre;
- Release, when requested, lecturers in specified disciplines, to contribute to the teaching of courses or for the supervision of student research projects;
- Assess, on a regular basis, the human resource needs in all aspects of insect science, with the view of making appropriate recommendations to the sub-regional centre concerning student intake, changes in course content and projections for the future;
- Nominate an identifiable representative who will act as the focal point at the university for the sub-regional programme. Among his/her duties would be to liaise between the university community in the home country, and the Sub-regional Coordinator in the host university.

#### 4.4.9 Programme management at institutional level

The ARPPIS Network places no control over member universities on how they organise internally to implement the programme. However, the network links up with university

boards of postgraduate studies of member universities through the ARPPIS representatives who are also members of the AAB. At the level of university senate, both the ARPPIS representative and the Vice Chancellor are also officials of the ARPPIS Network. Some universities have established interdepartmental committees to deal with ARPPIS issues.

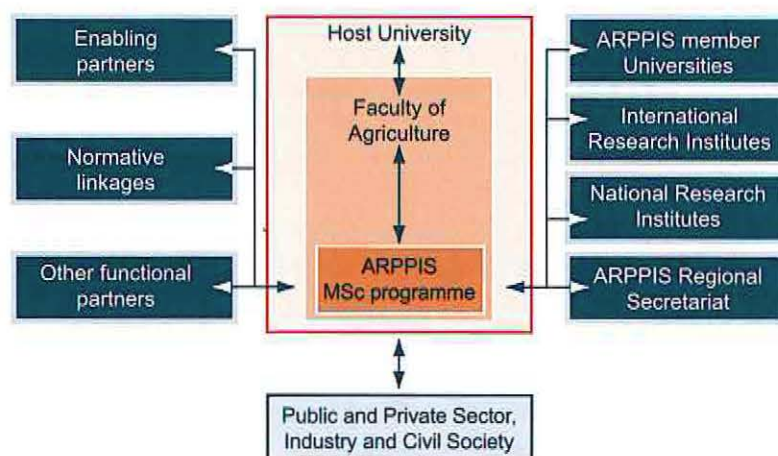


Figure 5. ARPPIS programme organisation at sub-regional centre level

The situation is different for universities hosting the ARPPIS sub-regional centres. For general guidance, ARPPIS expects an elaborate programme set up for implementation of the ARPPIS Masters programme at these universities. First and foremost the programme must establish linkages that should ensure its sustainability through student fellowships and collaborative training. Figure 5 illustrates such a set up, with the programme hosted in the Faculty of Agriculture.

## 4.5 Other capacity building models

### 4.5.1 Challenges to capacity building in Africa

For a long time now, capacity building has been considered the key form of intervention to enable Third World countries realise their development objectives. Indeed capacity development is one of the core MDGs that touches almost all sectors of desired development. As alluded to in the early sections of this book, developing countries faced major challenges in attaining sufficiency in human resource capacity in the 1970s, especially in science and technology. There is adequate evidence that the situation has not changed much. In a paper presented at a UNESCO conference, Massaquoi (2006) identified five major challenges to human resource capacity building in Africa:

- *Size of the problem:* The human resource capacity for research is minimal and non-existent in most universities and it requires training of twice the numbers existing for capacity to begin to function;
- *Weak human resources base* means that higher education institutions are not in a position to quickly develop postgraduate training programmes to begin to build the research capacity;
- *Threat of brain drain* to more developed countries or through decay (brain-in-the-drain);
- *Weak institutional capacity* to build human resources due to lack of appropriate programmes and manpower;
- *Isolation* suffered by the scientists that are recruited in higher education institutions.

The challenges listed above have enhanced the need for regional co-operation in capacity building and indeed the approach has been adopted in many different forms in all parts of the developing world. In Africa, regional cooperation in capacity building has been boosted by three key developments: advances in information and communication technology and adoption of the same by African governments; renewed interest in regionalism; improved performance of most African economies. All forms of cooperation require some guiding principles for the partnership to work effectively. Effective cooperation in capacity building and research requires the understanding of four principles. First, although equal partnership in terms of responsibility and accountability would be the ideal situation, the establishment and effective implementation of a regional network in Africa, where there are inequalities in levels of development, should take recognition of the disparity in resource endowments among would-be partners. Second, regional training networks should put emphasis on training within the region. Third, there is need to establish links with counterparts outside the region to avoid isolation. Fourth, the principal of subsidiarity dictates that, within the network, responsibilities should best be delegated to those who are best placed to handle them.

The operational set-up and performance of ARPPIS as a regional network must be looked at in terms of the above challenges and best practice in regional networking. The programme must also be viewed in light of the other capacity building models.

#### **4.5.2 Types of capacity building models**

In Africa, regional cooperation has been implemented in three main types of networks (Massaquoi and Savage, 2002):

##### **Single (stand alone) regional centre of excellence**

This is the form of regional cooperation that leads to the establishment of a single regional centre which is not a network as such, but is a point of pooling resources by countries or institutions for the purpose of capacity building. There are a few such cases in Africa which are used for capacity building. In East and Southern Africa, ESAMI is such an institution with a long-standing reputation. In West Africa, the Africa Regional Centre for Engineering Design and Manufacturing (ARCEDEM) which is based in Ibadan, Nigeria is an example. ARCEDEM was established in 1979 to facilitate skills and technology transfer. The centre has 24 member states. However, over the past five years the Centre has suffered from some of the problems afflicting similar organisations, i.e. ownership, sovereignty and refusal of member states to pay their contributions.

One problem with stand alone centres of excellence is the expectation of equitable service by its members. In the absence of such a perception, the affected member would normally refuse to remit the necessary subscriptions to run the centre.

##### **Consultative Group on International Agricultural Research**

This is the case where regional centres of excellence are built anew (purpose built) with the intention of making them work as a network. The Consultative Group on International Agricultural Research (CGIAR) is a model of networks of centres of excellence, whose resources are pooled and managed by a secretariat at the World Bank. A distinguishing feature of this type of network is that the institutional members of the network are newly designed with completely different mandates and focus of activity.

The Consultative Group on International Agricultural Research (CGIAR) is an example of network of centres of excellence. Established in 1971 the CGIAR sponsors a network of 16 international research centres four of which are located in Africa. The Africa-based centres are: The West African Rice Development Association (WARDA) based in Benin; the International Institute of Tropical Agriculture (IITA) based in Nigeria, the International Livestock Research Institute (ILRI) in Kenya and the World Agroforestry Centre (ICRAF) also

headquartered in Kenya. These regional centres which are fully equipped with the most up-to-date equipment and facilities form the nodes of the network. Unlike ANSTI which brings together institutions from various countries, the CGIAR brings together regional centres. None of the CGIAR centres belong to a single country. For instance WARDA's 17 members include Benin, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo.

The CGIAR network of centres of excellence provides a very important model for pooling together Africa's scarce research resources to engage in cutting-edge research that can contribute to the food security of the region. It limits brain drain of African scientists and technologists from the continent through provision of good terms of service, high quality research facilities and links with the global scientific community. It is the ideal form of networking for strengthening research productivity and ensuring the use of science and technology for development. It is, however, not useful in human resource capacity building on the scale that is now required in the region due to greater focus of its mandate on research. It has a network of training units of the CGIAR centres called the Inter-Centre Training Group and uses a joint website for fostering information on capacity building activities. However, the ICTG has not been able to operate as a cohesive training entity with graduate-producing programmes.

### **Networks of training institutions**

This type of network relies on the coming together of already existing institutions, which happen to have a common focus of activity and want to boost their capacities through resource sharing and geographic advantages. Most regional capacity building programmes in Africa belong to this category but they may vary in the content of programme activities. An excellent example of a network built on this model is the African Network of Scientific and Technological Institutions (ANSTI); others are BASIC, RUFORUM and AICM among many others. We are proud to state here that the forefather of this capacity building model is the African Regional Postgraduate Programme in Insect Science (ARPPIS), and all the aforementioned examples were only built in its likeness.

**ANSTI model:** The African Network of Scientific and Technological Institutions (ANSTI) is one of the oldest institutional networks dedicated to human resource capacity building in science and technology in Africa. Indeed, the network is the only regional cooperative activity with a mandate for high level manpower development in all fields of basic and engineering sciences in Africa. Established by UNESCO in 1980, at the request of African ministers responsible for science and technology the network brings together 105 institutions in 33 countries in sub-Saharan Africa. It pools together the resources of its member institutions for training and research. It recognises that regional cooperation for human resource capacity building cannot take place without fellowships, grants that facilitate staff and student mobility. Therefore its programme activities include fellowships for staff exchange, postgraduate training, conference/ travel grants and the organisation of conferences/seminars and forums for exchange of experiences.

**RUFORUM model:** The Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) is an association of 12 universities of agriculture and related sciences in East, Central and Southern Africa that recognises the important and largely unfulfilled position that universities occupy in contributing to the wellbeing of small-scale farmers throughout the sub-region. The association aims to address these issues through better focused training of graduates entering the rural development workforce, and also by conducting more relevant and development-oriented research that is directly linked to participatory outreach programmes. The work of RUFORUM is guided by five strategic goals: Masters and PhD programmes are responsive to stakeholder needs and national/regional development goals; shared research and training facilities and capacities for enhanced economies of scope

and scale; innovative training, research and outreach activities supported by adaptive management structures in universities contributing to policy and development practice; mainstreaming the development of operational capacity and approaches for innovative quality and impact-oriented research for development at universities; and providing a dynamic regional platform for policy advocacy, lobbying, coordination and resource mobilisation for improved training, research and outreach by universities.

**AICM model:** Established in 2007 by the RAIN of ASARECA, the Postgraduate Programme in Agricultural Information and Communication Management (AICM) endeavours to fill a gap in most agricultural training programmes in African universities, whose graduates lack adequate capacity to integrate ICT in communicating agricultural knowledge, while ICT graduates lack specific knowledge to effectively package and communicate new developments in science. The programme comprises three levels: a two-year MSc programme and a one-year postgraduate diploma (PGD) which target graduates and professionals from a variety of backgrounds, and a course module that will be incorporated into ongoing MSc programmes in agriculture and related fields to enhance their ICT/ICM content. The programme operates through a network of participating universities supported by a regional secretariat which maintains with strategic partners who also contribute to the management and sustainability of the programme. The course curriculum was developed through collaboration among pioneer university members. Implementation and management of the programme are done collaboratively, with the regional secretariat coordination at regional level. Each country has a national committee that oversees fund raising and quality management. Each university is free to offer the course depending on having achieved a set level of infrastructural and human resource capabilities. A university offering the programme admits students from any country in the region under special terms of mutual agreement. Degrees are awarded by the university implementing the course.

### Networks of national research systems

In the agricultural research sector, the creation of the CGIAR system as an international initiative also saw the establishment of similar organisations arising from the initiative of national agricultural research organisations (NAROs). Over time, relevant faculties of universities have joined these networks, which have then become networks of national agricultural research systems (NARS). The purpose of these regional organisations is to increase the efficiency of agricultural research in each region and, thus, promote economic growth, food security and export competitiveness through productive and sustainable agriculture. They do so by coordinating resource mobilisation and allocation, and minimising duplication of effort. There are four such strategic research organisations (SROs) in sub-Saharan Africa:

- The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), was established in 1994 and is based in Entebbe, Uganda. ASARECA is a non-political organisation of the national agricultural research institutes (NARIs) of 10 countries: Burundi, D. R. Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania and Uganda. It aims at increasing the efficiency of agricultural research in the region so as to facilitate economic growth, food security and export competitiveness through productive and sustainable agriculture. ASARECA's website provides information on its activities and other resources related to agricultural research in the region.
- West and Central African Council for Agricultural Research and Development (CORAF/WECARD) is a regional association of the national agricultural research institutes of 21 countries in West and Central Africa, whose general objective is to improve the efficiency and effectiveness of small-scale producers and promote the agribusiness sector. It was established in 1987 and is based in Benin.

- SADC/FANR: The Food, Agriculture and Natural Resources (FANR) Directorate is one of four directorates at the Southern African Development Community Secretariat, based in Mbambane, Botswana. Its main function is the coordination and harmonisation of agricultural policies and programmes in the SADC region, in line with priorities in the Regional Indicative Strategic Development Plan (RISDP). The main focus of FANR is to ensure food availability, access, safety and nutritional value; disaster preparedness for food security; equitable and sustainable use of the environment and natural resources; and strengthening institutional framework and capacity building.
- The Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA) was established in 1985 to strengthen cooperation among national, regional and international research institutions and centres through the dissemination and exchange of information, experiences and research results. Its mission is to contribute to the enhancement of agricultural and rural development in the WANA region. By fostering agricultural research and technology development and by strengthening collaboration within and outside the region, AARINENA aims to achieve greater degree of self-reliance in food and agriculture, and to improve the nutritional well-being and overall welfare of the people of the West Asia and North Africa (WANA) region while sustaining and further improving the productive capacity of the natural resources base.

### **Network of networks**

The best known example of a network of networks is the Forum for Agricultural Research in Africa (FARA), whose aim is to achieve improved broad-based agricultural productivity, competitiveness and markets sustainability in Africa. FARA is a network of the sub-regional organisations (SROs) listed above, and operates through many other specialised regional networks, such as the Regional Agricultural Information Network (RAIN) of ASARECA. FARA's key results areas correspond to the priorities of its clients, the SROs and include: establishment of appropriate institutional and organisational arrangements for regional agricultural research and development; provision of access to the knowledge and technology necessary for innovation; development of strategic decision-making options for policy, institutions and markets; development of human and institutional capacity for innovation; and providing support to platforms for agricultural innovation.

With advances in IT, the trend is more and more towards establishment of mega networks, such as FARA. A similar development has taken root in southern Africa in the field of environment management. In 1998, several southern African universities established the Southern African Consortium of Universities for Development and Environment – Industry and Urban Areas (SACUDE-I&UA), which was adopted from the Linked University Consortia for Environment and Development (LUCED) model based in Denmark (Fincham *et al.*, 2006).

### **4.5.3 Unique characteristics of the ARPPIS model**

ARPPIS embodies at least seven characteristics which, in combination, build an aura of success and singularity in this network which does not accompany other cooperative arrangements for postgraduate education elsewhere.

First, there is a strong linkage between an advanced research and education (which brings to the partnership its strength in priority R&D in a field directly relevant to the tropics, as well as its worldwide linkages in the same area) and a consortium of African universities (which bring to the partnership their collective interest in advancing tropical insect science, as well as their commitment to high-level staff development in the field). This is a unique partnership anywhere in the world, and a most worthwhile achievement in Africa in itself.

Second, the creation of a new field of scientific endeavour, namely insect science (in place of classical entomology), which brings together an array of scientific disciplines (physiology, biochemistry, biophysics, biomathematics, molecular sciences, genetics, ethology, social sciences, ecology, etc.) to understand the life and times of insect species in relation to their hosts and the environment, so as to design more rational means to manage their populations for the sustainable benefit of man. This new endeavour was created during the planning of a new international scientific journal concentrating on tropical insects, and has greatly been fostered by the ARPPIS educational programme.

Third, the introduction of a semester of mandatory coursework to bring up the level of knowledge of modern insect science among the ARPPIS scholars for the PhD degree before they actually start on thesis project research.

Fourth, the establishment of an Academic Board, in which all partner institutions are represented, and which decides policy issues regarding the academic programme, the exchange of staff, and the maintenance of a high level of excellence and relevance through regular monitoring and inspection.

Fifth, the continuing close communication maintained by the *icipe*, as manager of the ARPPIS network on behalf of all partner institutions, of all ARPPIS graduates among themselves (through the founding of an ARPPIS Alumni Association), and with the ARPPIS partner institutions (through biennial ARPPIS symposia, the first of which was convened in December 1990), and a quarterly newsletter.

Sixth, provision for *in-situ* training of Africans in Africa was a bold digression from the traditional 'participant student' of the bilateral agencies and international foundations. The ARPPIS model had higher promise to contain brain drain than even the sandwich model that came later and is still promoted today by some networks, such as BioEarn. The ARPPIS model has informed the founders of the more recently established graduate training programmes. Examples of such recent 'innovations' which are close to home include the Collaborative MSc Programme in Agricultural and Applied Economics, which is being implemented by the African Economics Research Consortium and the African Doctoral Dissertation Research Fellowship (ADDRF) Programme of the Population and Health Research Centre.

Seventh, ARPPIS had the benefit of the multidisciplinary nature of *icipe's* R&D activities, which made it possible to bring in students from different disciplinary backgrounds (biology, chemistry, biochemistry, molecular biology, maths/physics and social sciences). This has been reflected in the diversified thesis projects of ARPPIS scholars. Two major benefits arise from this flexibility (1) students are able to work at any point along the innovation chain: upstream exploratory stage, or downstream technology development, assessment and delivery; (2) as interdisciplinarity took root at *icipe*, more students have been able to work at the interface between different disciplines. Hence from inception, the *icipe* developed multidisciplinary core research programmes aimed at solving a wide range of pest and vector problems including crop pests, livestock ticks, medical vectors, tsetse flies as well as research aimed at economic exploitation of beneficial insects. The students had access to mentoring from different basic science departments and support including, chemistry and biochemistry, cell biology, sensory physiology, institutional building, biomathematics and social science interface.

There is no doubt that the network conceptual and operational framework has out-yielded our best expectations. Any new developments, to enhance the content and quality of the ARPPIS network, must conserve and utilise these factors of success to the utmost.





# CHAPTER 5

## Achievements and Impacts of ARPPIS

### 5.1 Introduction

ARPPIS was launched in 1983, with the vision of training young African scientists to take regional and indeed international leadership in insect science. ARPPIS has lived up to this dream, and has earned world-wide recognition as the 'breeding point' for some of Africa's finest young scientists. ARPPIS has filled a void whose existence was realised by the early initiators of Africa's R&D in insect science, i.e. general shortage of experts to teach and conduct research on the continent's extensive variety of arthropods. Research undertaken by ARPPIS scholars has contributed to solving some of Africa's most critical problems that threaten food security and human health. The work of the ARPPIS scholars is part of the *icipe's* own work, which has been based on the 4Hs paradigm of human, plant, environmental, and animal health, and therefore has benefited from the unique insights and scientific discoveries of ARPPIS students. In turn this enormous resource of African scientific talent has helped to strengthen the capacity of key African universities and institutions.

After 25 years of operation under considerable strain from insufficient resources, ARPPIS has grown and flourished to become, what is now considered by many, a model capacity strengthening programme in Africa and beyond. Presently the programme has a large, and still increasing, number of participating universities, and a sub-regional programme based in three sub-regions of the continent. It boasts an output of several hundred doctoral and masters degree level graduates, most of them holding responsible positions in various governmental and private institutions in Africa, USA and Canada, whose capacities they have greatly enhanced. Research by the graduates has also helped to advance *icipe's* own mandate of improving the lives of Africa's poorest people through higher food production, improved health, and better household income levels by adopting and investing in commercial insect production. The ARPPIS alumni have also organised themselves into a network of insect scientists, the ARPPIS Scholars Association (ASA), that aims to foster their objectives as individuals while bringing them together as a cohesive group of like-minded experts. By holding annual conferences and symposia, the ASA has kept in touch with the needs of Africa in insect science and beyond.

Achievements and impact of ARPPIS are viewed in the following key performance areas based on the original objectives of the programme:

1. Successful nurturing and growth of the programme, contribution to strengthening individuals;
2. Research capacity strengthening research skills development at individual level, staff and infrastructure development for member universities and strengthening of scientific community at sub-regional and regional levels through networks development;
3. Knowledge production and contribution to science, both regionally and to *icipe's* research;
4. Informing policy, which includes how research results have been used to inform agricultural policies and any effort made towards engaging policy makers with research evidence; and
5. Socio-economic benefits to society, measured in terms of contribution of research on insect pests and vectors of livestock and human diseases towards resolving threats to food security and human health.

## 5.2 Programme growth

Nurturing and growth of ARPPIS is viewed in terms of growth of university and other membership of the network, development and expansion of programme content and successful fundraising for programme sustainability.

### 5.2.1 Growth of the ARPPIS Network

The ARPPIS network was born in 1983 with a membership of 7 universities. These founder universities were the Universities of Ghana, Zimbabwe, Sierra Leone, Khartoum, Zambia, Dar es Salaam and Addis Ababa. The absence of Kenyan universities among the founder members of ARPPIS is, perhaps, testimony to the scepticism that the founders of ARPPIS experienced with academicians in *icipe's* home country in those early days. It is also a reflection of the effort of the international scientific community outside Kenya in the initiation of ARPPIS. But this did not last long, as Prof. Shellemiah Keya's Moi University in Eldoret, Kenya came on board by end of 1987.

As illustrated in Figure 5, growth of the ARPPIS network was rapid, hitting the 30-member mark in 1995. All along, members were tied to the network through

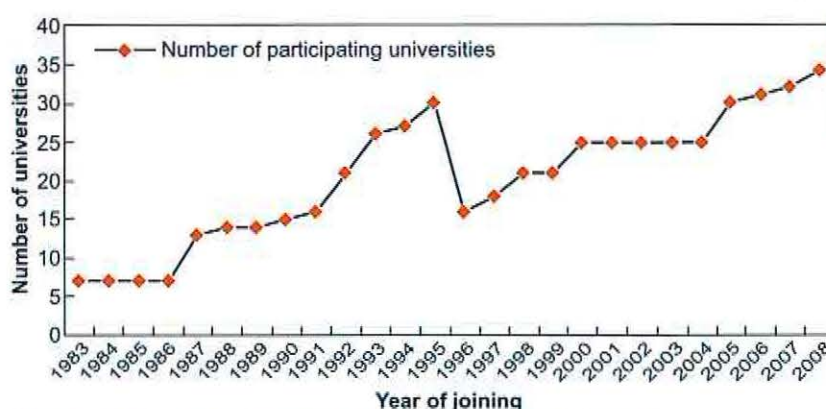


Figure 5. Growth of the ARPPIS network from 1983–2008

the inaugural memorandum of understanding (MoU) that did not fully bring out the need for equal partnership in terms of contribution to the programme by members, with member universities perhaps expecting the lions share of contribution to the programme to come from *icipe*.

The ARPPIS Academic Board reviewed the MoU with a view to improving university contribution through fee waivers and sponsorship of academic supervision. There were marked delays in some universities reaffirming their membership as they took time to review the new terms. University membership grew gradually, reaching 30 in 2005 and rising to 34 in 2008. Five old members of the network, including the University of Sierra Leone which was a founder member, were yet to sign the revised MoU although they remained actively participating in the programme (Exhibit 4). In effect, the ARPPIS network presently has 35 members. The 33rd meeting of the AAB held in October 2007 approved another review of the ARPPIS memorandum of agreement in line with recommendations by a study to revamp the programme but this did not seem to reflect on membership records.

In addition to participating African universities, ARPPIS has enjoyed the support of associate members in the form of national agricultural research institutes (NARIs) in African countries signatory to *icipe*, international agricultural research centres (IARCs), academies of science and universities in developed countries. To date, ARPPIS collaborates effectively with several IARCs, whose partnership has been made possible through the Centres' collaboration with *icipe*; they include ICRAF, ILRI and IITA. Academies of science and networks presently collaborating with ARPPIS include the African Academy of Sciences (AAS), Third World Academy of Sciences (TWAS), Third World Organization for Women in Science (TWOWS); and African Network for Agriculture, Forestry and Environment Education (ANAFE). ARPPIS has linkages with the following universities and advanced laboratories

outside Africa: Brazil: Federal Rural University of Pernambuco, University of Sao Paulo, University of Viçosa, Regional University of Cariri; France: ENSA Montpellier; Netherlands: University of Amsterdam; Germany: Universities of Constance, Kiel, Hanover, Zena; USA: Miami, Pennsylvania, Michigan State, Yale Universities; Sweden: Swedish University of Agricultural Sciences; UK: University of Newcastle-upon-Tyne and Rothamsted Research. ARPPIS collaborates with NARIs through member universities.

### *5.2.2 Expansion of programme content*

Within the 25 years of implementation, ARPPIS had grown substantially in the variety and content of its programmes. When the doctoral programme became a reality in 1983 the need for training at middle cadre had already been recognised with the intention of filling human resource gaps experienced by NARIs and middle colleges. Steadily, the ARPPIS Academic Board proceeded to champion a number of studies and regional tours that eventually came up with a viable structure for a sub-regional programme for training at the MSc level.

The MSc component was conceived as a network of sub-regional centres hosted by selected universities strategically located in parts of Africa, with the main objective of making training relevant to the students' home environment and reducing non-academic costs and social problems associated with training outside their sub-regions. It was also envisaged that the main function of the sub-regional programme was to feed the doctoral programme with suitable candidates. Thus, a coursework was developed which was thoroughly reviewed and core content approved with a provision for adjustment of supplementary content in accordance with sub-regional priorities. Suitable centres to host the programme were evaluated in the four sub-regions of the continent. The sub-regional centres became a reality in the 1990s, with the Centre for Southern Africa opening up at the University of Zimbabwe in 1992; the Centre for West Africa opening up at the University of Ghana in 1994 and the Centre for Eastern Africa being opened at Addis Ababa University in 1997. With both the doctoral and the sub-regional MSc programmes operational, ARPPIS is able to satisfy the needs of governments and industry for researchers and academicians for national research systems as well as suitable candidates for employment as insect pests and vectors management (IPVM) practitioners while at the same time prepare ready material for admission into the doctoral programme.

In addition to training researchers and technologists, ARPPIS has stimulated the growth of non-degree programmes and other complementary activities that have benefited the region as a whole. Because of ARPPIS it became fairly easy to sell ideas for activities that were complementary to research and higher education. For example, most of the ARPPIS programme grants also supported technology dissemination through international group training courses, and the development of training manuals and text books in insect science. Other activities aimed at fostering cooperation and strengthening partnerships through networking support.

### *5.2.3 Growth in programme funding*

Funding of ARPPIS comes in two main forms:

1. Core grants have been the main form of support to the network; they support all types of costs including university costs, research costs, personal support for scholars, secretariat support and network strengthening;
2. Scholarship grants mainly provide for university costs, personal support for scholars and may or may not pay for student research expenses.

**Table 3. Main funding sources for ARPPIS from 1983–2008**

Name of donor	Title of programme	Year started	Year ended	Currency	Amount
Dutch Government (SIR)	Studies in the Region	1982	1990	DFLs	1,269,611
Dutch Government (DSO-I)	Human Resource Development for Scientific and Technological Capacity in Arthropod Science in Africa	1991	1996	DFLs	2,875,950
Dutch Government (DSO-II)	Human Resource Development for Scientific and Technological Capacity in Arthropod Science In Africa - Phase II	1997	2002	DFLs	4,110,070
Dutch Government (SII)	Human Resource Development for Pest/Vector Management and Biodiversity Conservation in Africa	2004	2009	US\$	3,419,425
German Government (DAAD)	DAAD In-country and Third Country Scholarship Programme for ARPPIS	1983	to-date	US\$	1,885,700
<i>icipe</i>	Research support for DAAD scholars through <i>icipe</i> projects	1983	to-date	US\$	2,616,000

Since inception, ARPPIS has received both core and scholarship support from at least 20 donor governments and international support agencies. In the earlier years, the ARPPIS secretariat received one-time human resource and infrastructure support from four organisations: Arab Bank for Economic Development in Africa (BADEA), Australian Development Association Bureau (ADAB), Overseas Development Administration of the United Kingdom (ODA), and United Nations Educational, Scientific and Cultural Organisation (UNESCO). The Dutch and German governments have been the main supports on ARPPIS on a long-term basis. The Dutch have supported ARPPIS through three of their programmes; these are, Studies in the Regional Programme (SIR) which gave the very initial grant that established the doctoral programme in 1983, the Direct Support to Training Organisations (DSO) which supported ARPPIS from 1991–2003, and the International Institutes Cooperation Programme (SII) whose grant started in 2004. The German government has supported ARPPIS mainly through scholarships of the German Academic Exchange Service (DAAD) from 1983 to date; additional scholarships were received through the BMZ programme. In addition to support from external agencies, *icipe* provided the bulk of research project support to scholars whose sponsorships had no such provision. The main funding of ARPPIS through core and scholarship support is summarised in Table 3, while the list of scholarship providers, including those received through core programmes, is provided in Table 4.

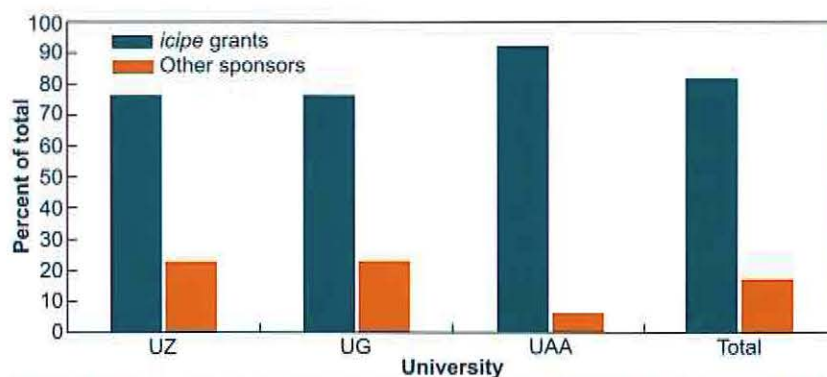
In conclusion, ARPPIS has been able to generate resources necessary to support student scholarships and aspects of secretariat services over the period. The programme has admitted students under scholarship support in each year of its existence to date. From secretariat funds the programme supported annual meetings of the academic board and paid for travel expenses of some of the members who attended the meetings, especially coordinators of the sub-regional MSc programme. It would appear that a lot more resources would be required for the programme to finance many of the desirable network activities, including alumni collaboration and infrastructure development for the large number of participating universities. Most of programme grants had no provisions for these activities and those that did, such as the Dutch grants, did not provide adequate resources to cater sufficiently for the needs of stakeholders.

Finding sponsorship for students in the sub-regional MSc programme had been a major problem for ARPPIS, with the majority of scholarships being provided by Dutch and DAAD grants through programme grants to ARPPIS secretariat. As for most graduate programmes at universities, the ARPPIS Masters programme was not able to attract sufficient scholarships outside those provided through *icipe* grants. Figure 6 shows sources of scholarships for the programme at the three Sub-regional Centres between 1992 and 2008. The University of Ghana (UG), and the University of Zimbabwe (UZ) were able to generate some scholarships

through self-financing and state sponsorship during their inaugural years but this did not seem to happen again. Addis Ababa University (AAU) only managed a couple of students sponsoring themselves. As from 2000 none of the Centres has secured a single scholarship outside of those provided through *icipe* grants.

**Table 4. Providers of scholarships for ARPPIS doctoral scholars from 1983–2008**

Name of Sponsor	Period of operation			TOTAL
	83–89	90–99	00–08	
Dutch Government (SIR, DSO-I, DSO-II, SII)	5	30	22	57
German Government (DAAD)	20	41	41	102
German Government (BMZ)	2	1		3
International Centre of Insect Physiology and Ecology ( <i>icipe</i> )	5	5		10
United States Agency for International Development (USAID)	1			1
Ford Foundation	6			6
European Economic Community	1			1
International Institute of Tropical Agriculture (IITA)	5			5
Rockefeller Foundation	1			1
PEW Charitable Trust	2			2
Norwegian Agency for International Development (NORAD)		1		1
United Nations Development Programme (UNDP)		4		4
International Fund for Agricultural Development (IFAD)		5		5
European Union		3		3
Singerberg Foundation			2	2
Kirkhouse Trust			1	1
<b>Total</b>	<b>48</b>	<b>90</b>	<b>66</b>	<b>204</b>

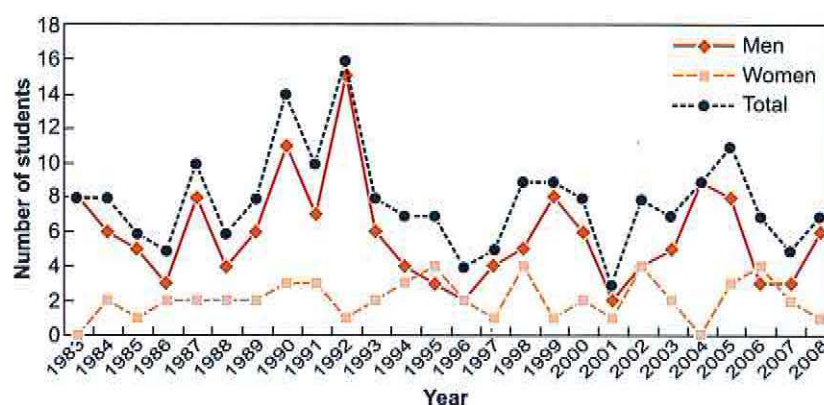


**Figure 6.** Sources of student scholarships at the ARPPIS Sub-regional MSc centres from 1992–2008

### 5.3 Strengthening research capacity in insect science

#### 5.3.1 Enrolment of doctoral scholars

From 1983 to 2008, ARPPIS admitted 204 men and women scholars under the doctoral programme as is illustrated in Figure 7. The geographical and gender distributions of the beneficiaries are summarised in Table 5. Only four of these scholars had their training fellowships discontinued, two of them on academic grounds having failed to pass the mandatory coursework. The ARPPIS doctoral training database is provided as Exhibit 5. To date, 183 members of the 1983–2005 classes have completed their training and have joined the community of scientists serving in various parts of the continent. Still on training are 19 members of the 2006–2008 classes that are contributing to *icipe's* research.



**Figure 7.** Annual student admission to ARPPIS doctoral programme 1983–2008

The gender and geographical balancing policy of ARPPIS has had little effect in increasing the number of women trained in ARPPIS as well as equitable geographical distribution of training opportunities in the continent. To date, one can say that ARPPIS has successfully accomplished its benchmark of realising at least 25% of its doctoral graduates being women. The benchmark was set in the early eighties and is now out of date, yet the programme is still unable to exceed it. A review by the ARPPIS Academic Board<sup>1</sup> of the annual applications for ARPPIS fellowships over the years revealed a very low application rate by women candidates, which explains their equally low admission rates. Gender imbalance in ARPPIS training remains a problem to be tackled. The same analysis by the ARPPIS Academic Board also showed that there were significantly more applications from eastern Africa region than from all other regions combined, hence the disparity in geographical distribution of ARPPIS scholars in favour of eastern Africa.

**Table 5.** Summary of scholars admitted to the ARPPIS doctoral programme from 1983–2008 by gender and sub-region

Period	Number of men	Number of women	Eastern Africa	West Africa	Central and French West Africa	Southern Africa	North Africa	Total
1983–1989	39	11	35	11	2	2	0	50
1990–1999	65	24	51	13	10	10	5	89
2000–2008	46	19	41	5	14	5	0	65
<b>TOTAL</b>	<b>150</b>	<b>54</b>	<b>127</b>	<b>29</b>	<b>26</b>	<b>17</b>	<b>5</b>	<b>204</b>
<b>Percent</b>	<b>74</b>	<b>26</b>	<b>63</b>	<b>14</b>	<b>12</b>	<b>9</b>	<b>2</b>	<b>100</b>

### 5.3.2 Enrolment of Masters students

The ARPPIS sub-regional Masters programme has come of age through serious teething problems, mostly associated with funding. The three centres have together enrolled 173 candidates, 75% of whom have since graduated. Table 6 shows the distribution of student enrolment at the three centres. As in the case of Doctoral programme, the Masters programme has trained more candidates (57%) from the host country than from the rest of the sub-region for obvious reasons of ease of access and, in this case, the possibility of self-sponsorship by locals. The possibility of enrolling candidates from outside the sub-region as has happened at West Africa and Southern Africa Sub-regional Centres is encouraging and, indeed, has enhanced interregional integration for the ARPPIS network. Again, enrolment of women has come a poor second to that of men.

<sup>1</sup>ARPPIS (2007) Minutes of the 33<sup>rd</sup> meeting of the ARPPIS Academic Board held on 2<sup>nd</sup> October 2007, Centre for African Wetlands (CAW), University of Ghana, Legon: Agenda Item 4.

**Table 6. Summary of students admitted to the ARPPIS Sub-regional MSc Programme from 1992–2008**

Sub-regional centre	Period of operation	Number of men	Number of women	Number of nationals	Others from same sub-region	Candidates from other sub-regions	Total
Southern Africa (University of Zimbabwe)	1992–2005	27	7	21	9	4	34
West Africa (University of Ghana)	1994–2008	86	24	65	37	8	110
Eastern Africa (Addis Ababa University)	1997–2006	23	6	15	14	0	29
<b>TOTAL</b>		<b>136</b>	<b>37</b>	<b>101</b>	<b>60</b>	<b>12</b>	<b>173</b>
Percent of total		79	21	58	35	7	100

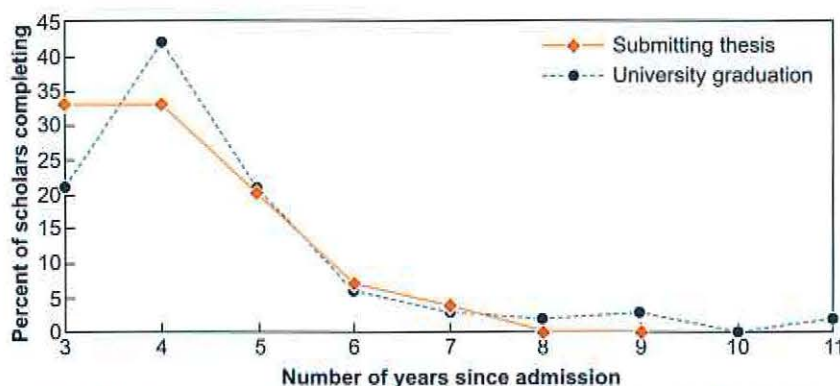
The three Centres have operated at different levels of satisfaction: The Centre for Southern Africa started in 1992 and admitted students every other year until 2001 when it ceased operation. The Centre resumed training in 2005 but data for 2006–2008 operations were not available. The Centre for Eastern and North-Eastern Africa was inaugurated in 1997 and admitted students every year until 2000 when it ceased operations. The Centre resumed operations by admitting students in 2006 but information for 2007–2008 was not available. A study sponsored by ARPPIS secretariat (Musewe, 2005) revealed that the two centres had relied heavily on *icipe's* support through DAAD and DSO programmes; a scholarship crisis arose when DAAD disqualified the two Centres for presenting candidates that did not meet the minimum qualifications and age limits for DAAD scholarships. And, when the DSO-I project closed down after 2001 the two Centres could no longer admit students.

The Centre for West Africa has so far been the most successful. It was inaugurated in 1994 and, except for 1995, has admitted students every year till now; the 2008 class is included in this analysis.

### 5.3.3 Reduction in training time

With resources made readily available to the scholar, including dedicated research supervision, working in an exclusively research environment in an international setting, unlimited support to scientific forums and a zero teaching load unlike their counterparts based at universities who simultaneously work as tutorial fellows, shortening of the training duration of thesis research has been a strong argument in favour of ARPPIS.

This assertion has been tested by examining the time it took ARPPIS students since their admission to complete and submit their theses and even graduate from their registering universities. The analysis also facilitated the monitoring of university performance in



**Figure 8.** Duration from admission to thesis submission and graduation for scholars of ARPPIS doctoral programme



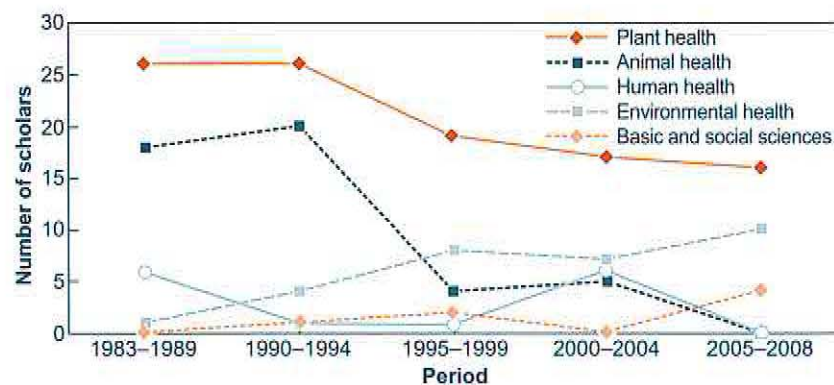
examining the scholars following submission of the thesis. The findings in Figure 8 show that 33% of ARPPIS scholars submitted their theses to their universities within the normal programme duration of 3 years but only 20% graduated within that time. More evidence shows that more than 85% of ARPPIS scholars graduate within 5 years of starting their training. Experience from universities reveals that university lecturers who are on staff development programmes while on staff role take 7 to 10 years to complete doctoral studies.

### 5.3.4 Multiplicity of fields of specialisation

Over the years, organisation of *icipe's* research has changed to embrace the 4-H paradigm, which includes human health, plant health, animal health and environmental health. These topical issues identified by the *icipe* are the central ingredients in any attempt to develop Africa on a sustainable basis. It accounts for the relevance of the ARPPIS programme in tropical and sub-Saharan Africa and the success of ARPPIS alumni in the world of science.

In the last few years, the ARPPIS training programme has made a significant contribution to *icipe's* R&D (including upstream exploratory research ideas) and almost all programmes benefited from extra manpower that was closely linked to the overall research goals of the *icipe*. In the process, ARPPIS has made substantial contribution to human resource development for research in important sub-sectors of agriculture, human and environmental health.

Table 7 shows the distribution of specialisation areas of ARPPIS doctoral scholars, with the largest proportion of 54% being on plant pests. Figure 9 illustrates how the gradual change in *icipe's* research portfolio has influenced the specialisation areas of ARPPIS scholars. The evidence reflects the continued emphasis of *icipe's* research in the area of plant health, the waning focus on animal health and the gradual increase in attention to environmental health.



**Figure 9.** Change in student research focus in line with *icipe's* changing research emphasis

**Table 7. Nationalities and areas of specialisation of students on the ARPPIS doctoral programme from 1983 to 2008**

Country of origin	Plant Health	Animal Health	Human Health	Environmental Health	Technology adoption	Bio-math / modelling	Men	Women	Total
Benin		1					1	0	1
Burkina Faso	1						1	0	1
Cameroon	2	3	1	2		1	7	2	9
Chad		1	1				2	0	2
D.R. Congo	1	2	2	1			6	0	6
Egypt	3						3	0	3
Ethiopia	8	3	1	3			14	1	15
Ghana	3	2		2			6	1	7
Kenya	28	21	6	10	2	1	45	23	68
Lesotho	1						0	1	1
Malagasy	1						1	0	1
Malawi	1	1		1			3	0	3
Mali		1					1	0	1
Mauritania	2						2	0	2
Mozambique	2	2					2	2	4
Namibia		1					1	0	1
Nigeria	12		2	1			8	7	15
Rwanda	1						1	0	1
Senegal	3	1		1			5	0	5
Sierra Leone	2	1					3	0	3
Somalia	2						2	0	2
South Africa				1			0	1	1
Sudan	8	5					11	2	13
Tanzania	7	2		2			8	3	11
Togo	2						2	0	2
Uganda	13	2				1	12	4	16
Zambia	2	2					3	1	4
Zimbabwe	6						2	4	6
<b>Total</b>	<b>111</b>	<b>51</b>	<b>13</b>	<b>24</b>	<b>2</b>	<b>3</b>	<b>152</b>	<b>52</b>	<b>204</b>
% of Total	54	25	6	12	1	1	75	25	100

### 5.3.5 Multiple capabilities of graduates

One of the core principles of ARPPIS is to ensure that the incoming generations of African scientists have a strong and holistic science-based training with a socio-economic background that is relevant to the needs of the society. They must be equipped with problem-solving and critical thinking skills, as well as possess good communication and interpersonal skills. The research training programme is therefore designed on a holistic, interdisciplinary approach that is anchored firmly on a strong disciplinary pillar, emphasising the creation and application of knowledge, strengthening of skills and changing of mindsets so as to empower individual researchers and institutions to initiate problem-solving research that will impact on socio-economic development.

In line with this principle, ARPPIS produces graduates who are conversant with concepts and principles of modern IPVM and able to implement and direct projects through multi-disciplinary teamwork. The graduates are trained to be able to analyse insect-related aspects that impact on food and health security policies and effectively utilise contributions and other disciplines such as socio-sciences, economics and policy studies.

The multidisciplinary nature of *icipe*'s R&D activities has made it possible to bring in students from different backgrounds, including biology, chemistry, biochemistry, molecular biology, physical sciences and even social sciences. This has been reflected in the diversified programmes of ARPPIS scholars. For example:

1. Students work at any point along the innovation chain: upstream exploratory stage, or downstream technology development, assessment, or delivery; and
2. As interdisciplinarity took root at *icipe*, more students were able to work at the interface between different disciplines. From inception, the *icipe* developed multidisciplinary core research programmes aimed at solving the respective problems: Crop Pests, Livestock Ticks, Medical Vectors and Tsetse Flies. These core research programmes were complemented by discipline-oriented research support units such as: Chemistry and Biochemistry, Cell Biology, Sensory Physiology, Institutional Building, Biomathematics and Social Science Interface.

The core research activities of the *icipe*, from which ARPPIS scholars design their thesis projects, have tremendous community service outreach components. Many of the research themes done at the *icipe* have direct applications to socio-economic and environmental problem solving. One example only; the Tsetse Research Programme produced odours baited trapping technology which is being used in the control of tsetse flies in the continent. These problem solving research initiatives are being undertaken in the areas of Plant Health, Animal Health, Human Health and Environmental Health with promising practical applications. There are a number of social problems associated with the introduction, acceptance and adoption of new technologies by the communities.

The *icipe* programmes are all directed to solving community problems and the *icipe* scientists and scholars have not found serious difficulties in introducing their technologies to the communities because of the Social Science Interface Unit mentioned earlier in this book. It is also pleasing to note that some ARPPIS alumni have diversified to work on policy formulation and national legislation (political) in their countries. Besides the advancement in science and technology, appropriate policies and political stability are equally critical for the development of Africa. It is not enough to be a very good scientist in Africa, but it is equally important for the alumni to give political direction to the population. It is a well known fact that political stability is the primary ingredient in any socio-economic development in the world. Hence alumni are encouraged to concurrently take part in political affairs of their country.

The multidisciplinary approach in ARPPIS has been reflected in the large and varied nature of research partnerships and projects implemented throughout the last three decades. The ARPPIS training programme therefore formed the basis on which the graduates conducted relevant research aimed at sustainable food production and economic empowerment of the rural communities for effective poverty reduction in Africa; while at the same time taking care of the human and animal health from tropical vector-borne diseases. Research focus has therefore been on carrying out research relevant to crop and livestock insect pests, as well as insect vectors of tropical diseases crucial to rural health, with a view to developing sustainable pest management technologies, as well as the beneficial uses of insects. Indeed through their research, ARPPIS scholars have been significant players in what Odhiambo (2003) called "transforming insect science in Africa, a paradigm shift from focusing on killing only 0.3% of individual insect species to a holistic approach of managing in a sustainable and integrated manner insect populations". With the awareness of the negative side effects of pesticides, integrated pest and vector management became the call for implementing programmes at the *icipe*, and ARPPIS was not to be left behind. In the Crop Pests Research Programme, IPM became the new approach focusing on varietal resistance, habitat management, biological control and judicious chemical control.

The ARPPIS programme brings in graduate students from diverse academic backgrounds in life sciences, notably agriculture, veterinary, medicine and biology under one academic

roof during the coursework and multidisciplinary research during thesis project work. The ARPPIS graduates therefore do not have the usual professional narrow minded pride and arrogance found in graduates from mono-professional faculties in African universities. ARPPIS alumni no longer consider themselves as medical doctors, agriculturalists, veterinarians or zoologists etc.

### 5.3.6 Enhancing graduate output of universities

Lack of government support for postgraduate training is a major constraint in most African universities. Apart from the few excellent performers that win absorption into university employment under staff development programmes, postgraduate students are, invariably, self or privately sponsored. ARPPIS has made a significant contribution towards enabling universities realise this important objective.

Table 8 shows the list of 26 African universities that have so far been enabled by ARPPIS to register and train insect science scholars at the doctoral level. Kenyan universities have benefited more than others mainly because of their proximity to *icipe* where the scholars are based, but also due to the method of scholar recruitment into the programme, which is not strictly based on prior sponsorship by a participating university. Many new scholars report to *icipe* after winning admission on account of their suitability for the project-specific fellowships which are advertised within the region. Once at *icipe*, and with the help of potential *icipe* supervisors the scholars look around for a suitable university in which to register. Kenyatta University, which has registered the largest number of ARPPIS scholars, happens to have a large contingent of ARPPIS alumni among their faculty, who have very close links with their former host programmes at *icipe*. Kenyatta also has a reputation for efficient processing and registration of graduate students as well as a good record of timely examination and awards of the degree. Graduates of the sub-regional Masters programme shown in Table 6 above have also boosted the graduate output of the host universities.

**Table 8. Registration of ARPPIS scholars at member universities from 1983–2008**

Rank and name of university	Number registered
1. Kenyatta University, Kenya	57
2. University of Nairobi, Kenya	20
3. Rivers State University of Science and Technology, Nigeria	18
4. University of Khartoum, Sudan	10
5. Jomo Kenyatta University of Agr & Technology, Kenya	10
6. Makerere University, Uganda	10
7. University of Ghana, Legon	10
8. University of Pretoria, RSA	9
9. University of Dar es Salaam, Tanzania	8
10. Moi University, Kenya	8
11. University of Sierra Leone	7
12. Egerton University, Kenya	4
13. University of Gezira, Sudan	4
14. Ahmadu Bello University, Nigeria	3
15. University of Zimbabwe, Harare	4
16. University of Zambia, Lusaka	3
17. Addis Ababa University, Ethiopia	3
18. North West University, Republic of South Africa	2
19. University of Cape Coast, Ghana	2
20. Ain Shams University, Egypt	1
21. University of Malawi	2
22. Assiut University, Egypt	1
23. Nnamdi Azikiwe University, Nigeria	1
24. University of Ibadan, Nigeria	1
25. University of Abidjan, Côte d'Ivoire	1
26. University of Mauritius	1

Note: Four scholars of 2008 class were yet to secure university registration

### 5.3.7 Institution building through staff development

The findings of a mini tracer study of ARPPIS alumni of 1983–2005 classes undertaken in June 2008 are shown in Table 9. The data shows 68% of ARPPIS graduates are employed by academic and research organisations within Africa in the following ratio: universities (31%), national research organisations (19%), regional and international research organisations (9%), administration of research within government ministries (7%), while others are serving as professional consultants (3%) and research advisers in private industry (2%). A further 6% of the graduates are serving Africa in fields where they are likely to influence policy; this is true of those employed in international aid agencies where they make decisions on research project funding and in politics where they influence all fields of governance including research policy. Only a small percentage of graduates have been lured to work in developed countries but further follow up has shown that many of them are training as postdoctoral fellows in universities in reputable universities or research organisations. The loss of 8% through natural attrition is significant and points to the need for long term strategies in human resource development.

Graduates of the sub-regional Masters programme are reportedly serving either in mid level careers promoting the utilisation of technologies in plant, animal, human and environmental health, or have progressed to doctoral programmes in the same fields, either in Africa or abroad. In terms of performance, only the Sub-regional Centre for West Africa has performed satisfactorily while the other two have had operational problems and even ceased to admit students.

**Table 9. Careers of ARPPIS doctoral graduates of 1983–2005 classes**

Type of work	Absolute number	% of sample
Research and teaching at African university	59	31
Research in national research organisation in Africa	36	19
Research in regional or international organisation in Africa	16	9
Administration of research in African government ministry	14	7
Consultancy work in Africa in professional area of training	6	3
Research in private industry in Africa	4	2
Programme administration in international aid agency in Africa	3	2
National politics in Africa	1	0.5
University work in developed country	9	5
Unemployed	1	0.5
Deceased	15	8
No response	24	13
<b>Total</b>	<b>188</b>	<b>100</b>

### 5.3.8 Infrastructure development at universities

ARPPIS has been working to build institutional capacity in the participating universities so that they are able to undertake frontier and cutting-edge research that directly contributes to solving critical national and regional problems, and thereby meet the millennium development goals (MDGs). In that respect the Network has supported staff development in partner universities through scholarships for staff training and departmental support. Attachment at *icipe* facilities is offered for students and researchers wishing to undertake projects that require specialised laboratory expertise, such as chemical ecology, molecular biology, biotechnology, bioinformatics, biostatistics, arthropod rearing and pathology.

One area where ARPPIS has not made impact is infrastructure development for member universities. This is probably so because doctoral students have mainly used *icipe* as their research base, thereby denying their registering universities any facility development, such as purchase of research equipment, that may be associated with their research budgets.

However, ARPPIS has provided modest departmental support to university departments hosting the sub-regional Masters programme. In addition, the regional nature of the programme makes it appealing to international donors, but this mostly depends on the effort of the host university in mobilising such support. For example the Centre for West Africa was able to secure assistance from the Ghana Education Trust Fund (GETFund) for infrastructure development and managed to put up its own building facility outside the host faculty.

### 5.3.9 Building a community of insect scientists

*“Programmes at the icipe, at that time and maybe even now, depended on the fund raising abilities of the various scientists and management under the general directorship of Professor Thomas Odhiambo. We were aware the present site (Duduville) was built through intensive lobbying skills of the Director. The ARPPIS graduates understudied these fundraising skills and many of them acquired the ability to raise funds through writing project proposals. I do not want to believe that some ARPPIS alumni have never got research funding from the many donor agencies. Many ARPPIS alumni have continued to get funding through hard work, dedication and strict accountability of project funding. Those ARPPIS alumni who are heading institutions are using the fund raising skills acquired from the icipe to prosper their institutions”.*

These were the words of Prof. John Nyeko Pen-Mogi, Vice Chancellor of Gulu University, Uganda and ARPPIS alumni of the inaugural class of 1983. He was speaking at the ARPPIS Scholars Association (ASA) Symposium held at Duduville, Nairobi in November 2008 as part of the ARPPIS Silver Jubilee Celebration, where he delivered a paper titled: “What the African Regional Postgraduate Programme in Insect Science (ARPPIS) has done to the Alumni.”

Very true indeed! And ARPPIS did not stop at the excellent grounding of scholars in resource mobilisation. The programme followed its alumni to their work places and promoted their recruitment into a community of scientists to champion collaborative resource mobilisation in support of insect science in Africa. ARPPIS achieved this in two ways:

First, a post-training grants scheme was created with the assistance of the Dutch government through the DSO-II project starting 1992. The scheme provided for four categories of grants for ARPPIS alumni:

1. Internship fellowships were awarded to alumni who graduated from the programme over five years back, to enable them return to *icipe* or visit other centres of excellence for retooling in newly emerging areas of science and technology;
2. Re-entry grants of up to US\$ 10,000 each were jointly awarded to recent graduates of the programme to enable them establish their careers through collaborative research projects;
3. Scientific exchange fellowships were awarded to any ARPPIS alumni who wished to visit another or group of alumni for purposes of initiating joint programmes; the fellowship also supported attendance of research project management training at specialised institutions; and
4. Sponsorship of ARPPIS scientific symposia for exchange of experiences. At the expiry of the DSO-II project grant in 2001, ARPPIS had awarded 10 internships, 9 re-entry grants and four scientific exchange fellowships. Also, the programme sponsored the development of the ASA website and two ARPPIS symposia in 1999 and 2000, respectively, in which over 60 alumni and current scholars participated.

Second, ARPPIS has spearheaded the strengthening of ASA in at least two ways. In 2006, ARPPIS extended assistance to ASA to enable them acquire the services of a consultant to

lead the association in charting its future. The outcome of this assistance was a working paper on the ASA strategic plan, which was discussed at the ASA annual meeting held the same year. The ASA strategic plan was finalised and became operational thereafter. Also, ARPPIS secretariat has been working with ASA in joint project development. To this end, ASA is being incorporated in many activities of ARPPIS. Presently the association's secretariat is housed at the ARPPIS secretariat. The recent meetings under the ARPPIS Silver Jubilee Celebrations were jointly resourced for by ARPPIS and ASA and the latter actually hosted the meetings that discussed at length the future role of ARPPIS in insect science research and training in Africa.

During training, scholars are linked to scientific networks through their *icipe* supervisors. Most *icipe* staff are members of the African Association of Insect Scientists (AAIS). A recently formed network of researchers in the biosciences, BioNET, has been formed to link African universities with prominent centres in the North and South. For 23 years, *icipe* and AAIS hosted an international peer-reviewed journal, *Insect Science and Its Application* (now *International Journal of Tropical Insect Science*), to promote science writing and build capacity in publishing. Through the ARPPIS Scholars Association (ASA), the alumni foster close collaborative linkages with the Centre's research and training work, and provide mentoring for trainees-in-residence.

#### TEXT BOX 1

##### Survey Instrument for Alumni Contribution to Capacity Strengthening

- Number of PhD students trained to-date
- Number of completed and ongoing research projects
- Number of collaborative projects undertaken
- Number of MSc students trained to-date
- Number of projects under development
- Number of networks initiated to-date
- Number of researchers employed in own projects

#### 5.3.10 Multiplier effect of graduates

To illustrate further the capacity building impact of ARPPIS in insect science research and education, we sought to know the achievements of graduates themselves since graduation, with respect to the indicators listed in Text Box 1.

Although response to the questionnaire was low mainly due to the inability to locate the alumni at short notice, the limited data obtained from the few responses shown in Table 10 illustrate the multiplier effect of these graduates on the impact of ARPPIS. A case study on a wider scale is needed to evaluate and document the impact of ARPPIS graduates on insect science research capacity development in the region.

**Table 10. Capacity strengthening efforts of ARPPIS alumni through training and project development**

Respondent	ARPPIS class	Career type	PhD students trained	MSc students trained	Projects done and ongoing	New projects in planning	Collaborative projects	Networks initiated	Researchers employed
Joash	1983	Lecturer	8	26	4	6	5	5	6
Dorington	1990	Lecturer	4	8	4	2	2	3	3
Stephen	1991	Lecturer	3	13	1	1	1	–	1
Ali	1992	Research Manager	3	3	3	4	3	2	5
Linus	1996	Lecturer	9	16	10	3	10	–	–
Hassan	1998	Research Scientist	–	–	–	–	–	–	–
Fred	2000	Postdoc (abroad)	–	–	–	–	–	–	–
Norbert	2008	Admin	–	–	–	–	–	–	–
<b>Total</b>			<b>27</b>	<b>66</b>	<b>22</b>	<b>16</b>	<b>21</b>	<b>10</b>	<b>15</b>

## 5.4 Contribution to knowledge and technology

The contribution of ARPPIS to insect science in Africa goes beyond the numbers of graduates added to the pool of researchers, academicians and policy makers. There is need to consider the impact of this output of graduates through their individual contributions to the promotion of development. In the previous section we examined the possible contribution of ARPPIS graduates to research capacity strengthening through mentoring of young scientists and development of research projects. In this section of the ARPPIS historical report, we examine the contribution of ARPPIS graduates to science and technology in Africa by looking at the relevance of their research expertise, contribution to knowledge through scientific publications, promotion of utilisation of science through its application in development and in informing policy. We introduce this discussion by examining the variety of forms in which ARPPIS graduates might contribute to science-based development in Africa.

### 5.4.1 Diversity of approaches

The ARPPIS alumni have been influenced in several ways by the general academic and research environment at the *icipe*. The ARPPIS graduates enter the world of the scientific community with confidence, determination, humility and respect for other professionals. They have wider vision of applied science and technology transfer for sustainable development. They are very aggressive and committed scientists who are determined to succeed both in science and in life. The scholars have been able to participate together with *icipe* scientists in the conversion of the benign topics in insect science or traditional practice into aggressive and highly productive areas of research. An example: The elevation of intercropping as is practised by many peasant farmers in Africa into 'trap cropping' and 'push pull' strategies, which are more knowledge-intensive than many other forms of pest management.

Many ARPPIS alumni are holding responsible leadership positions in national and international academic and research institutions. Through ARPPIS training the alumni have become aware that social insects have better systems of governance than many African leaders. That is why some of us are applying the management structures practised by the social insects in the day-to-day running of our institutions. Some alumni have joined national politics with a view to making policies that are favourable for the promotion of science and its practitioners. This is equally important because without good governance and accountability, we cannot have committed scientists who can cause technological advancement in their country. The issue of brain-drain comes when national policies do not recognise the contribution of scientists. It is therefore important to have active participation of some alumni in politics.

### 5.4.2 Relevance of research expertise

The scientific expertise and research contribution of the ARPPIS can be categorised into the 4H paradigm of *icipe's* research programmes in plant, environmental, animal and human health.

#### **Plant Health**

The plant health area has been a great beneficiary from ARPPIS research. As the Crop Pests Research Programme, the Plant Health Division attracted a large number of ARPPIS projects, both at Duduville and at Mbita, and many research scholars were implementing projects in the crop borers, sucking arthropods and leaf feeders. In subsequent years ARPPIS projects were to form a critical constituent of the newer elements of research that were not necessarily within the core programmes, such as those on pest population dynamics and



other pest ecological studies – after all in the search for knowledge, and having the extra duty of picking on projects that were of interest to their parent universities, the scholars could delve in topics that were not necessarily being undertaken by core programmes in *icipe*.

ARPPIS research projects covered both traditional pest management practices, that are often cultural or physical, and of special interest for farmers that cannot afford expensive inputs. Cultural control was promoted through changing the plant environment so that the pest loses the cues that would guide it to its plant host, or making the cropping environment less suitable for insect pests and more suitable for their natural enemies. ARPPIS projects at Mbita Point Field Station therefore focused on intercropping or impact of early planting on infestation by stemborers or legume pod borers. Trap crops are interesting as it includes both natural differential attractiveness for oviposition and feeding, and they act as a sink for insects or the pathogens they vector. The intercropping technology would advance to the current push-pull strategies, which is a behavioural manipulation of insect pests and their natural enemies. As in trap cropping, the push-pull strategies are more knowledge-intensive than many other forms of pest management. Even here, ARPPIS scholars would be significant players and participants. In the push-pull strategy, the crop is protected by associating it with stimuli that make it unsuitable or unattractive (push), while luring them to an attractive source (pull) where the pest is subsequently removed.

The classical biological control approach (the use of introduced natural enemies to control an exotic, invasive pest species) has shown impressive results, and the ARPPIS scholars were to be deeply involved in various aspects of biological control studies on various natural enemy studies from the inception of the programme in early 1980s. The major crops and pests that formed the main focus for this research were the cereal stemborers *Chilo partellus* (Walk.) in maize and sorghum, the legume pod borer *Maruca testulalis* in cowpea and pigeon pea, and the green spider mite on cassava. Indeed these three pests were to form the basis for the earlier research by ARPPIS scholars, with both basic research on the behaviour of the pest and its natural enemies, as well as the more field oriented trials on the control of the pest, or the ecological studies on the pests being undertaken in farmers fields.

Driven by research from IITA's field station in Benin, ARPPIS scholars embarked on taxonomy of the spider mites, their predators, or their pathogens. Similarly ARPPIS scholars actively participated in classical biological control programmes of *icipe*. The stemborer *Chilo partellus* was accidentally introduced from Asia before the 1930s and became the predominant stemborer in the 1990s in eastern and southern Africa with more than 70% yield loss in lowland and mid-altitude areas. The parasitoid *Cotesia flavipes* was introduced by *icipe* from Asia in 1991 and released in coastal Kenya in 1993 (Overholt *et al.*, 1997). It became established in nine countries in eastern and southern Africa, and ARPPIS scholars in the Biological Control Department undertook active programmes in Mbita and at the Kenya coast.

*Sustainable pest management strategies:* Working within the *icipe* and therefore following the principles of the use of environmentally friendly and economically feasible methods for pest control, the ARPPIS projects were to be influenced greatly in their content, following the path of sustainable pest management strategies. Hence projects such as those on insect ecology, insect taxonomy, and insect pathology were to test the sustainability of pest management strategies based on biological control principles. Indeed ARPPIS scholars were among the first teams to test the principles of conservation biological control in which habitat management aims to increase the effectiveness of natural enemies. This is directed at enhancing habitat suitability for immigration and host finding, provision of alternative prey/hosts at times when the pest is scarce, provision of supplementary food sprays, pollen and nectar for predators and parasitoids, provision of refuge especially during unfavourable weather as in the dry season, or for finding mates, maintenance of non-economic levels of

the pests or alternative hosts over extended periods to ensure continued survival of natural enemies. The beneficial fauna can be enhanced by wild flower strips, grassy banks and strip intercropping.

Mbita Point Field Station was to be the centre for testing the practical basis of sustainable pest management strategies, and many ARPPIS scholars would be involved in some extremely interesting projects, both in small plots within the field station and in farmers' fields. Traditional pest management practices are often cultural or physical, and of special interest for farmers that cannot afford expensive inputs. Cultural control is making the cropping environment less suitable for insect pests and more suitable for their natural enemies. Trap crops are interesting as it includes both natural differential attractiveness for oviposition and feeding, and they act as a sink for insects or the pathogens they vector. In the later years, ARPPIS scholars would be involved in the very interesting research that evolved from intercropping – the push-pull strategies. In this aspect of sustainable pest management in which *icipe* is playing a leading role in research on stemborers, the basis for control is a behavioural manipulation of insect pests and their natural enemies.

*Migratory Pests – The Desert Locust:* The desert locust, *Schistocerca gregaria*, inhabits the central, arid, and semi-arid parts in Africa, the Middle East and South-West Asia. The species recession is estimated at 14.6 million km<sup>2</sup>. This is about half the area that is liable to be invaded by swarms, with an area estimated at 29.3 million km<sup>2</sup>. In the recession area there are 25 countries involved, and large scattered populations are potential sources for outbreaks (van Huis *et al.*, 2007). The Locust Research Programme-run ARPPIS projects covered various themes, including the physiology and ecology of phase change and the process of gregarisation and solitarisation in the desert locust as well as tactile stimulation, olfactory and visual cues are involved impacting on neuronal, physiological and biochemical changes. Due to its transboundary nature of infestation often over a large swathe of land, the nature and geographical distribution in difficult terrains, and limitations and because of its unpredictability of temporal and spatial occurrence in the sites of infestation, field research was a challenge for ARPPIS projects, and most of the ARPPIS work was limited to laboratory studies.

### **Environmental Health**

Environmental research has included biodiversity programmes in *icipe*. The concept of biodiversity fitted well into the longstanding philosophy of environmentally friendly ecologically sound and economically feasible pest management strategies. ARPPIS projects undertook to define the position of diversity within the fragile ecological systems of the tropics. The Convention on Biological Diversity defines biodiversity as: "the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems." Therefore biodiversity includes not only the species of living things in an area, but also their genetic variation, the genus or genera they belong to, and the variety of habitat types within the landscape. Stress on biodiversity is therefore placed on the variety of living organisms in a specified habitat or environment.

On environmental science, ARPPIS has teamed up with BirdLife International, a global partnership of NGOs striving to conserve birds, their habitats and global biodiversity, working with people towards the sustainable use of natural resources. In Africa, the BirdLife Africa Partnership is a growing network of 19 NGOs, and is involved in research, conservation action, environmental education and sustainable development through a broad agenda focusing not only on birds but also on other flora and fauna and socio-economic issues such as poverty alleviation. BirdLife has sponsored a number of ARPPIS scholars through their doctoral and Masters research projects.

*Natural Resource Utilisation:* Natural resource utilisation is a major component of environmental health research and includes the conservative and environment-friendly exploitation of arthropod products as foods and in industrial production. ARPPIS has been active in the areas of honey and silk production.

*Insects as livestock:* Research on the beneficial side of insects has been an intricate part of *icipe's* research. Already Odhiambo (1977) was wondering "why we have not yet harnessed some of our tropical insects to help us live a more satisfying life as our insect livestock". He referred to the crude technology and exploitation of bees, the hunting phase of the insect pastoral life, but not being able to engage in the knowledge of the science of insect livestock production. He was suggesting that we must find ecologically and economically sound ways of exploiting the insect world to our own uses and comfort. Although insects as food has not caught on in ARPPIS research, major activities would spring up from other beneficial insects, including the silkworm and the honeybee.

*Arthropods eco-technology adoption and utilisation for sustainable development:* One of the more recent developments has been the area of arthropods eco-technology adoption and utilisation for sustainable development. This basically means that the ARPPIS programme has produced 204 various areas of research on insect science.

### **Animal Health**

Animal health programmes covered two major areas: Tsetse Research Programme and Ticks Research Programme. ARPPIS scholars actively participated in various projects within the animal health programmes, both in the field and at laboratory level. Key frontiers of *icipe's* research on animal vectors include:

*Development of tsetse repellents:* Two types of repellents were identified for reducing tsetse challenge, disease incidence and drug use. These repellents were developed from synthetic equivalents of natural repellent blends from non-preferred animals like the waterbuck, or by molecular optimisation of existing natural repellents found on body odours of tsetse bovid hosts (Patent No. KE00185).

*Concurrent use of odour-baited traps and repellents (push-pull):* This has been shown to represent a more efficient way of tsetse suppression and disease reduction. Dispensers for the identified potent waterbuck repellent blend are being developed. Production of synthetic repellent was undertaken in-house and this provided an opportunity to transfer the process to potential entrepreneurs for commercialisation. Pastoralists and other farmers show a high preference for *icipe's* repellent technology even though it is still a prototype.

*Tsetse trapping:* In Ethiopia the well-established NGU trap, particularly suited for savannah species is used in an adaptive management approach. This includes utilisation of geographical information system (GIS) technology to identify 'hot-spots' of high tsetse fly densities for strategic deployment of traps to improve efficacy of trapping. For long-term sustainability, communities are involved at every stage of the control operations – from planning to construction of traps to monitoring and evaluation. Community-based tsetse trapping was also being undertaken in the interface between agricultural land and game reserve to reduce human/wildlife conflicts through effective tsetse control and improvement of livestock health and productivity.

*Epidemiology of trypanosomoses:* Considerable progress has been made in the understanding of the epidemiology of trypanosomosis and associated conditions, which cause nagana, one of the most debilitating diseases of livestock in Africa and sleeping sickness, the human version of the disease. Characterisation of odour-binding proteins

and receptors of tsetse was in progress for development of more potent repellents and attractants.

### Human Health

Right from the early days, ARPPIS programmes covering human health were among the initial research areas that featured in both laboratory and field studies. Most of these covered a wide range of medical vectors (malaria, biting midges and sand flies).

*Integrated vector management:* The Malaria Programme was one of the earliest programmes of the *icipe*, and housed the earliest ARPPIS projects, and was later to convert to the Medical Vectors Research Programme. Vector-borne diseases are responsible for 17% of the global burden of parasitic and infectious diseases. They result in avoidable ill-health and death, economic hardships for affected communities and are a serious impediment to economic development. Malaria control is high on the international research and public-health agenda. The basic research on vector populations was accompanied by research on integrated vector management (IVM) involving population studies to feed into control strategies involving *Bacillus thuringiensis israelensis* (Berliner), environmental manipulation, and use of insecticide-treated bednets. Research covered both laboratory and field studies in Vanga, Baringo (Marigat), and at Duduville. The research target was an increased coverage and utilisation of interventions and markedly reducing malaria-related morbidity and mortality while ensuring a better protection of the environment.

#### 5.4.3 Contribution to scientific knowledge

Submission of a thesis or dissertation as evidence of research training is a standard requirement for the award of higher degrees in all African universities. Theses and dissertations are peer reviewed scientific publications that are indexed by university libraries and made accessible to any user. Abstracts of the theses are also published in Dissertation Abstracts, which is an international publication that provides references on how the full theses can be accessed. Exhibit 5 provides the titles of theses of ARPPIS doctoral scholars, of which 172 have been awarded since inception of the programme.

Publications in refereed journals are one way of assessing contribution to knowledge. Level of contribution is determined from the number of articles published, but more importantly, from the impact of the journal publications. Impact is assessed in two ways:

1. The prestige of the journal in which the article is published, measured as the journal's impact factor (IF), and
2. The extent to which the article has been cited by other authors, especially in other journals. Impact of publications is determined through bibliometric studies of specialised databases that assemble such information, a widely used database of this kind is Thomson Scientific's World of Knowledge database and Google Scholar.

The requirement for scholars to publish their research findings in reputable scientific journals is a standard *icipe* policy. On completion of thesis writing, scholars are facilitated to remain at *icipe* for a few months during when they work with their *icipe* research supervisors and collaborate with university academic supervisors to prepare journal manuscripts out of their theses. Scholars leave *icipe* only after manuscripts have been submitted to the journals. This ensures that knowledge generated by scholars is communicated to the scientific community. The efforts of *icipe* in encouraging scholars to publish their research findings in journals is being boosted by the growing trend among universities to have student theses produced in the form of journal articles.

A questionnaire survey of publications records of ARPPIS alumni, which was attempted as part of this report yielded insignificant response that could not be reported here. A major problem, seemingly, was that of communication since most email messages were unanswered. The survey had sought to establish the extent and quality of journal and other

forms of research publications, including their impact as measured from journal ratings and citation indices of published articles.

The survey realised only six responses out of the 158 who were contacted. The respondents gave lists of their publications with little analysis as to quality and impact. The only one respondent who tackled the issue of publications quality and potential impact by way of analyses of impact factors and influence of the publishing and quoting journals was based abroad, a significant pointer to the difficulty of accessing such facilities or lack of knowledge of their significance in Africa. Yet it is known that non-journal publications, such as those made through study reports by national research institutes, may have great impact in informing agricultural policy and practice at national level. This debacle points to the need for a well-organised case study of the impact of ARPPIS with respect to alumni contribution to scientific knowledge and application of knowledge. Such a study must include a comprehensive bibliometric analysis of journal publications and a review of knowledge contribution from national research reports. In the absence of such studies statements as to the impact of ARPPIS remain mere claims and assumptions that yearn to be proven.

#### *5.4.4 Contribution to science use*

The ultimate impact of ARPPIS would be realised if the programme contributed significantly to application of insect science for development. This could be achieved not only through the application of technology generated through research in productive processes aimed at mitigating hunger, poverty and disease but also in the use of research-based scientific evidence to inform policy development.

In a limited survey we engaged the ARPPIS alumni in an attempt to assess their contribution to science use. The limited response to this survey reveals that ARPPIS alumni are making substantial contribution to research use through various approaches. These include, but are not limited to (i) translation of research to inform policy development, (ii) participation in advisory commissions and technical assistance through consultancy, (iii) enhancing research use through political influence, (iv) use of senior positions held in government employment to determine research policy, (v) interventions through participatory development initiatives, (vi) role in farming and as managers in industry, and (v) advocacy roles as managers of NGOs. It should be recognised that impact evaluation of this kind is a specialised field that requires technical know-how, and many alumni are contributing to science use without realising it, and through processes that they themselves take for granted.

The above observations show that, whereas ARPPIS may have made much impact to insect science research in Africa, the contribution of the alumni to development through promoting the use of science requires an elaborate investigation and documentation. Perhaps some alumni have patents to their names, we may not know until such evaluations are undertaken. One aspect of the impact of ARPPIS has been easy to track and it is fairly common knowledge: ARPPIS graduates occupy some of the most influential positions within the region. In Chapter 6 we present the post-training careers of a cross section of ARPPIS alumni in Africa and beyond, which demonstrates, with just a few examples, the huge impact of ARPPIS graduates that awaits revelation through in-depth tracer studies. Examples of research undertakings of ARPPIS scholars are summarised in thesis abstracts provided in section 5.5.

## 5.5 Sample of doctoral thesis abstracts



### *Alioune Toure (Senegal)*

**PhD thesis title:** "An Assessment of the Use of Botanical Extracts and Pheromones for the Off-Host and On-Host Control of *Amblyomma variegatum* Tick"

**Registering university:** Kenyatta University, Nairobi, Kenya

**Supervisors:** Dr Ellie O. Osir, *icipe*, Nairobi, Kenya; Prof. Ahmed Hassanali, *icipe*, Nairobi, Kenya; Dr Sammy S. Kubasu, Kenyatta University, Kenya; Dr Rosebella Maranga, Jomo Kenyatta University of Agriculture and Technology (JKUAT), Kenya

**Duration:** 2001–2005

**Sponsorship:** DSO

**Major findings:** The possibility of enhancing attraction of ticks to the attraction–aggregation–attachment pheromone (AAP) with 1-octen-3-ol and 2,6-dichlorophenol was investigated in a T-tube olfactometer in the laboratory. While males were attracted to increasing proportions of 1-octen-3-ol, females were repelled. A combination of 8 ng of 1-octen-3-ol with 1.1 mg of AAP was adopted for the attraction of both sexes, enhancing the attraction of ticks by 20%. Unlike 1-octen-3-ol, 2,6-dichlorophenol did not improve the attraction of *Amblyomma variegatum* in the laboratory. In the field, the attraction of *A. variegatum* to different doses of AAP + 1-octen-3-ol from various distances was investigated. The longest distance from which ticks were attracted was 7 m. The effects of continuous and intermittent releases of carbon dioxide (CO<sub>2</sub>) on the performance of AAP and 1-octen-3-ol in attracting ticks in the field were also investigated and the results showed that attraction was increased to 8 m in the presence of CO<sub>2</sub>. The continuous and intermittent releases of CO<sub>2</sub> were not significantly different. The efficacy of traps treated with neem cake extract (NCE) baited with the attraction–aggregation–attachment pheromone (AAP), 1-octen-3-ol and CO<sub>2</sub> was evaluated. The attraction to the traps as well as the mortality of *A. variegatum* were significant compared to the controls. The mortality of attracted ticks was dependent on the concentration of NCE and the time of exposure. Mortality (98%) was recorded at a concentration of 30% of the neem cake extract. *Ocimum kilimandscharicum* was also found to repel adult *A. variegatum* by 33%.



### *Aruna Manrakhan (Mauritius)*

**PhD thesis title:** "Feeding Behaviour of Three African Fruit Flies: *Ceratitis cosyra*, *C. fasciventris* and *C. capitata* (Diptera: Tephritidae)"

**Registering university:** University of Mauritius, Reduit, Mauritius

**Supervisors:** Dr Slawomir Lux, *icipe*, Nairobi, Kenya; Prof. I. Fagoonee, University of Mauritius, Reduit, Mauritius

**Duration:** 2000–2004

**Sponsorship:** DSO

**Major findings:** The feeding activities of *Ceratitis cosyra*, *C. fasciventris* and *C. capitata* were found to be confined mostly to host trees. The fruit flies exhibited dual patterns of feeding that varied according to species and sex. Carbohydrates obtained from natural food sources such as fruit juices and honeydew sustained the flies for more than four weeks after adult emergence. Total sugar intake was found to be similar for males and females of the three fruit fly species. Nutrition significantly influenced

the reproductive behaviour of the flies. Fecundity of the flies was higher when fed on a source of carbohydrates than when fed on a sugar only. *Ceratitis cosyra* males and females consumed fewer carbohydrates than males and females of *C. fasciventris* and *C. capitata*. The nutritional state of a fly was the most influential factor in guiding it to food odours. The effects of the nutritional state and age were additive. The mating status was the least important factor in influencing fly responses to food sources. Odours from natural food sources were found to be more attractive than odours from artificial food sources for all three fruit fly species. These findings have practical implications on (1) the establishment of a protocol for evaluation of food baits, and (2) the implementation of food baits in fruit fly-infested areas.



**Adèle Josée Ngi-Song (Cameroon)**

**PhD thesis title:** "Parasitisation of Selected African Stemborers by *Cotesia flavipes* Cameron and *Cotesia sesamiae* (Cameron) (Hymenoptera: Braconidae) with Emphasis on Host Selection and Host Suitability"

**Registering university:** University of Ghana, Legon, Accra, Ghana

**Supervisors:** Dr Wilber Lwande, *icipe*, Nairobi, Kenya; Dr P. G. N. Njagi, *icipe*, Nairobi, Kenya; Dr W. A. Overholt, *icipe*, Nairobi, Kenya; Prof. J. N. Ayertey, University of Ghana

**Duration:** 1991–1995

**Sponsorship:** DSO and DAAD

**Major findings:** The host and host habitat location, the acceptability and suitability of *Chilo partellus* (Swinhoe) and indigenous stemborer hosts for the development of an exotic parasitoid *Cotesia flavipes* Cameron and a local natural enemy *Co. sesamiae* (Cameron) (Hymenoptera: Braconidae), as well as the semiochemicals involved in host finding were investigated. There were no differences in the acceptability of the four hosts exposed to *Co. flavipes*. In contrast, *Co. sesamiae* preferred *Sesamia calamistis* Hampson larvae followed by the two *Chilo* species. Both parasitoid species did not develop in *Busseola fusca* (Fuller) and egg encapsulation was observed. *Chilo partellus*, *Ch. orichalcociliellus* Strand and *S. calamistis* were suitable hosts for the development of *Co. flavipes*. It was observed that female parasitoids were attracted to odours from uninfested maize, sorghum and Napier grass in a Y-tube olfactometer. In a dual choice test, the three plant species infested with *Ch. partellus*, *Ch. orichalcociliellus*, *Busseola fusca* or *S. calamistis* larvae were more attractive than uninfested plants. *Cotesia flavipes* and *Co. sesamiae* did not show preference for any of the stemborer species under study in dual choice tests. Odours from frass, produced by the four stemborer species fed on maize, sorghum and Napier grass were attractive to both parasitoid species. The main attractive volatiles from infested plants were (E)- $\beta$ -farnesene and (Z)-3-hexenyl acetate. Other chemicals identified from maize infested with *Chilo partellus* included myrcene, 2-heptanone, 4, 8-dimethyl-1,3,7-nonatriene, (Z)-2-hexenal, (Z)-3-hexen-1-ol, cyclosativen, cedrene and  $\alpha$ -copaene. GC comparison of infested and uninfested maize seedlings showed a quantitative and qualitative difference in the volatile composition.



### *Laila Uweso Abubakar (Kenya)*

**PhD thesis title:** "Molecular Characterisation of Lectin-Trypsin Complex from the Midgut of Tsetse Fly, *Glossina fuscipes fuscipes*, and Its Role in Determining Susceptibility to Trypanosome Infection"

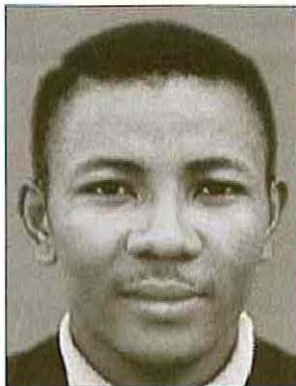
**Registering university:** University of Nairobi, Kenya

**Supervisors:** Dr Ellie Osir, *icipe*, Nairobi, Kenya; Dr Francis Mulaa, University of Nairobi, Kenya

**Duration:** 1998–2002

**Sponsorship:** DAAD and WHO/TDR (Grant No. 970648)

**Major findings:** Screening a *Glossina fuscipes fuscipes* midgut cDNA expression library with polyclonal antibodies raised against the lectin-trypsin complex identified a lectin-trypsin gene. The gene designated *Glossina* proteolytic lectin (*Gpl*) comprised of 933 bp cDNA that encoded a 274 amino acids polypeptide. It contained the catalytic domain of serine protease with aspartate in the specificity pocket, suggesting that the clone was a typical trypsin. Expression of the gene in a bacterial system yielded a protein with Mr  $\sim 32,500 \pm 2828$  Da that exhibited D-glucosamine binding and agglutination activity against bloodstream trypanosomes. In addition, *Gpl* exhibited trypsin activity of  $6.025 \text{ units} \times 10^{-4}$ . Using immunofluorescence assays, the recombinant protein was found to be capable of inducing differentiation of bloodstream-form trypanosomes into procyclic forms *in vitro*. These results provide evidence for the possible involvement of the midgut lectin-trypsin molecule in both clearance and development of parasites in tsetse.



### *Maxwell Kelvin Billah (Ghana)*

**PhD thesis title:** "Biosystematic Studies of *Psytalia* species (Hymenoptera: Braconidae) Parasitoids Attacking Fruit-Infesting Flies (Diptera: Tephritidae) in Africa"

**Registering university:** University of Ghana, Legon, Accra, Ghana

**Supervisors:** Dr Susan Kimani-Njogu, *icipe*, Nairobi, Kenya; Dr William Overholt, *icipe*, Nairobi, Kenya; Dr R. A. Wharton, Texas A&M University, USA; Dr D. D. Wilson, University of Ghana, Legon, Accra, Ghana; Ms M. A. Cobblah, University of Ghana, Legon, Accra, Ghana

**Duration:** 1999–2004

**Sponsorship:** DSO and in part by IFS, Sweden (Grant No. C/3190-1 of 2001)

**Major findings:** Morphological comparison of the ovipositor, ovipositor sheath and hind tibia showed ovipositor–tibia and ovipositor sheath–tibia ratios could differentiate *Psytalia cosyrae* and *P. phaeostigma* from other species. Parasitoids reared on larvae other than their natural hosts showed significant changes in linear measurements and body colour. Morphometric studies assigned populations of unknown identity to groups based on variances. In a comparison of individual populations veins enclosing the submarginal cell accounted for the main differences. Cross-mating studies showed that once mating was successful, viable female offspring were produced in all crosses up to F<sub>2</sub>, indicating the absence of post-copulatory isolating mechanisms, and suggesting the inadequacy of the biological species concept alone in separating species in the genus. Total genome comparison by AFLP separated the populations into groups that matched the clustering defined by morphometry, lending genomic support to the clusters. In the morphology and



DNA studies, a population from Shimba Hills was shown to be similar to *P. perproximus* from Cameroon and *P. perproximus* from Tafo in Ghana. The Shimba Hills population is suggested as belonging to *P. perproximus* and is a new record from Kenya and East Africa. The study also characterised the populations based on outcome of the different taxonomic tools used.



**Samira Abuelgasim Mohamed (Sudan)**

**PhD thesis title:** "Biology, Host and Host Plant Relationships of Two *Psytalia* Species (Hymenoptera: Braconidae): Parasitoids of Fruit Flies (Diptera: Tephritidae) in Kenya"

**Registering university:** University of Gezira, Wad Medani, Sudan

**Supervisors:** Dr W. A. Overholt, *icipe*, Nairobi, Kenya; Dr S. A. Lux, *icipe*, Nairobi, Kenya; Dr E. A. Eltoum, University of Gezira, Wad Medani, Sudan; Dr R. M. Khafagi, University of Gezira, Wad Medani, Sudan

**Duration:** 1998–2002

**Sponsorship:** DAAD and USDA

**Major findings:** Host–habitat relationships of two parasitoid species (*Psytalia cf concolor* and *P. cosyrae*) of tephritid fruit flies were observed in a Y-tube olfactometer. Except for coffee, which was not attractive to *P. cosyrae*, all two parasitoid species were attracted to volatiles of the uninfested fruits tested compared to clean air, but infested fruit increased the attraction. *Psytalia cf concolor* preferred coffee infested with *Ceratitis capitata* to all other fruits. Host acceptability for oviposition of six fruit fly species (*C. capitata*, *C. cosyra*, *C. rosa*, *C. fasciventris*, *C. anonae* and *Bactrocera cucurbitae*) by the two *Psytalia* parasitoid species, revealed that all hosts were accepted; although, acceptance varied among the different hosts. However, when testing for suitability for parasitoid development, only *C. capitata* and *C. cosyra* were suitable for the two parasitoid species. Eggs of the two *Psytalia* species oviposited in any other host were encapsulated, or encapsulated and partially or completely melanised. In light of the results obtained during this study, it can be concluded that both parasitoid species are fairly specific in their host selection, a desirable character when selecting natural enemies for biological control. These results also indicate that *P. cosyrae* is (i) more specific in locating its host habitat and (ii) has a relatively wider thermal tolerance than *P. cf concolor*.

**Sidi Ould Ely (Mauritania)**



**PhD thesis title:** "Relative Oviposition Preferences of Solitary Desert Locusts on Different *Heliotropium* spp. and their Semiochemicals Basis"

**Registering university:** University of Khartoum, Sudan

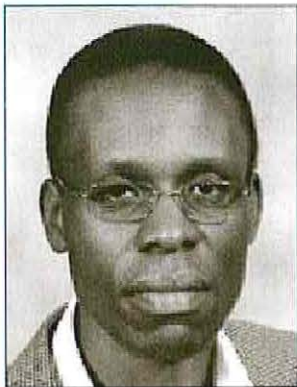
**Supervisors:** Prof. Ahmed Hassanali, *icipe*, Nairobi, Kenya; Dr Peter Njagi, *icipe*, Nairobi, Kenya; Prof. M. Bashir, University of Khartoum, Sudan

**Duration:** 1999–2003

**Sponsorship:** DSO

**Major findings:** Mate attraction in the desert locust by monitoring the sexual behaviour of solitary reared, gregarising and gregarious locusts was studied in *icipe*, Nairobi as well as in the field station in the Red Sea coast of Port Sudan. The study showed evidence of a sex pheromone in female solitary insects that attracts gregarising

locusts (shifting them from the solitary to the gregarious phase). This behaviour facilitates the recruitment of solitary locusts in the field during locust invasions. A study on the diel behavioural activity patterns of adult solitary desert locusts, *Schistocerca gregaria* (Forskål), by monitoring their activities in a wind tunnel was also carried out. The results of this study confirm previous field observations that solitary desert locusts are more behaviourally active after onset of dark than during the day. This is manifested as short distance and migratory flights in the field after sunset. While the diel behavioural patterns are preserved in the laboratory-reared solitary locusts, it was evident that there is a significant decline in the levels of these behavioural activities after several generations. Investigations also extended to host-plant odour preferences by the solitary desert locust *Schistocerca gregaria* Forsk. This study showed that field-collected locusts showed attraction to a broad range of desert plant volatiles compared to locusts reared on one plant for many generations. Feeding choice assays showed that the locusts preferred annuals for feeding rather than the perennial plants, balancing their food intake between the plants. Some aspects of the reproductive strategy of female desert locusts in the solitary phase were also studied in the field. It was noticed that all incoming females at the beginning of the rainy season are mated and fertile. This suggests that, since mate finding is not easy between scattered individuals, solitary females may compensate for this by their high fertility during the breeding season, which ensures the spreading of their eggs through the rainy season.



**Vincent Oduol Ochieng (Kenya)**

**PhD thesis title:** "Genetic Variation in Banana Weevil *Cosmopolites sordidus* (Coleoptera: Curculionidae)".

**Registering university:** University of Nairobi, Department of Biochemistry, Nairobi, Kenya

**Supervisors:** Dr E. O. Osir, *icipe*, Nairobi, Kenya; Dr C. Gold, International Institute of Tropical Agriculture (IITA), Uganda; Dr F. J. Mulaa, University of Nairobi (UON), Department of Biochemistry, Nairobi, Kenya

**Duration:** 1998–2001

**Sponsorship:** Rockefeller Foundation and German Academic Exchange Service (DAAD)

**Major findings:** Genetic variability in banana weevil populations was analysed in samples obtained from different banana growing regions using random amplified polymorphism (RAPD). The results of the study clearly demonstrated genetic variability in the different banana weevil populations. According to the study, the populations fell into distinctive clusters depending on their degree of genetic similarities. In addition, specific molecular markers for the different clusters were identified. This proved the genetic distinctiveness of the clusters. Indonesian samples were different from the rest of the populations as shown by RAPD and PCR-RFLP of CO1 mt DNA. This confirmed the hypothesis that the banana weevil could have originated from Asia. The results show that different tactics would have to be devised for managing the banana weevil in different regions.



**Frederick Ndhoga Baliraine (Uganda)**

**PhD thesis title:** "Development of Molecular Markers for Species Diagnosis and Analysis of Genetic Diversity in African Fruit Fly Populations"

**Registering university:** University of Nairobi, Kenya

**Supervisors:** Dr E. O. Osir, *icipe*, Nairobi, Kenya; Dr S. A. Lux, *icipe*, Nairobi, Kenya; Dr F. J. Mula, University of Nairobi, Kenya; Prof. A. R. Malacrida, University of Pavia, Italy

**Duration:** 1999–2003

**Sponsorship:** German Academic Exchange Service (DAAD), International Fund for Agricultural Development (IFAD)–AFFI, CICOPS–University of Pavia, ICSC–World Laboratory, Switzerland (Projects FIP-10 & T-1), International Atomic Energy Agency (IAEA), Vienna, Austria

**Major findings:** Twenty-four *Ceratitis capitata* (medfly) simple sequence repeats (SSRs or microsatellites), based on published sequences obtained from the GenBank database, were screened for amplification on the genomic DNA of congeneric pest fruit flies *C. rosa*, *C. fasciventris* and *C. cosyra*. Amplification success ranged from 79.2% (*C. cosyra*) to 91.3% (in both *C. rosa* and *C. fasciventris*). Some loci differentially amplified in the four species examined, with one locus amplifying only in *C. capitata*. The majority of the amplicons were similar, if not identical in size to those expected in the medfly. Sequence analysis revealed the same repeat type as the homologous medfly SSRs in the majority of the isolated SSR loci. The most common repeat units were (CA)<sub>n</sub>/(TG)<sub>n</sub>. Some species-specific nucleotide differences were observed among the four species. Ten of the cross-species SSRs markers were used to survey the levels of genetic variability and analyse the genetic aspects of the population dynamics of *C. rosa*, *C. fasciventris* in Africa, in comparison with variability data from *C. capitata*. The degree of microsatellite polymorphism in *C. rosa*, *C. fasciventris* was extensive and comparable to that of *C. capitata*. In *C. rosa*, the evolution of SSR polymorphism in its distribution area reflected the colonisation history of this species. The SSR data of *C. fasciventris* over the Uganda/Kenya spatial scale suggested a recent expansion and possibly continuing gene flow within this area. Low levels of genetic differentiation were observed among the different geographic populations of *C. rosa*, *C. fasciventris* and *C. capitata* in Africa; implying that the same control tools/strategies may work across Africa. The SSR variability data from this study suggest Kenya as the source area of *C. rosa*, *C. fasciventris* and confirm the ancestral status of the Kenyan *C. capitata* population. From a taxonomic point of view, *C. fasciventris* had previously been considered to be a variety of *C. rosa*. However, in this study, differences were observed in allelic lengths and levels of polymorphism of the homologous SSR loci between these two entities, together with distinct differences at sequence level; all of which support a different species status for each of these two pests. In addition, data from this study give molecular support to the hypothesis of an East African origin of the *Ceratitis* spp.

# CHAPTER 6

## ARPPIS Alumni – Showing Science Leadership in Africa and Beyond

### 6.1 Introduction

The success of the ARPPIS Programme may be best measured by the professional roles alumni play in society. One time ARPPIS students now occupy key positions in scientific administration, parastatals, universities and national and international organisations. Many others remained in research, delving into new frontiers of scientific investigations. This chapter reviews some of the key positions and fields held by a cross section of ARPPIS Alumni in Africa and beyond.

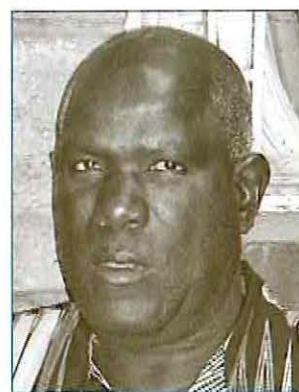
This chapter describes the careers of some ARPPIS alumni who are well-known internationally for their powerful positions in university lectureship and administration, institutional management, IPM practice and national politics.

### 6.2 University Lectureship and Administration

ARPPIS scholars have contributed directly to university education in Africa, thus paying back in kind to the education of Africa's youth and providing guidance to Africa's education. Among key contributors at professorial, lectureship or deanship levels are Prof. J.B. Okeyo-Owuor, Prof. Jack H. Pen-Mogi Nyeko, Dr Tekie Habte, Dr Nicholas Gikonyo, Dr Jean-Berkmans Muhigwa, Prof. Samuel Kyamanywa and Prof. Arop Deng.

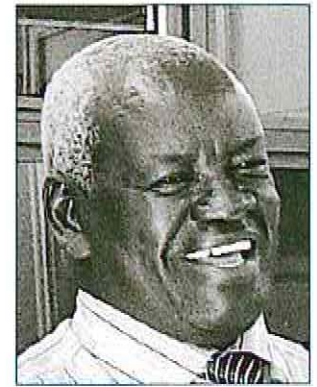
#### *Prof. Joash Barrack Okeyo-Owuor*

Currently an Associate Professor at Moi University, Kenya, J. B. Okeyo-Owuor is one of the most distinguished integrated pest management (IPM), and environmental conservation and food security specialists in the region. In June 1996, Dr Okeyo-Owuor left *icipe* and joined Moi University, School of Environmental Studies, as a Senior Lecturer. He has since worked his way to the top, and for the past six years, he has held the position of Associate Professor and Head of Environmental Biology and Health. He has supervised many MPhil and DPhil students, and continues to conduct research in collaboration with other scientists from different national and international organisations. Further, he is an expert in environmental impact assessment, and helped found the Friends of Lake Victoria Environmental Programme (OSIENALA). He is also the founder and Director General of the Victoria Institute for Research on Environment and Development (VIRED) International. Both OSIENALA and VIRED International, located in Kisumu, are conducting excellent work in the Lake Victoria Basin and continue to contribute well to environmental conservation, capacity building and research findings in the region.



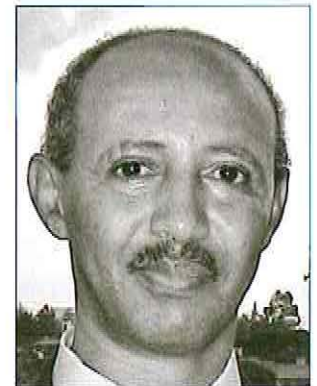
### Prof. John Pen-Mogi Nyeko

Prof. J.H. Pen-Mogi Nyeko is the Vice Chancellor of Gulu University. He has brought changes to Gulu University, where through his effort there are now plans to build one Biosciences Research Laboratory to be used for medical, agricultural, environmental and biological research. He believes that sharing research facilities the way it is done at the *icipe* will give the university a well-equipped laboratory which will be maximally utilised by all the life scientists.



### Dr Tekie Habte

Dr Tekie Habte carried out his ARPPIS research at the *icipe's* Mbita Point Field Station, on neem *Azadirachta indica* (A. Juss.) seed powder and extracts for the control of the spotted stemborer *Chilo partellus* (Swinhoe), on maize and its potential for pest management and published two papers in international journals. He did most of the field and laboratory research work at the *icipe* Mbita Point Field Station in South Nyanza, western Kenya. He then returned to Ethiopia in 1997 to complete part of the field research work, where he also did the data analysis and write-up of his thesis in the Department of Biology, at the AAU in 1999.



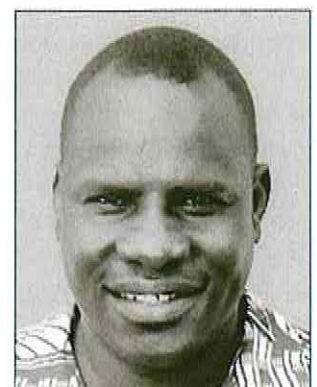
Pending the defence of his thesis and graduation, he resumed his position at the university as a lecturer. He formally received the PhD in July 2000, and was promoted to Assistant Professor.

He continues his teaching and research career in the Department of Biology (AAU). The rich experience he gained at *icipe* has benefited him immensely in advancing his career. The courses offered at *icipe*, which covered basic theoretical and practical entomology, helped him to consolidate his scope and experience in different core areas in insect science. The training also involved using different entomological techniques, designing and conducting of laboratory and field experiments, as well as analysis of biological data from field and laboratory experiments. He considers working at *icipe's* facilities a lifetime experience. Moreover, being able to participate in scientific presentations, conferences and other symposia greatly widened his scope in different fields of insect science.

The AAU's Department of Biology is structured into eight streams, one of them being Insect Science. Students are trained up to PhD level in various areas of specialisation. The Department also hosts the ARPPIS Sub-Regional Centre for East and North-Eastern Africa.

### Prof. Arop Leek Deng

If a tale of inspiration and success should inspire millions of African children and young scientists that face hardships, but need to endure and come out triumphant, the story of Prof. Arop Leek Deng stands out like no other. Prof. Deng was born, raised and schooled under constant civil strife, the result of the civil war that has ravaged his birth country of Sudan for 38 out of the 52 years of its independence. His life and achievements represent the life of a poor rural child, an internally displaced person (IDP), a refugee, indeed that of many people in Africa, who are constantly struggling for a decent livelihood, against many odds.



Prof. Deng recognises ARPPIS as the catalyst that sparked his career as a researcher and as an academician. Working in a multicultural society such as the one that the ARPPIS programme offered, enabled him to fit in with ease in any multinational institution or environment that he has since visited. He considers the network of alumni and friends that one gains through ARPPIS an invaluable treasure, unmatched to any other. After leaving *icipe* in 1997 after his tenure as a Postdoctoral Research Associate, he joined his current employer, Egerton University as a lecturer and rose through the ranks to the position of Associate Professor. He has been involved in several funded collaborative research projects, supported by various donors, including *icipe*, AICAD, USAID-CDR Israel and Egerton University, and IUCEA-VicRes. He is serving as an external examiner for the Department of Zoology, Makerere University, Uganda. He is currently Secretary General of the ARPPIS alumni and member of the Board of Trustees of Padak Fisheries Training Centre in Southern Sudan, and has contributed to training and institutional capacity development. As a member of a number of professional societies and career groups (AAIS, ESK, ACSS, and others), he has helped to influence policies that advocate for the conservation and commercial utilisation of arthropods and natural resources. He has also been in the frontline in advocating for the use of environmentally safe, non-chemical management options or the judicious application of synthetics to combat arthropod pests and vectors. Moreover, he has held different administrative and research positions, as an Acting Chairman (Head) of Department, Dean of Faculty, Director of Graduate School, and member and Chair of various university standing committees. In the area of socio-economic development and community empowerment, he has worked with small-scale farmers around the Lake Victoria region to control post-harvest grain pests.

In Southern Sudan, he co-founded a local non-governmental organisation, Sudd Development Agency (SUDA), focusing on the fishery sector, with the overall aim of improving the livelihood of the riparian communities. The Sudd region has since 2004 been designated as the second largest wetland in the world. Through *icipe*'s Commercial Insects Programme (CIP), Prof. Deng has helped to improve apiculture through the New Sudan Beekeepers Association (NSBA). This has led to the construction of a honey marketplace in Maridi and the introduction of mulberry sericulture into Yei, in Southern Sudan.

### *Prof. Jean-Berckmans Bahananga Muhigwa*

For Jean-Berckmans Bahananga Muhigwa, the ARPPIS programme was beneficial in many ways. From the lectures on insect science, he acquired skills in computer science and statistics that empowered him in data analysis and experimental design. From his training in project management and on how to write a scientific dissertation, he managed to publish two papers while still an ARPPIS scholar, and had two more accepted for publication, while still in the programme. So the long road from a small village on the shores of Lake Bukavu has finally landed Prof. Muhigwa in his current position as the Dean, Faculty of Sciences, at the State University of Bukavu in the Democratic Republic of Congo (DRC). He was also the Director of the Rural Studies and Development Centre (CERPRU Bukavu).



The lessons he learned became even more evident when he returned to the DRC in June 1998. He realised that in environments where there are a few academics, the impact of an individual could be quite high. During the war years, between 1998 and 2004, he worked as the dean of the Faculty of Science, where he founded the Department of Hydrobiology, with a focus on aquatic stages of vectors (mosquitoes, black flies) and other aspects of water biodiversity. He has been teaching entomology to agricultural and medical students. Many of them are now practising professionals. Some have gone on to Masters and PhD programmes.

He is a member of the commission set up to design a modern university after 10 years of rapid growth of the State University of Bukavu. He is a representative of the DRC in two major scientific SADCC country networks: SIMDAS and SAFNET (South African Fire Network). His own research career has also been fruitful. He was involved in the discovery of a new version of the biconical trap – a blue/purple combination – which catches the riverine tsetse fly *Glossina fuscipes fuscipes* with an increase up to 10-fold as compared to the Challier-Laveissiere (1976) blue/black reference trap.

### *Dr Nicholas Kamindu Gikonyo*

Dr Nicholas Kamindu Gikonyo completed his PhD in the ARPPIS programme, from where he earned a postdoctoral fellowship in *icipe's* African Fruit Fly Initiative under Dr Slawomir Lux, where he stayed until 2001. Subsequently he joined the Department of Pharmacology and Pharmacognosy, School of Pharmacy of the University of Nairobi where he taught pharmacognosy and pharmaceutical chemistry. While at the University of Nairobi, Nicholas supervised nine Bachelor of Pharmacy projects, a responsibility which provided him yet another dimension of research – the utilisation of natural resources (mainly herbs) for the cure and prevention of human diseases. He also chaired the review of the university's pharmacy curriculum. Following his experiences at the University of Nairobi, Dr Gikonyo joined Kenyatta University as a Senior Lecturer in 2006 to spearhead the establishment of the Department of Pharmacy and Complementary Medicine in the School of Health Sciences, where he is a Senior Lecturer and Coordinator of Pharmacy and Complementary/Alternative Medicine. The assignment involved developing three Pharmacy Degree Programmes, from curriculum to strategic planning for their implementation. He also developed a policy document on 'Traditional Medical Practitioners and Their Role in Kenyatta University'.

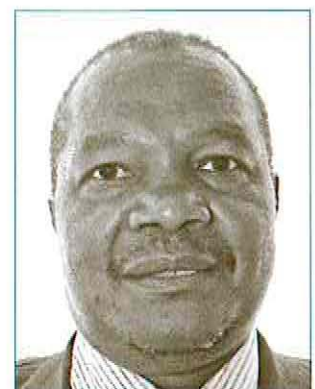


In addition, at Kenyatta University, Nicholas teaches undergraduate students and has supervised six Bachelor of Science students in Public Health, in addition to three Master of Science (Chemistry) students at the neighbouring Jomo Kenyatta University of Agriculture and Technology (JKUAT). Dr Gikonyo is also currently working on a consultancy basis on two proposed universities in Kenya. His own research has included being a principal investigator on a World Bank funded project on the 'Integration of Production, Value Addition and Marketing of Grain Amaranth to Sustainably Manage Household Health including HIV/AIDS in Kenya', which started in 2007. In addition, he is the Principal Investigator of a Kenyatta University Vice-Chancellor's Research Grant project entitled 'Poverty Reduction, Household Nutritional Security and Sustainable HIV/AIDS Management through Grain Amaranth'. Last year Nicholas travelled to China, under a fellowship from the Chinese government, to undertake an Advanced Training Programme of Research and Development of Medicinal Plants at the Tianjin University of Traditional Chinese Medicine.

## **6.3 Science management**

### *Dr Richard Kiome Bagine*

The ARPPIS Alumni has extended its influence and expertise into some major government institutions. Dr Richard Kiome Bagine has, over an era covering 25 years, been practising biodiversity conservation, research and development. He has held senior positions in academic and scientific research circles, which have allowed him to serve his nation, region, as well as the international community. After the training at *icipe*, Dr Bagine



joined the National Museums of Kenya (NMK), where he remained until 1997 when he was seconded to the Kenya Wildlife Service (KWS). While at NMK, at the level of Chief Research Scientist, he held key managerial positions, including, Head of Invertebrate Zoology Department, Deputy Director in charge of Centre for Biodiversity and Director of Collections Management and Documentation. In these roles, he developed institutional research policies and guidelines, carried out research, promoted capacity development programmes and conducted social economic programmes for the communities. For instance, he was involved in initiating a butterfly-farming programme at the coast in Kenya. He also led the establishment of the Centre for Biodiversity at the NMK. He helped to integrate its capacity into the country's biodiversity studies and into the development of the Kenya National Environment Action Plan. He joined the KWS in 1997 as a Senior Scientist and rose to the designated Head of Department and Chief Scientist in charge of research and planning in 1999.

He has held other senior management positions, including that of Deputy Director in charge of wildlife research, biodiversity and monitoring. His work responsibilities entailed biodiversity and wildlife research, conservation and management of fauna and flora, development of project proposals for funding, preparation of management policies, personnel administration and co-ordinating multilateral environmental agreements. In addition, he continued with research and capacity building responsibilities. As a chief scientist, he developed key research studies that propelled KWS to be recognised as an active wildlife research institution. He established viable national and international research collaborations especially in the areas of biodiversity, conservation and bioprospecting, which have now advanced strongly in Kenya. He developed programmes and activities that now benefit communities especially in areas adjacent to protected areas. Today, these communities, alongside their local authorities, participate in conservation and are good managers and co-managers of biodiversity resources in their wildlife conservancies and reserves. Through biodiversity assessment, he has contributed in the nomination and listing of critical sites, habitats and endangered species in international agreements, e.g. the UNESCO World Heritage/Man and Biosphere Reserve, RAMSAR, CMS and CITES. In 2007, he returned to the NMK as a Research Scientist. Currently, he is in the board of trustees of JRS Biodiversity Foundation based in USA, which provides research grants to scientists and research organisations. He has continued to represent Kenya as a delegate in international conventions, agreements and protocols. He also serves as a regional representative in technical and scientific committees of CITES, RAMSAR and CMS. For the past 24 years, he has published many quality scientific papers in nationally and internationally accepted journals in areas of biodiversity and insect taxonomy (biosystematics).

### *Dr John Davies-Cole*

In the days of widespread conflict in Africa, ARPPIS made it possible for young African scientists unable to study or work in their own homelands the possibility of carrying out their studies in relative tranquility and peace. Dr John Davies-Cole from Sierra Leone can bear testimony to this, and turned this unfortunate scenario into a blessing, for himself, his country, the continent, and indeed the world.

When ARPPIS scholar John Davies-Cole obtained his PhD in 1992, civil war in his home country Sierra Leone prevented him from going back and carrying out the programmes that his training had prepared him for. As a postdoctoral researcher of *icipe*, Dr Cole undertook research at the University of Oldenburg, Germany in 1992, and in 1999, he left to pursue further studies in public health in the United States of America. In 2000, he was involved in the development of the





first syndromic surveillance system in the United States National Capital Region to detect bioterrorism. He conducted research to assess the performance of the system and evaluated specific algorithms through both abstract simulations and simulations based on actual data. These studies were published as a book chapter in *Statistical Methods for Counterterrorism* in 2006. He also developed and taught students in the university's School of Public Health and Health Services from 2000 to 2008 in the Department of Global Health. Additionally, he runs new courses on the prevention and control of vector-borne and tropical diseases. Currently, he heads the Centre for Policy, Planning and Epidemiology at the District of Columbia Department of Health, United States of America. Examples of his work include working with the Department of Health Programmes and the Washington DC community to collect and analyse data for translation into health policies in the district. For instance, in 2007, he provided data to the Department of Health's Community Health Administration to develop a plan towards the implementation of new policies to reduce the infant mortality rate to no more than 10 per 1000 live births. The average US rate is 6 per 1000 live births.

### *Dr Kenneth Oyugi Kambona*

Dr Kenneth Kambona started off in scientific research, moved to the private sector where he worked in various industries before getting into the public sector. Between 1988 and 1993, Dr Kambona worked as a research scientist at the *icipe*, an opportunity that enabled him to develop a strong background in sustainable agricultural research and natural resource management. During this time, Dr Kambona was a key member of an Africa-wide biological pest management programme, funded by the International Fund for Agricultural Development (IFAD). This culminated into a posting to Somalia, to advise the government on post-conflict rehabilitation of agriculture.

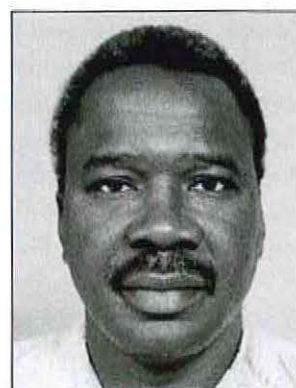


Kenneth joined Farmchem Agrochemical Company as a technical manager. After this, he took on an assignment as the marketing and corporate affairs manager at Syngenta East Africa Ltd, where from 1996 to 2005, he oversaw the company's regional activities in this regard, including the development of agricultural input markets aimed at promoting commercial and subsistence agriculture in the region. As a business manager, Kenneth established a strong local biocontrol division at Syngenta. This incorporated the marketing of biocontrol products alongside agrochemicals. In addition, Kenneth helped to turn Syngenta East Africa into an agribusiness company, by introducing Syngenta Seeds, which complemented Syngenta's agrochemical line. The seeds included two maize hybrid varieties (Duma and Simba), which not only mature quickly, but are resistant to maize streak virus. This was a pioneering move, which compelled other players in the industry to introduce seed lines, selling them to farmers alongside chemicals. Kambona's ARPPIS training background at *icipe* provided the necessary experience in implementing this project.

Currently, Dr Kambona is the Regional Agricultural and Policy Advisor at the United States Agency for International Development (USAID) where he holds the portfolio of Regional Economic Growth and Integration, a division that covers East, Central and southern Africa. He leads and manages the implementation of a Regional Agricultural Trade Expansion Programme. Among his roles are programme design and strategy development, programme implementation and management, and trade and policy reform. His skills portfolio includes project evaluation, market analysis and development, planning, administration and communication capabilities, set against a background of agronomic expertise and experience in agricultural development.

### Dr Dona Dakouo

Dr Dona Dakouo fits into many categories of expertise, but is probably best described as a world-renowned scientific institution leader. Dr Dakouo is currently Director of Research at the Institut de l'Environnement et de Recherches Agricoles (INERA), Burkina Faso but has also been a presidential award winner, a multi-award winning scientist and a cross-regional and cross-continental trainer of African farmers. He has been involved in training and institutional building at national and regional levels, and served as the principal technical advisor of the ADB/IPM pilot project in Lake Chad Basin (Cameroon, Chad, Niger and Nigeria) in 2004–2005. He teaches an entomology course at Université Polytechnique de Bobo-Dioulasso (Burkina Faso), where several MSc and PhD students are under his supervision. He has been a scientific adviser of young scientists at INERA since 1999.



Currently, Dr Dakouo is the Editor-in-Chief of the scientific journal *Science et Technique* at CNRST, Burkina Faso. He was the chairman of the IPM Task Force and Steering Committee Member of the Rice Research Network (ROCARIZ) from 2000 to 2004 and was involved in linking rice scientists from the West African Rice Development Association (WARDA) 17-member countries. From a career point of view, the exposure in ARPPIS earned him a promotion twice at INERA: in 1998 as a senior research scientist and in 2005 as Director of Research. It also helped him to be the recipient of several awards: the best scientific award in 2002 by the West Africa Rice Development Association (WARDA), a presidential award in 2002 (as team leader) for the development of resistant sorghum varieties to insect pests, an award from the West and Central Africa Rice Research Network (ROCARIZ) for his work as the chairman of its IPM task force (2000–2004), and a second presidential award in 2006 as a member of the team that developed and released seven NERICA varieties for lowland and irrigated rice in Burkina Faso.

### Dr Fanuel Afrika Demas

The versatility of ARPPIS training is best illustrated by the career of Dr Fanuel Afrika Demas. Having successfully finished his training at the *icipe* in 1997, Dr Demas went back to Namibia. He taught entomology at the University of Namibia. This was an interesting challenge since the Faculty of Agriculture and Natural Resources, to which he was assigned, was new. In fact, he was the first entomology lecturer. He was involved in the development of the curriculum, teaching material, as well as guides for practical lessons. In general, he made sure that entomology was given due recognition in the university, as an important field in agriculture and natural resources management. There were few entomologists in Namibia, and therefore the country benefited from my training at *icipe*. He was the first Namibian to train under the ARPPIS programme. In turn, he has trained many students in agricultural entomology at undergraduate level. Furthermore, he has supervised students at MSc and PhD levels in entomology and related fields. He recommended some of these students to train through the ARPPIS MSc programme at the University of Zimbabwe. He is an external moderator for the Polytechnic of Namibia and he serves on the Board of the Faculty of Agriculture and Natural Resources at the University of Namibia. This is because he wants to plough back the knowledge and experience he gained through *icipe* as well as other training and work environments into the youth of Namibia.



For the past six or so years, he has been part of the Ministry of Environment and Tourism where he joined as a Deputy Director for Monitoring, Research and Planning in the Directorate of Scientific Services. In January 2008, he was promoted to the position of Director. He is responsible for all wildlife related permit control, wildlife trade, CITES and RAMSAR Conventions, game capture and translocation, research and planning, and wildlife survey and monitoring. Although he did not get much time to do entomological research due to the administrative side of his job, all research proposals on wildlife, including entomological research by Namibian and international institutions, and researchers, are cleared through his Directorate.

## 6.4 IPM Practice

### *Dr Eliaineny Mose Minja*

In the early days of ARPPIS Programme, IPM formed the main area of research that attracted many scholars, most of these registering under the tutelage of *icipe* scientists based in the Crop Pests Research Programme at the Mbita Point Field Station. One of these scientists was Eliaineny Mose Minja. Although initially challenged by ill health, Dr Minja managed to attain her PhD ahead of the rest of her class, thanks to her own willpower as well as support from colleagues at *icipe*. Today, the IPM practitioner from Tanzania is giving back, by helping small-scale farmers in eastern and southern Africa improve their livelihoods.



Dr Minja is currently an independent researcher and IPM practitioner, where she uses her knowledge in collaboration with other stakeholders to reach out to smallholder farmers in rural areas in East, Central and southern Africa, improving their knowledge and skills in integrated pest management. She has also made contacts and worked with different research and training organisations, government institutions and donor agencies. In the past, she has conducted on-station and on-farm research on integrated pest management options for maize, sugarcane, pigeon pea, sorghum, pearl millet, groundnut, chickpea and beans. She did this work at the national (Ministry of Agriculture, Tropical Pesticides Research Institute-TPRI, Arusha) and regional programme (International Crops Research Institute for the Semi-Arid Tropics-ICRISAT, International Centre for Tropical Agriculture-CIAT) levels. She has also participated in training smallholder rural farmers, national research and extension workers and other stakeholders in IPM practices for target cropping systems. In addition, she has supervised Bachelors, Masters and Doctoral students from national, open and overseas universities in IPM uptake and socio-economic evaluation of IPM practices. She has also helped to implement institutional building with the target participating farming communities, national research and extension systems, policy makers, universities, some collaborating NGOs and private institutions. Her research work with rural smallholder farming communities has helped to sensitise policy makers, including grassroots leaders, on the importance of men as well as women to be involved in the development, decision making and implementation of projects.

Dr Minja's efforts on working with rural communities has led to the formation of farmers' research groups, which in turn has facilitated experimentation and adaptation of traditional as well as modern technologies. The processes have also enhanced knowledge and skills, and increased food production and nutrition among the target groups. The participants are now able to meet their day-to-day needs, such as feeding their families, improving their housing and paying school fees for their children. Communities that participated in the research project activities steadily gained confidence and pride through group work, formal and informal training, field experimentation and evaluation, frequent dialogue with different

stakeholders, and organised tours for knowledge sharing and exchange of experiences. These activities have enhanced the capacity of individuals and groups to communicate and demand for services, and empowered them to seek for assistance while owning their problems and solutions.

### *Dr James Ogwang'*

In some instances, the future of ARPPIS scientists was shaped by their past. Dr James Ogwang' is one such example. Growing up in northern Uganda in the early 1970s, Dr Ogwang's brother drilled into him that the world belonged to those who were trained adequately to embrace and practice science. That was at a time when news that a man had landed on the moon was a wonder in itself. Three decades later, James' own scientific achievements are grabbing international headlines. Today he is actively contributing to practical solutions on a number of problems that threaten the environment in Uganda, for instance the biocontrol of water hyacinth, and also in the area of food security where he has worked on the biocontrol of cassava pests and cereals. The success of this project has been the focus of two scientific documentaries. One of them, entitled *Strange Days on Planet Earth* was done by the world renowned National Geographic TV in 2005. The South African Broadcasting Corporation TV filmed the second documentary in 2006 under the title *Africa Rising*.



### *Dr Jean Joseph Randriamananoro*

Dr Jean Joseph Randriamananoro went back to Madagascar in 1997 and started working in rural development. He joined a private organisation called Bureau d'Etudes ADRE, an organisation supporting rural and environmental development. His objectives were to develop rural development projects, and train farmers and their groups on different cropping systems and also assist them in the implementation of their projects. In the course of this job, numerous farmers sought his assistance on modern beekeeping and silkworm rearing. Once more, he felt challenged and in 2001, when he was offered a postdoctoral position at *icipe* under the ARPPIS programme in the Commercial Insects Programme, he decided to concentrate his efforts on beekeeping and sericulture. The knowledge acquired at *icipe* placed him among the top development practitioners, particularly in rural issues, in his country. Therefore, back home in 2002, he enhanced his rural development activities even more.



Since then, he has been working on different development projects, such as the Programme de Soutien au Développement Rural (PSDR) under the Ministry of Agriculture and Livestock co-financed by the government of Madagascar, the World Bank, and the Suisse Inter-cooperation Programme, the PPRR project financed by IFAD, the ANGAP project, the Feedback Madagascar project, and others. Through this project he gives technical training, and follow-up, to farmers. So far he has trained more than 160 farmers' groups, with each group consisting of about 15 members, on apiculture, sericulture, rice and other food crops production. He has also trained more than 50 technicians in apiculture, as well as sericulture trainers, and hopes to contribute more towards the improvement of food crop production and to assist farmers to develop sustainable and profitable activities through training, technical assistance and relationship with donors.

## 6.5 Research and Development

### Baldwyn Torto

In early 2008, Ghanaian-born scientist, Baldwyn Torto, left a thriving career, in a world class institution in the United States of America, to take up leadership of *icipe's* Behavioural and Chemical Ecology Department (BCED). Why did he come back? "I came back because I had unfinished business to help complete the vision of my late uncle (Dr F. G. Torto) and of the late Prof. Thomas Odhiambo of developing a truly African scientific capacity based on international standards."



The African Regional Postgraduate Programme in Insect Science (ARPPIS), which is today a partnership of more than 30 African universities, was established by *icipe* in 1983 with the main objective of harnessing and fostering the continent's most precious resource – the intellectual knowledge and capacity of its people, in response to challenges such as providing science-based solutions to poverty and hunger and to minimise the effects of brain drain. One of the aims of this approach was the creation of a breed of young indigenous scientists, whose leadership the continent would enquire into, and find solutions for its own unique problems. This was even more critical within the realities of globalisation, and the Centre deliberately strived to elevate Africa's place in the global scientific arena, by training, retaining and equipping scientists to be on the same footing with their international peers. A case study of Dr Baldwin Torto, *icipe's* new head of the BCED, provides an example of the success of ARPPIS in realising this prime objective. In the interview reproduced here below, Dr Torto, explains why, having earned his stripes in the world, he came back to work in Africa.

#### **Q. What is your personal background?**

**A.** I was born on 17 August 1955 in Accra, the capital of Ghana, where I grew up and went to school. I earned a BSc degree, with a double major in chemistry and biochemistry, from the University of Ghana in 1979. After National Service for one year, I was employed as a teaching assistant in chemistry at the same university, where I then enrolled as an MSc student in natural products chemistry in the laboratory of Prof. Ivan Addae-Mensah, an eminent Ghanaian and world-recognised scientist. After graduating in 1982, I started lecturing in chemistry, still at the University of Ghana, until 1985 when I left to pursue a PhD degree at *icipe* in Nairobi.

#### **Q. Why choose another developing country to pursue postgraduate studies when you could easily have gone to Europe or America?**

**A.** Studying in the UK would indeed have been the natural route to follow, especially considering that most of my colleagues in the University of Ghana's Department of Chemistry had earned their postgraduate degrees there. A good majority of the organic chemists had received their PhDs from Cambridge University, while the physical chemists were graduates of either Imperial College, London, or Oxford University. However, I was advised by my late uncle, Prof. Frank G. Torto, himself a 1947 University of London graduate and the then Head of Chemistry at the University of Ghana, to join the *icipe's* ARPPIS programme. His vision at the time was to have a new crop of young scientists in the Department who had doctorate training in applied chemistry, and who at the same time, had research experience on African problems. At that point, most scientists in the Department had all obtained their PhDs in classical chemistry working on British problems. My uncle also wanted to contribute towards the vision of *icipe's* founder, Prof. Thomas Odhiambo, of making ARPPIS truly pan African, and a reality. I was therefore convinced that there was no better

place to work on African-related scientific issues than either in my own country or in another African country, such as Kenya. I came to *icipe* as an ARPPIS scholar on a German Academic Exchange Service (DAAD) scholarship. The University of Ghana was a founding member of the ARPPIS programme, which in 1985 enrolled its third batch of PhD students. I was the first chemistry student to be admitted into the programme.

**Q. What did that experience mean to your future career?**

**A.** A lot! First, I worked on a truly African problem, on feeding stimulants for the stemborer *Chilo partellus*, a major pest of cereal crops such as sorghum and maize. More importantly, under the tutelage of Prof. Ahmed Hassanali, the then Head of BCED, I was transformed from a classical natural product chemist into a chemical ecologist. I started looking at research problems from the point of view of the organism in question, using bioassays to guide my research in chemistry. I was ready to work at the interface of chemistry and biology and to train students to think that way too, as I did at Egerton University in Kenya, where I taught for a year immediately after obtaining my PhD in 1988.

**Q. Why did you decide to leave for the United States of America?**

**A.** It was due to a combination of reasons: Soon after obtaining my PhD, I got the opportunity for postdoctoral research, between 1989 to 1991, at the University of Maine in Orono, USA, in the laboratories of Prof. Michael Bentley and Prof. Barbara Cole. I worked on the synthesis of biologically active compounds and some natural products chemistry. I did, however, return to Kenya after the two years, to work at *icipe* as a scientist on a new project researching the chemical ecology of the desert locust. I was employed in the programme for 10 years, rising to the position of Senior Scientist.

**Q. How long were you in the USA and who did you work for?**

**A.** I was in the USA for almost six years, working for the United States Department of Agriculture (USDA), in the Agricultural Research Services' Centre for Medical, Agricultural and Veterinary Entomology as a Research Chemist. I worked on the chemical ecology of the small hive beetle, an insect originating from Africa and a pest of European honeybee colonies in the US. I learnt a lot working in the chemistry unit, under two prominent scientists, Dr Jim Tumlinson, a chemical ecologist and Dr Peter Teal, an insect physiologist.

**Q. What would you say were the challenges for you, as an African working in research in a developed country?**

**A.** I can't say I found any peculiar challenges based on my nationality. For instance, I was accorded the same respect and recognition as my colleagues. I was using similar facilities to those I was used to in *icipe* and the research questions were also pretty much the same. What I did find, however, was that I had to prove myself as a scientist all over again. Initially, I felt I had to work harder as the research at USDA is mission-oriented. My project was to identify an attractant (insect- or food-derived) that could be developed into a lure for the beetle. I was also to develop a trap for the lure. We had clients, beekeepers, to account to. Because their livelihoods depend on bees, they needed solutions to their problems right away. I was not used to this type of research and pressure. But what it all came down to is that the USDA is a world class institution, with first class chemical ecologists known to have answered many questions in that field and developed many analytical techniques. I felt privileged to be working there, and in the end what really mattered was my performance.

**Q. Did you feel you were contributing to Africa's development?**

**A.** Yes, I did, because until the small hive beetle hit the USA, not much was known about the beetle, except for the fact that it was a minor pest of African honeybees. Today, we know

a lot more about its biology, chemistry and ecology. We also have a lure and a trap for it, which we are currently testing here in Kenya, where beekeeping has become an important income-generating activity in some rural areas, as a result of activities of, among others, *icipe's* Commercial Insects Programme. The beekeepers are using a modified version of the Langstroth hive used for managing European honeybees in the US and Europe and in which the parasitic beetle thrives. We already have a monitoring and control system for the beetle, so we should be able to contain the situation should there be an outbreak of the beetle in Kenya and beyond.

**Q. Why did you make the decision to return to Africa, when your career in the USA was thriving?**

A. I suppose I should say I had unfinished business. I wanted to complete the vision of my uncle and that of Prof. Thomas Odhiambo. I feel I have a lot to contribute to this continent in terms of research and student training.

**Q. As a 'returnee' to Africa, what do you think of the continent in terms of scientific advancement, in comparison to what is happening globally?**

A. My main concern is the science policies, which I find to be rather weak in many African countries. For instance, research and development will not take off without adequate financial support from our governments. We continue to over-rely on external donors to support scientific research in Africa, yet this is not sustainable. Our politicians often talk about 'science-led development', but where is the evidence of their commitment to it? What is the equivalent in Africa of the US National Institutes of Health (NIH) or the USDA, which fund health and agricultural research in various US institutions and universities in our own countries, or the equivalent of the scientific research arm of the European Union (EU) in the African Union? It makes no sense to invest in training a scientist to PhD level, only for them to have to look for funding in Europe and America to work on African problems. The continent needs to take the lead in finding solutions for its problems. I also feel that not enough investment is being made in our universities, and as a result, many of them have been reduced to higher secondary schools. We also have too much 'deadwood', and not enough new blood being injected into our research and tertiary institutions.

**Q. What ought to be done in terms of bridging the ever-widening North–South scientific gap?**

A. The hope of equipping every university in this continent to the levels in the North might be an elusive dream. But a more likely reality would be to set up regional centres of excellence like *icipe*, focusing on aspects such as agriculture, environmental management, medical research, and so on, where African scientists can spend their sabbaticals.

**Q. How valuable are programmes like ARPPIS towards this objective?**

A. I would rate ARPPIS as a true success story. No one institution in Africa has produced more than 200 PhDs in the insect sciences, which is what *icipe* has done. ARPPIS could, in fact, be used as a model for similar centres in Africa, for medicine, engineering, management, etc., which would be funded by our own governments through the AU.

**Q. What are your plans at *icipe* in your new position?**

A. I plan to carry on the good work done by my predecessor, Prof. Hassanali. I want to expand the network of our collaborators, to involve multidisciplinary teams within and outside *icipe* for both research and training within the institution's 4Hs paradigm. My focus will also be on the training, personal and professional development of our young scientists, to enable them to work in an environment where they feel confident to test their own ideas. I also strongly believe in mission-oriented research and the use of state-of-the-art equipment

to accelerate research, and to get efficient, timely and accurate results for the benefit of our end-users, be they the other research projects at *icipe*, the scientific community or the general public. My experience in the US attests to this. Without the right equipment, one will be groping in the dark for a long time. Of course, I also plan to identify new donors to help fund these activities.

### **Q. What are your thoughts on brain drain?**

**A.** Brain drain is when skilled people, for instance from Africa, leave for training, or in pursuit of opportunities in developed countries, and then they never return to their countries or regions. I tend to see my experience as 'brain circulation', where people move to other countries to bring back new knowledge and networks, which enhance their work, and therefore their contribution to the development of the continent. This is why attending conferences and presenting one's work is so important. I feel that one needs to move back and forth, to share ideas and to learn new things. For example, in 2000, while a scientist at *icipe*, I spent nine months in the UK as a Rothamsted International Fellow in the laboratories of Prof. John Pickett and Dr Lester Wadhams. I believe my experiences have made me a better scientist because I am constantly learning.

Dr Torto believes that the opportunities he has had to move back and forth in other regions of the world, interacting with other scientists and building new knowledge and networks have made him a better scientist.

### **Dr Hassane Mahamat Hassane**

The ARPPIS Programme is attributed with expanding the horizon of its scholars to a level that few scientists in its institutional cadre can. One of its alumni, Dr Hassane Mahamat Hassane, is a clear model of this. In his youth, Hassane used to visit the Laboratoire de Recherches Vétérinaires et Zootechniques de Farcha, a station of the France-based Institut d'Élevage et de Médecine Vétérinaire Tropical (IEMVT) in his home town of N'Djaména, Chad. Young Hassane pledged to achieve one target – that he would study to a level where he could lead the institution. With experiences gained in the ARPPIS and the *icipe*, Hassane realised his dream to be not only a scientist at the Laboratoire de Recherches Vétérinaires et Zootechniques de Farcha, but to become its Director. He held that position from 2003 to 2006, during which period he turned the institution around, from one that was not working to one that is starting to gain recognition among other national agricultural research institutes in Chad.



By 2006, the veterinary laboratory in Farcha had become a base centre of the West and Central African Council for Agricultural Research for Development (CORAF/WECARD). "*icipe* contributed to my being cited in the 'Who is Who in the World of Science'", he notes. In March 2006, he was appointed the Deputy Director General in charge of livestock development in the Ministry of Livestock. Concurrently, he was put at the disposal of the FAO Country Office, which in May 2008, recruited him as the National Programme Officer. While holding the FAO/NPO position, Hassane has contributed greatly to the visibility of the organisation in Chad, and also supported all its activities in various fields of rural development. Subsequently, Hassane left the FAO to concentrate more on field and research oriented work, to join a team of experts within the Pan African Tsetse and Trypanosomosis Eradication Campaign (PATTEC) coordination office at the commission of the African Union, who are aiming to eradicate tsetse and trypanosomosis. Here he was appointed as the monitoring and evaluation expert at the PATTEC coordination office, where he works currently.



### Rosemary Sang

Since leaving university, Rosemary Sang, currently a Principal Research Scientist at the Kenya Medical Research Institute (KEMRI) has been actively engaged in medical research in the field of virology and other aspects of tropical infectious diseases. She has developed research proposals and made significant accomplishments, with her work attracting support from donors including the World Health Organization (WHO), the United States Army Medical Research Unit (USAMRU), the United States Department of Agriculture (USDA), Centres for Disease Control (CDC) and Nagasaki University, Japan. Her research has been published widely, i.e. over 20 papers in peer-reviewed scientific journals and a chapter contribution to a book on emerging infections, which is now in press. As Head of the Department of Arbovirology and Viral Haemorrhagic Fevers, Rosemary spends most of her time in the arbovirus laboratory of KEMRI, which now serves as a WHO collaborating centre for arbovirus and haemorrhagic fevers reference and research. KEMRI acts as a point of reference and research, serving Kenya and the eastern Africa region in outbreak response and surveillance. In this position, which she has held since 2002, Rosemary has led research teams in providing support in outbreak investigation and control of these fevers in Kenya and other countries in the region including the Sudan, Somalia, Union of Comoros and Ethiopia.



### Dr Esther Kioko

Over the years, Esther Kioko has focused her research, and therefore spent a considerable amount of time, in the field in Mwingi, an arid and semi-arid district in her own eastern Kenya region. Even after being awarded her PhD in October 1999, Esther continued to work in this place. Today, she is proud of the achievements her research through *icipe's* Commercial Insects Programme, has had in this region. "We have touched the lives of the people in this fragile ecosystem through projects on wild silk farming and beekeeping," she notes. "Using funding from the International Fund for Agricultural Development (IFAD) and other partners, our main objective is to improve productivity through biological research, to add value to the products, and to facilitate farmers to access markets. Mwingi beekeepers are now pioneer organic honey producers in Kenya," she further explains. The CIP programme, Esther further notes, also develops incentives for forest-adjacent communities to participate in forest conservation, an aspect that is funded by the Global Environment Facility (GEF) through the United Nations Development Programme (UNDP). In addition, in 2004–2006, Esther was involved in a research programme supported by the Swedish International Development Agency and the Swedish Agency for Research and Co-operation (SIDA/SAREC) through the Research Programme on Sustainable Use of Dryland Biodiversity (RPSUD). This work looked at the status of pollinators in the dryland Kima area in Makueni District, Kenya. It also focused on the conservation of useful insects and their food plants for the eco-development of these regions.



Esther has also contributed to project trials and validations of promising income generation options based on sericulture and apiculture technologies in projects where the CIP team has helped groups in various parts of Kenya to generate income from beekeeping, silk farming and processing through marketplace development. She has also acted as a grant proposal reviewer for the National Geographic Society. In addition, in 2005, she was

part of a Beekeeping Evaluation Mission that looked at projects in Kenya that are funded by the Government of the Republic of Kenya and the European Commission through the Community Development Trust Fund Biodiversity Conservation Programme (CDTF-BCP). Last year, Esther was part of a team that met in Cairo to put together a project concept note on the 'Development of Community-driven Income Generating, Integrated Use of Commercial Insects' for several countries in the Near East and North Africa (NENA) region. These include the Sudan, Yemen and Egypt. Esther, who is a member of the *icipe* Board of Training and Postgraduate Studies (IBTPS), has supervised students at MSc and PhD levels, and has, since 1999, been involved in the Training of Trainers Course in Commercial Insects, which is held every May and October at *icipe's* headquarters and field sites. Today, Esther, who is a Senior Research Scientist of the National Museums of Kenya (NMK), is currently on secondment to the *icipe* Commercial Insects Programme.

## **6.6 National Politics**

### *Dr Morris Ogenga Latigo*

Some alumni have joined national politics with a view to making policies that are favourable for the promotion of science and its practitioners. This is equally important to science, as policy and regulations that govern scientific practice and provide a conducive environment for research. Many of the ARPPIS alumni have experienced how poor governance can negatively affect scientific practice, and result in loss of research opportunities. Among the founding ARPPIS scholars Dr Ogenga Latigo is probably the best example of a scientist turned politician of the alumni, and continues to play a great role in the opposition in the Uganda Parliament.



# CHAPTER 7

## Future Role of ARPPIS in Science and Education in Africa

### 7.1 Introduction

The ARPPIS programme can trace its beginning to an era, three decades ago, when much of Africa lacked the human resource base to counter the many challenges that were facing the continent in insect science. To develop individual capacity and strengthen institutional capabilities in arthropod science and its application, *icipe* established the African Regional Postgraduate Programme in Insect Science in 1983 to facilitate human resource development in insect science within the continent. This was done in collaboration with the intended beneficiaries: the African universities and national research systems. In an arrangement designed to be inclusive, *icipe* provided one of the students' two supervisors and availed its excellent research facilities for the use of the students; the other supervisor was drawn from one of the 25 participating African universities, who awarded the degrees.

Right from the start, the planning and designing of the ARPPIS programme was based on a participatory approach, embracing all stakeholders, including representatives of African and European universities, Ministries of Higher Education of some African countries, international organisations, national and international research institutions, donor agencies, and the *icipe* research scientists and management. Two milestones made the programme successful: establishing PhD programme in 1983 and MSc sub-regional centres in insect science in 1992. The first evaluation conference on the ARPPIS impact on national programmes in insect science research and education in 1990 demonstrated the importance of the programme for the graduates' professional career, their host institutions and their countries.

Initiated through an African need, the ARPPIS programme has advanced into a premier institution for advanced studies in insect sciences. The needs of advanced courses in addition to classical insect sciences such as project planning, management, documentation, etc. were emphasised by the ARPPIS graduates of first classes (1983–1986). The experience of ARPPIS should be used as a model for other education networks of newly emerging disciplines in developing countries. As the parent institution *icipe* changes in status and programming, it is time for ARPPIS to reinvent itself and re-plan its future in the dynamic world of insect science, in an ever evolving environment. The programme should critically re-evaluate present relations and responsibilities of the participating universities, the ARPPIS secretariat and the *icipe* to strengthening scientific content and cost-sharing responsibilities. In its wealth of history over the last 26 years, and an array of stellar scholars, the ARPPIS has a chance of pushing science and technology in Africa to the next level.

ARPPIS was initiated for a strong need and had four basic functions: develop science leadership through postgraduate training, professional development programmes and science bursaries; generate knowledge and new technologies, through students' participation in *icipe's* research programmes and adaptive research activities; diffuse technologies developed by *icipe* and its partners through training of IPM practitioners, community training and empowerment, and production of technopacks (teaching materials, manuals, books, etc.); and support former beneficiaries through post-training activities such as by offering re-entry

grants (for further training) and internships, and organising exchange visits and special courses. This it has achieved in an exemplary and exceptionally successful manner. Built on a strong foundation, its success is likely to be felt deep into the future, and well beyond Africa's borders. The challenge for ARPPIS now is to ensure that it maintains its role as a premier institution for spawning young African scientists in a sustained and pragmatic manner into the future.

There have been ongoing initiatives to strengthen the ARPPIS network, which if pursued to logical conclusion should enhance the capacity and effectiveness of the programme. They include the following:

- Enhancing university participation through more involvement of universities in student selection to PhD programmes; improvement in the quality of supervision; timely thesis examination; and enhanced collaboration in *icipe's* programmes resulting in the development of more research and training activities to the universities.
- Ensuring sustainability of the network through establishment of long-term fund mobilisation plan and the sustainability of ARPPIS, the establishment of long-term fund mobilisation plan and the diversification of the resource base are of high priority, with enhanced contribution of partner universities through such actions like fee waivers.
- Providing institutional strengthening support to the university partners by including an institutional strengthening component in all ARPPIS grant applications, and by developing projects that specifically fund institutional support.
- Modernising and upgrading the ARPPIS programmes by enhancing the development and use of shared online programmes at universities through open distance learning strategies.

In this chapter, we look into these four channels in-depth and suggest further improvements that will make ARPPIS an outstanding world-class science training programme, with direct relevance to science education in Africa. ARPPIS has clearly demonstrated its capacity to produce scientists with the competence to meet the challenges of the academia, administration, or research for the development of Africa. When set up 25 years ago, the major focus of attention was to fill the void that existed in the civil service, research institutions, and the universities for high calibre insect scientists. That the gap is gradually getting filled, there is no doubt. The ARPPIS alumnus has 'lost' some of its highly capable scientists to either non-science areas such as politics, local or national administration. These are gaps that must continue to be filled in the future.

In spite of the great effort of the last two and a half decades of producing the African insect scientist, it may be safely said, Africa still needs even more scientists from ARPPIS programme. This can be approached from several facets.

## **7.2 Tackling emerging challenges in insect research**

### **7.2.1 Meeting demands in biotechnology**

Biotechnological advances have opened up new opportunities in research and development in insect science, and released routes for research in academic and research institutions that ARPPIS can take advantage of. The philosophy of tracking of modern biosciences with a strong bias on insect science aims to integrate newer approaches and scientific discoveries into the curricula, for example in population ecology and ecosystem science, behavioural and chemical ecology, bioinformatics and genomics, that are aimed at broadening the capacity of science to make a significant impact on national development, would add great value to the essence and a stronger future for research in Africa.

### 7.2.2 Expanding demand in science

In the past years, new participating universities were recruited on the basis of past successful involvement in ARPPIS, representative regional distribution, and capability to fit and complement the areas of *icipe's* research programmes. As would be expected, this left out a great many potential participants in the ARPPIS programme. It is the opposite approach – seeking potential partners on the basis of their potential, rather than on their current performance – that would yield greatest returns. This could be based on institutions already manned by past ARPPIS alumni, to those in regions deemed to hold greatest opportunities for research – medical, taxonomy, veterinary, agricultural, or genetic – whichever area would be deemed to hold the greatest opportunities.

### 7.2.3 New trends in insect pest and vector control

New trends in insect science must take into account issues that could change the opportunities in pest and vector control. Key among these includes the old and emerging reports on resistance of vectors to insecticides. Among the plant pests, insects continuously pose problems in rapidly showing resistance to new generation pesticides. ARPPIS training content could lean towards chemical ecology to meet demand in these areas.

### 7.2.4 Spreading the cake to African institutions

At a casual glance, it is obvious that the eastern Africa region has been the greatest beneficiary to the ARPPIS programme. One sees the need for expanding the programme further afield, and in involving the ARPPIS scholars' universities particularly to management of the research theses. This effort to spread the cake would increase the perception of ARPPIS as being relevant to a wider audience among the African academic and research institutions.

### 7.2.5 Refocusing for maximum impact

Africa, it is said, probably offers the greatest opportunities for insect science than any other continent. Numerous prospects exist in whichever direction one takes – medical entomology in malaria vectors and tsetse flies, transmission of dengue fever and other vector-borne diseases, animal disease vectors, and plague and other pestilences, and an abundance of beneficial insects. With this wide array of opportunities, research topics need to be strong and relevant. Similarly, old and emerging pests of crops, forest trees, ornamental plants and storage cereals offer chances for ARPPIS and its partnership in education institutions to make a mark in the lives of the target communities throughout Africa.

### 7.2.6 The ever changing environment

Climate change has introduced new dimensions in pest and vector control. A less stable environment generally means that the lines for pest or vector activity are less clear. Possible opportunities therefore present themselves for ecological studies, in a dynamic and ever changing environment. Unseasonal rains have expanded the distribution of malaria bearing *Anopheles gambiae* s.l. beyond its normal borders, into fresh territories leading to a higher frequency of highland malaria, and into the normally arid environs. Unseasonal rains have also widened the outbreak areas of locusts, armyworms and other seasonal pests. Such changes have brought fresh opportunities for projects in insect science in educational and research institutions, and opened up fresh routes for collaborative efforts between ARPPIS and national and regional research bodies and universities.

### 7.3 ARPPIS in an expanding university system

At its inception, only a handful of universities offered insect science as a subject – and even then it was deeply hidden as a minor component of such subjects as agricultural entomology, mainly covering pests of agricultural importance and storage crops, medical entomology with focus on mosquitoes, tsetse flies and phlebotomine flies, or veterinary entomology, focusing on ticks and insects implicated as vectors of diseases of cattle, sheep, goats, fowls or other animals. Over the years this approach has changed and insect science has gained recognition as a separate area of science. With the rise in the number of universities in Africa, there is demand for lectures with the right content and technologists with relevant qualifications to meet this demand. ARPPIS is the most established programme to generate the scientist to provide the required personnel for such courses. As an example, at the pre-ARPPIS era in Kenya, there were only a handful of universities – almost all public – offering any courses related to insect science, and almost all housed in the departments of zoology. Now, the numbers of universities offering subjects with science content have increased tremendously, with the public universities alone growing several fold – even before considering the constituent colleges spread country-wide. The same story is repeated elsewhere throughout the continent.

ARPPIS offers the opportunity for Africa to move from the net receiver of scientific personnel and information generated elsewhere in the West to help in solving its problems connected to insect science, including pest and vector management to a net provider of such qualified scientists to the world. Africa has remained in most part unaffected by trans-national higher education. In most part, individual universities have remained enclosed in their individual cocoons, showing little evidence of sharing in knowledge or skills. ARPPIS and *icipe* had come in and showed that it is very much in order to share resources and work towards a common good for Africa. Insect scientists coming from the ARPPIS programme have fitted well in their respective national agricultural, health and academic systems, including research institutions and universities, international agencies, or in their national programmes as shown elsewhere in this book.

Available evidence shows that up to the time that ARPPIS was instituted, the vast majority of foreign educational activity was concentrated in meeting the immediate needs of the civil service, which was mostly administrative, with little native personnel engaging in research or higher education. Thus while the developed world engaged in science at the cutting edge, the developing world has generally possessed insufficient capital or individual wealth and capacity to attract or sustain this type of provision on a substantial scale. Furthermore, in insect science – as also true for other areas of science – higher education in African countries faced the divide provided by the two major foreign languages of the continent – English and French.

Countries in Francophone Africa faced a double challenge – in addition to the problems common to most African countries (e.g. capacity gap, fiscal constraints, poor infrastructure, low political support for science), the dominance of the English language presented various difficulties in a divided continent separated by foreign languages, yet shared common problems of disease and pestilence. ARPPIS appears to have found a way around this problem, and scholars from Cameroon, DRC, Burundi, Rwanda, Madagascar, Chad, or Senegal have found no hindrance in registering and carrying out their research within the ARPPIS programme. At the conclusion of their studies, young scientists have gone back home and fitted snugly into key positions in the academia, research and other scientific (and non-scientific) programmes. This is a special position that ARPPIS should continue to perform – uniting and bridging together African scholars whatever their cultural or language background, into a singular loop for solving the numerous African health and food problems.

It should be accepted that the ARPPIS got into uncharted grounds by the *icipe's* initiative to get into postgraduate studies that were hitherto the reserve of overseas universities. Under the prevailing system, relatively little information was available from the native environment, and therefore issues that were relevant to the agricultural production, disease

control or veterinary relevance of the tropics, Africa in particular, were largely unknown. Until then, little information had been made available on trans-national and cross-border developments across Africa, even though malaria, nagana, sleeping sickness, rinderpest, desert locusts and a myriad of other problems reigned high and wide in the continent, observing no borders. Most of the information on African pest and vector situation had been gathered by expeditions from the developed countries. Publications from African scholars of the day were tagged somewhere in British, American, or French journals. ARPPIS ground-breaking studies saw to it that information was generated through taking projects that were researchable, yet relevant to the national governments. This is an area that offers opportunities for ARPPIS and its education partners for the future. ARPPIS still stands heads and shoulders above other institutions in bringing to the fore the insect science studies that are relevant to the continent.

Expansion opportunities is not limited to an increase in number of higher education institutions alone but can also be looked at in light of expansion in content of subjects and programmes in the universities. The various universities in Kenya for example, have several courses with an expanded content on science, many with relevance to insect science. New courses in horticulture, ecology, animal science, range management, food science or public health open up new opportunities for participation of ARPPIS programme, opening up new possibilities and opportunities for research by ARPPIS scholars and employment opportunities for the ARPPIS graduates.

#### **7.4 ICTs – Opening new opportunities in IPVM**

Information and communication technologies (ICTs) have taken a centre stage in the day-to-day operation of health, and strong international programmes now run on effective IT systems for health. Witness the following Health Management Information Systems (HMIS) running on IT systems:

##### **7.4.1 Providing health services through IMS – the Moi University example**

In the face of many challenges in deploying information systems in developing countries, several examples exist to illustrate successful integration of ICT into clinical workflows. Among the various ICT and information management systems (IMS) projects on health are the AMPATH Medical Records System (AMRS), Kenya, a project on collaboration between Moi University Teaching Referral Hospital and Indiana University School of Medicine. The collaboration bore fruit in 2001, where the Mosoriot Medical Record System (MMRS) was installed in a primary care healthcare centre in rural Kenya. In November 2001, the MMRS software was adapted to support the AMPATH (Academic Model for the Prevention and Treatment of HIV/AIDS) project and renamed to AMRS.

From two networked computers running Microsoft (MS) Access™, powered by a UPS with solar battery back-up, for the AMPATH project, the network has expanded to seven networked computers linked to a single MS Access database. Data are collected on all patients seen in the medical clinic, including their laboratory results and medications. The system ensures that both patient registration and visit data collection are kept operational. A comparison of the clinic before and after adoption of the MMRS showed patient visits were 22% shorter, provider time per patient was reduced by 58% ( $P < 0.001$ ), and patients spent 38% less time waiting in the clinic ( $P < 0.06$ ); clinic personnel spent 50% less time interacting with patients, two-thirds less time interacting with each other, and more time in personal activities.

The MMRS has also vastly simplified the generation of mandatory reports to the Ministry of Health. The next generation of the database, AMRS, has a completely revamped data model, and uses new technology (MySQL, Python-based Zope and Plone, and MSInfoPath to allow web-based data entry). Yet similar problems in pest and vector-borne disease outbreaks offer opportunities for ARPPIS and its partner institutions.



### **7.4.2 Community health service delivery through telemedicine – The AMREF example**

Here in Nairobi, AMREF runs an IT programme to support its field medical activities. The AMREF Telemedicine project has been designed to bring efficiency and improve its clinical outreach programme. A number of sites have been set up to test proof the concept and gradually expand across the nearly 80 rural hospitals currently served by the organisation across East Africa. The project uses a simple method of store and e-mail. AMREF depends on the clinical staff from the rural hospital to use email to forward the case notes and supporting images of the patients 'seen' the following day.

Notes may be scanned images of handwritten notes or PC-based using proprietary software such as Telemedmail. Accompanying the notes are full digital images of the patient together with digital images and/or video clips of any visible lesion. Digital images of X-rays accompany the notes together with the results of any other diagnostic procedures. The outreach clinic accesses the Internet for transmission of the clinical notes and attachments, and begins virtual consultation. The Telemedicine project sites have a standard ICT package that would enable it to communicate with AMREF's clinical services located in its Kenya Office in Nairobi. In this way, AMREF intends to access thousands more patients in remote areas yearly in an increasing number of hospitals in eastern Africa. Similar internet access and outsourcing can lift the service side of ARPPIS programmes in research with collaborating institutions to a new level, especially in sharing research results in a continual and uninterrupted basis.

### **7.4.3 IT based systems for ARPPIS training**

Expansion of ARPPIS training programmes would benefit greatly through IT. To ensure best delivery through the network, ARPPIS could use among other technologies the 'Open and Distance E-learning technique' (ODEL). This system is mainly used in the Mother-to-Child Transmission of HIV training. The ODEL module is used for masters level health care workers who are in mid-level or higher management positions in the public health sector. Selected participants are expected to be computer literate and have access to a reliable Internet service. Through this module trainees participate in interactive e-mail discussions which also require that trainees prepare class presentation and write a final exam. In addition, compact discs are used as reference sources for access of literature on the topics.

Other data management and information networks which have worked in other developing countries include the Partners in Health-Electronic Medical Records (PIH-EMR) web based project, which was established in 2001 by PIH programme to address the drug resistant problem among TB patients in the slums of Lima, Peru. The project is an open source web system backed by an Oracle database. The PIH-EMR system includes a clinical record with initial history, physical examination, laboratory results and medications on all patients receiving individualised treatment for MDR-TB. The custom medication order entry system provides advice on potential problems and feedback to the nurses, who can consult the physicians if, for example, a patient has new evidence of resistance to the drug they have been prescribed. The PIH-EMR is also used to create monthly reports for the Global Fund and the Health Ministry.

Fibre optics technology has made internet access cheap, creating fast linkages to the outside world. ARPPIS should take advantage of these emerging opportunities in the IT world to create space for expanding insect science education rooted on a continual web-based and linked system for its programmes.

### **Opportunities for e-learning in ARPPIS**

The virtual classroom is gradually gaining a foothold as a mode of instruction in some parts of Africa. Sadly though, the vast majority of universities in both Anglophone and

Francophone Africa are not endowed with sufficient capital or individual wealth to sustain large-scale investment or utilisation of IT for e-learning, even though ICT-enhanced learning could expand access to new information and increase opportunities for wide scale linkage to virtual libraries across the world without any in-country commitment required from the source country. However, poor technological infrastructure, low bandwidth availability and language remain important barriers to online access, and could affect any thought of expanding ARPPIS programming for the future.

Among the local universities, Kenyatta University probably stands as the most prominent example of an e-learning university in the region, and which ARPPIS e-learning initiatives could build partnership with. One site where the ARPPIS programmes could link to is the African Virtual University (AVU), a system into which various Francophone and Anglophone institutions have already formed partnership to collaborate in the development of course content in education, exchange of instructional material and technological experimentation. This therefore is an opportunity for ARPPIS to link into and to take benefit of both Francophone and Anglophone Africa. Until now, trans-national initiatives in French-speaking Africa have developed in relative isolation, but the AVU's recent partnership with various African institutions could be viewed as an effort to bridge the existing divide and promote institutional collaboration between the two language communities.

The African Virtual University is the obvious link where the French- and English-speaking worlds unite, and in which lays an opportunity for an online based learning opportunity for ARPPIS. The English-speaking world's knowledge of use of IT in e-learning in Francophone higher education is severely limited, but a placement of ARPPIS in both worlds (Francophone and Anglophone), could be important in filling up this gap in knowledge. ICT use in these two worlds, sharing of experiences and challenges as well as any related issues, and associated problems could be value adding for ARPPIS and partners in such a programme. Greater opportunities would also arise from more access to on-line journals, which are provided to the participating universities as a vital resource in building capability to undertake effective research and training. ARPPIS linkages into the AVU-AUF would benefit greatly for e-learning in insect science.

Other recent online foreign initiatives include plans by the President of Senegal, Abdoulaye Wade to launch the African University of the Future (AUF). The AUF will beam postgraduate courses via satellite from the US to partner institutions across French-speaking Africa. This could be a chance for ARPPIS-Francophone to link and beam its learning system to the world. They could be linked to yet another enterprise – the World Francophone e-University (UNFM). Yet another opportunity is the Pathfinder Foundation for Education and Development (a France-based non-profit organisation aimed at spearheading ICT initiatives in Francophone Africa) has formed a partnership with France's National Space Study Centre (CNES) and Alcatel Space (AS), a France-based satellite manufacturer to launch the international e-university project, and one into which ARPPIS could readily fit into.

International organisations could make an important contribution by providing financial assistance to support infrastructure development in relation to information and communication technology, student support and regulatory arrangements for e-learning in ARPPIS. Regional bodies such as the AUF, AVU and Centre for Arab and Middle-East Studies (CAMES) might assume an increasingly central role in overseeing trans-national developments, particularly as incoming providers move towards a more economically driven approach. Countries hosting the e-learning system might also consider developing appropriate quality assurance mechanisms for imported educational activity and imposing development-based conditions on foreign establishment. Until questions are raised over the extent to which foreign provision seriously addresses the development agenda of the host country, the added-value potential of trans-national higher education to both English- and French-speaking Africa will remain largely untapped for insect science.

ARPPIS should link into the ICT loop – both for generation of data, formulating it into usable quantum or the target audience, or converting it into information that can be used

by the ultimate beneficiary of science – the African farmer. The future lies in IT, and while it is still a minority trend, with most universities in Africa still relying on chalk and paper to deliver lectures to the students, e-learning is increasingly viewed as a viable alternative to large-scale face-to-face delivery, particularly in light of rapid population growth, increasing ICT funding and limited indigenous higher education infrastructure.

## **7.5 Opportunities in Francophone and Lusophone Africa**

At inception ARPPIS was seen as a pan African initiative with centres covering both Anglophone and Francophone Africa. University of Dschang was to be the centre of the French speaking universities participating in the programme. Francophone Africa is made up of 29 countries. In 18 of these, French is the official language, in 6, it is one of two official languages, and in 5 French is not one of the official languages but has a prevailing presence. The combined population of the Francophone countries is approximately 394 million. This offers a great prospect for ARPPIS to strengthen the opportunities that were not taken in the earlier initiatives, and promote its presence in Francophone Africa.

It is important though that possible pitfalls are factored into any plans for expansion into Francophone Africa, imperative among which being that Francophone Africa does not constitute a single economic, political, or cultural entity, and the various countries show a highly varied scale of foreign educational activity. Currently, most of the active and diverse sites of higher education training centres are found in the more prosperous of the Francophone countries, which tend to be concentrated in the North African states, i.e. Morocco, Lebanon, Algeria, Tunisia and Egypt and Indian Ocean islands of Mauritius and Seychelles. ARPPIS has had a good link with Egypt, Madagascar and Mauritius through their contact with the *icipe*, but great opportunities exist with both the large more prosperous countries to the north as well as with the less prosperous sub-Saharan countries to the south. As in the rest of Africa, opportunities abound for linkages with corridors of science in both sides of the divide in the Francophone countries.

ARPPIS is a unique institution and the only one of its kind not only in Africa, and possibly beyond. This uniqueness has not been seized for expansion and development at the Francophone countries level. It is possible to replicate what has been achieved and successfully executed by Francophone countries that have so far collaborated with *icipe* on implementing the ARPPIS programme. In collaboration with the existing Francophone institutions, a French-speaking ARPPIS may be initiated in a French oriented institution based in Mali or Senegal. This is already on implementation by several institutions such as the Centre for African Family Studies (CAFS) with headquarters in Nairobi and Lome. There is a rising demand for trans-national higher education across Francophone Africa, which such a move could target.

The vast majority of national higher education systems in Francophone Africa are characterised by a growing gap between demand and supply. Furthermore there is a gradual trend towards privatisation, but the domestic private sector has not been able to meet the escalating and expanding demand. ARPPIS presence in these countries would offer a unique opportunity for filling the gap in training and producing the much needed scientists. Local provision is in many countries perceived to be of low quality and high study abroad rates suggest a significant demand for foreign qualifications. However, for many countries in the region, overseas study remains too expensive for the majority of the population and the country. Therefore, the position of training at regional level already successfully implemented under ARPPIS at the *icipe* would, it is assumed, take root with the same vigour as it has done in the last 25 years in Nairobi, Kenya.

It is expected that ARPPIS will need to comply with the regulatory requirements in the Francophone countries, which may be quite different from those that it has worked under in the Anglophone countries, and may be different from one Francophone country to the next. However, with the vast networks that have been created in the last 25 years, many

also involving the same Francophone countries that may be targeted for expansion, this should mean that the path followed in the creation of rapport in establishing the ARPPIS of today should be much shorter in the 'Francophone ARPPIS'. It would mean that the regulatory environment would have to be explored, but without doubt the experience from the present ARPPIS would mean a much shorter route for the new initiative.

It might be that only a few countries have in place a regulatory framework for the establishment of a regional institution of higher learning that ARPPIS would require but for the most part, African governments, both Anglophone and Francophone, have encouraged the provision for country-based higher education rather than education in an overseas environment. Similar to other countries, other perceived benefits for in-country ARPPIS based in Francophone countries include capacity building at domestic level, widening student choice of subjects, and enhancing innovation and competitiveness in the education sector.

Since many countries lack the financial and material resources to initiate their own higher education programmes, this creates a void between what the national requirements are or should be and the reality on the ground. Therefore, there is a growing attempt to encourage a provision for institutional sharing at the regional and sub regional levels, which would reduce the need for isolated and stand-alone tertiary institutions. Further, a significant number of countries lack the resources and institutional coordination to implement a successful regulatory framework for an ARPPIS-like institution, and can therefore work in collaboration with such institutions as the African and Malgache Higher Education Council (CAMES), which was established in 2000 for coordinating the French-speaking higher education institutions in sub-Saharan Africa. There are sufficient examples of cross-border institutional collaboration from Africa, as outlined in the earlier chapters of this book, to draw experience from.

It is to be expected that the establishment of a Francophone ARPPIS would meet with stiff resistance and challenges from some quarters, least of which is the rampant political turmoil and uncertainty that is sometimes witnessed in some countries, misplaced mistrust for anything foreign, and sheer nationalism and protectionist policies in the education systems in some African countries. These challenges can be reduced by making the Francophone ARPPIS as native to the host region as possible, aiming its mandate at solving local problems and associating itself with solving issues close to the hearts of the native population. That there are now key ARPPIS alumni in most Francophone Africa that can play key responsibility in establishing these institutions is a big advantage for such an initiative.

The historical linkage between Francophone Africa and France has led to most institutions in these countries associating with institutions of higher learning based in France, with little involvement from local or regional actors. Linkages between ARPPIS and some of these existing institutions, for example the Agence Universitaire de la Francophonie (AUF) that has been at the forefront of higher education developments in French-speaking Africa, could open up higher channels for collaboration. AUF has among its responsibilities, that of an international body, unified by language, that is aimed at coordinating and enhancing French language for higher education worldwide.

Linkage to AUF would open up fresh opportunities between ARPPIS and other institutions linked to AUF in the Francophone region. Some examples of institutions linked to AUF that are based on the capacity-building model include the Pan African Institute for Economic Co-operation (ISPEC) that has headquarters in Benin, the Senghor Alexandria University, a multilaterally funded management training institution in Egypt, and the Francophone Institute for Business Management (IFE) in Mauritius.

Similar opportunities are available for the Lusophone Africa. Universities in Angola and Mozambique offer great opportunities for expansion of research and development beyond the more traditional and now more familiar English-speaking Africa. A fully pan African partnership would also lead to truly regional partnerships (South–South and North–South) and would facilitate a greater exchange of ideas, information and brain-power between the French–English–Portuguese triangle of nations in Africa.

## **7.6 Wrapping up unfinished business**

At inception, ARPPIS was to look at a much wider scope than what finally emerged. Although great strides have been made, yet there are numerous unfinished businesses.

### **7.6.1 *Insects as food – Feeding the hungry world***

At its inception, ARPPIS was to trail blaze in seeking opportunities for harnessing insects as food. Many examples were cited for insects as delicacies to grace the dinner table – ranging from the swarming termites and the lake flies of western Kenya, the green long horned grasshoppers (the *senesene/senene* of Uganda) to the lepidopteran larvae of Zambia. Little has been heard of coleopteran grubs of Southeast Asia. Yet problems of hunger and food scarcity abound unabated in Africa. Further research on nutritional value of insects in relevant institutions participating in the ARPPIS programme might open up opportunities for mass production of insects as food. ARPPIS could lead the way in studying entomophagy and its economic, nutritional and ecological benefits for rural communities in sub-Saharan Africa. Such studies could examine the sustainability of enhancement of cottage industries, farming of insects, harvesting wild insects and improved conservation practices, and the improvement of mass-rearing edible species.

### **7.6.2 *Insect taxonomy – The undiscovered species***

Insect taxonomy was one of the earliest courses offered by ARPPIS at its inception. Over the years, this and other courses offered then, including invertebrate pathology and insect ecology, fell by the wayside. Yet opportunities abound for ARPPIS – in collaboration with such institutions as the National Museums of Kenya (NMK) – to act as the centre for insect taxonomy for Africa. ARPPIS could act as the centre for expeditions into the great Sahara Desert or the Congo Basin for the yet-to-be-described Insecta in these vast remote lands.

### **7.6.3 *Integrated pest/vector management – A true integration***

A true integrated pest/vector management (IPVM) remains elusive today as it did 25 years ago at the inception of ARPPIS. Everyone agrees that it is a worthy cause, yet in practice, every system acted alone – the lone rangers of ecological principles (push-pull), environmental friendly technology (plant derivatives such as neem), or plant resistant varieties carry the day – on their own. Insufficient effort is being made on true integration for pest and vector management. ARPPIS has the opportunity to change this and give Africa and the world a truly integrated system that utilises the riches and plentiful opportunities in pest and vector management – including the naturally occurring pathogens, predators and parasites, to reduce pest infestation in farmers' fields.

### **7.6.4 *Enhancing a beautiful kingdom – The Insecta***

Towards the end of his life, Prof. T.R. Odhiambo was to write one of the most moving contributions (Odhiambo, 2003) for the African Association of Insect Scientists, of which he had been Founder and Chairman for many years, and which celebrated its own 25 years of Insect Science for African Development in 2003. His thought on the transformation of insect science in Africa and paradigm shift from focusing on killing only a small fraction of obnoxious insect species (0.3%) at the expense of neglecting the rest featured strongly in the depiction on the Insecta. Rather, he called for a holistic approach of managing in a sustainable and integrated manner all insect populations.

He noted the need to respect the existence of insects, and providing services to insects. Of the future of insect science, he was to write:

*[It is] one of providing services to insects...  
and respecting their existence.  
In this manner, life on this planet becomes once again,  
a little more beautiful,  
a little more magical,  
a little more of an expression of God himself.*

Under the visionary leadership that *icipe* prides itself in, ARPPIS can take over from here and approach insect science and education on insects in a holistic and pragmatic way, and set a fresh agenda on training – not only at tertiary level, but in the promotion of introduction of this fresh paradigm right from the biology classes of the high schools to the university lecture halls and college classrooms throughout the continent.

### **7.6.5 *Twinning of ARPPIS to institutions of higher learning and research***

ARPPIS has always encouraged and accepted the twinning arrangements with advanced research laboratories, designed to give exposure to new analytical methodologies and approaches. This should be strengthened especially in the face of the changing world of science.

Twinning and partnership with existing and new institutions from within and outside Africa is undoubtedly a viable option for expansion and strengthening for ARPPIS programmes, and for taking advantage of the scientific strides made by international institutions and universities. Such twinning should not only be with the better endowed institutions but also, for the purpose of offering opportunities for the less endowed organisations and universities of Africa, to provide capacity building and institutional strengthening to the selected but high potential universities and research institutions. For this latter group, it is expected that there would be limited possibilities for institutional partnerships due to a widespread lack of local expertise or knowledge. But here should lie the prospects for higher provident and sagacious results for the African insect scientist. There will also be need to build strong regulatory frameworks for these linkages and contacts that would provide opportunities to facilitate and coordinate these processes. Opportunities for this kind of arrangement abound in Africa, but more so in the new and emerging nations. The best opportunities can be linked for example in the Government of Southern Sudan, Eritrea or Angola.

### **7.6.6 *Linking ARPPIS to foreign universities and institutions of excellence***

It is to be appreciated that ARPPIS is already linked to some key universities in Africa, and beyond. Among these are Dschang (Cameroon); Assiut (Egypt); Addis Ababa and Alemaya (Ethiopia); Cape Coast and University of Ghana (Ghana); University of Malawi (Malawi); Egerton, Jomo Kenyatta University of Agriculture and Technology (JKUAT), Kenyatta, Maseno, Moi and Nairobi (Kenya); Ahmadu Bello, Enugu State, Ibadan, University of Agriculture Makurdi, Nnamdi Azikiwe, Ogun State, Rivers State University of Science and Technology and Alemaya University of Agriculture (Nigeria); University of Pretoria (South Africa); Gezira and Khartoum (Sudan); National University of Rwanda (Rwanda); Sokoine University of Agriculture, Dar es Salaam (Tanzania); Gulu and Makerere (Uganda); University of Zambia (Zambia) and University of Zimbabwe (Zimbabwe).

Among the national research organisations in African countries signatory to *icipe* Charter are the international agricultural research centres (IARCs), e.g. ICRAF, ILRI, IITA, various academies of science and networks, including the African Academy of Sciences (AAS), Third World Academy of Sciences (TWAS), Third World Organization for Women in Science (TWOWS), and the African Network for Agriculture, Forestry and Environment Education (ANAFE).

Further, there is already strong collaboration with advanced laboratories in many countries, including: Federal Rural University of Pernambuco, University of Sao Paulo, University of Viçosa, Regional University of Cariri (Brazil); ENSA Montpellier (France); University of Amsterdam (Netherlands); Universities of Constance, Kiel, Hanover, Zena (Germany); Miami, Pennsylvania, Michigan State, Yale Universities (USA); Swedish University of Agricultural Sciences (Sweden) and the University of Newcastle-upon-Tyne and Rothamsted Research Station in the UK.

ARPPIS can take advantage of the existing international and national institutions and universities to create strong and robust linkages for research and generation of information. Through such linkages, formidable union can be formed. Over time such joint ventures can be promoted to centres and programmes to branch campuses. Thus the overall swing is from small-scale, capacity-building projects to more large-scale, economically driven ventures (with more private investment). The current ARPPIS programme has several opportunities for large scale ventures including sericulture, apiculture and biodiversity programmes.

There are several examples of large-scale operations to be drawn from, which illustrate joint educational programmes between institutions. The US-based Suffolk University opened a joint centre in 1999 in collaboration with a local business school in Dakar, Senegal. In Mauritius, there are two examples of Indian branch campuses operating in the country. The Mauras College of Dentistry was established in 2003 by India's Bhavnagar University to offer postgraduate programmes to students across the Indian Ocean sub-region, and India's Sikkim Manipal University has a branch campus offering tertiary programmes in information and communications technology (ICT). Like twinning, linkages offer opportunities for using the established systems in foreign universities to strengthen upcoming African institutions.

#### *7.6.7 Strengthening quality of graduate output for beneficiary needs*

ARPPIS has over the years produced graduates that are conversant with concepts and principles of modern IPVM and have the capacity to implement and direct projects through multidisciplinary teamwork. The graduates are trained to be able to analyse insect-related aspects that impact on food and health security policies and effectively utilise contributions and other disciplines such as socio-sciences, economics and policy studies. The future for ARPPIS must target new opportunities and approaches towards strengthening quality of graduate output, and invest in farmer-friendly strategies.

#### *7.6.8 Institutional support to universities*

ARPPIS has been working to build institutional capacity in the participating universities so that they are able to undertake frontier and cutting-edge research that directly contributes to solving critical national and regional problems, and thereby meet the millennium development goals (MDGs). The staff development carried out in partner universities through scholarships for staff training and departmental support is significant in enhancing insect science in Africa. Such attachments are offered for students and researchers wishing to undertake projects that require specialised laboratory expertise, such as chemical ecology, molecular biology, biotechnology, bioinformatics, biostatistics, arthropod rearing and pathology. With experts in these areas, ARPPIS can extend support to other universities.

#### *7.6.9 Strengthening university participation in the network*

Within the framework of the ARPPIS arrangement, participating African universities have played largely administrative and facilitative roles in the past. As new areas are taken on, there will be need to revise the programme structure to enable the partner universities be more active participants in the conception of student research projects and student supervision, as well as in providing facilities for a substantial part of student research activities at the universities.

### 7.6.10 Modernising the curricular and teaching methodology

ARPPIS has carved out a niche and created a leadership role in science in Africa, and must continue to build university capability to offer quality higher education in Africa, especially in the area of biosciences in insect science. Strengthening the postgraduate training programme therefore needs to incorporate inter-linkages between key disciplinary competencies including modern approaches in population ecology and ecosystems science, genomics, computational biology, socioeconomics, behavioural and chemical ecology, conservation biology, biodiversity, insect pathology and environmental biology. This modernisation will significantly contribute to high-level trained brainpower, which will in turn undertake further training and hence sustain quality postgraduate training.

### 7.6.11 Facilitating information access

Since the universities have listed capacity limitations in terms of ready access to scientific information, especially journals, there is need for *icipe* and ARPPIS to facilitate the provision of online journals access to universities participating in its training networks, as a way of building institutional capacity to undertake research, and hence contribute to solving critical national and regional problems.

Many chances exist for opportune moments for building and developing ARPPIS capacity in biosciences.

### 7.6.12 Demonstrating impact

Impact is a major sustainability factor in the management of donor-funded programmes such as ARPPIS. All stakeholders, including development partners would rather associate themselves with successful organisations. Although ARPPIS has made considerable achievements through student research, and its graduates are in various prominent occupations throughout the African continent, these achievements have not been assessed and documented. Obviously, such monitoring and evaluation would be useful in guiding programme review and in advocacy as appropriate. The mini survey on alumni performance, which is reported in Chapter 5 of this book has revealed the dire need for tracer studies on ARPPIS graduates and case studies on the contributions of their research to knowledge and application of science to production and policy.

ARPPIS can no longer rely on numbers of graduates as a way of demonstrating impact. Such process indicators, though significant, yet it is more important to assess and document alumni contribution to scientific knowledge by looking at the intensity and quality of scientific publications including articles in peer-reviewed journals, books and book chapters, public information materials as well as those for informing policy with research evidence. It is also necessary to assess and document alumni contribution to technology generation and research use. Such assessment could, for example, examine the following: number of patents registered, effort in translation of research to policy, participation in advisory commissions of experts, enhancing research use through political influence, advocacy role through NGO work, held positions of leadership that set the course of research policy, number of policies contributed to to-date, or industrial/farming engagements applying high technology, and interventions through participatory development initiatives.

### 7.6.13 Final values – Revisiting the core principles of ARPPIS

For close to three decades now, *icipe* and ARPPIS have held the responsibility of ensuring that the incoming generations of African scientists have a strong and holistic science-based training with a socio-economic background that is relevant to the needs of the society. They must be equipped with problem-solving and critical thinking skills, as well as possess



good communication and interpersonal skills. These are values that must be copied and honed by other centres of excellence that wish to go the ARPPIS way. The research training programme was designed on a holistic, interdisciplinary approach that is anchored firmly on a strong disciplinary pillar, emphasising the creation and application of knowledge, strengthening of skills and changing of mindsets so as to empower individual researchers and institutions to initiate problem-solving research that will impact on socio-economic development of the society.

ARPPIS needs to be in the forefront in the search for a place among the top institutions of research and development, and must prepare to benefit from the latest scientific developments and technologies that it has been involved in generating. Consequently, ARPPIS must ensure that its research and training remains relevant to the needs of scientific community and is aligned to regional and national needs targeted at economic improvement of the African people. Surely challenges will be met: Challenges that have to do with complex interactions between technological, social, economic and political issues; linguistic and ideological challenges; and cross-border operations and inter-regional operation. ARPPIS must keep abreast with the ever-changing academic and research environment and take its place among the top institutions and recognised training centres for scientific applications and technological innovations and advancement to meet these needs of Africa and the world, at the cutting edge of science.

# EXHIBIT 1

## **Communiqué of the Planning Conference on Establishing the Sub-Regional Centres for the Masters Degree in Insect Science in Africa**

We, the Vice-Chancellors, Rectors, Directors-General, Principals and representatives of various African universities, representatives of the Association of African Universities (AAU), the Network of Deans/ Coordinators/ Directors of Graduate Studies of Eastern and Southern African Universities (NDGS), the Agencies for International Cooperation, the International Centre of Insect Physiology and Ecology (*icipe*), and the Academic Board of the African Regional Postgraduate Programme in Insect Science (ARPPIS), meeting at Jomo Kenyatta University of Agriculture and Technology (JKUAT) from 5th–7th August 1991:

*Recognising* both the damage caused by insects as pests and disease vectors, and the positive role they play in ecosystems;

*Noting* that new strategies for integrated pest management, focusing on the use of environmentally safe and sustainable control methods for conserving biodiversity, depend on appropriate training and research;

*Acknowledging* the need for increasing and sustaining a critical mass of scientists through research and training at the Masters degree level in insect science in Africa;

*Observing* that, in spite of national efforts in postgraduate training, there remains a dire need for such manpower in insect science for the continent;

*Considering* that postgraduate training outside the African continent is expensive and contributes to brain-drain from the continent and, is often conducted in culturally, technologically and ecologically different environment;

*Realising* that resources for postgraduate training in African universities are scarce;

*Noting* the success of the existing ARPPIS PhD training programme;

Hereby *endorse* the proposal for the establishment of Sub-Regional Centres offering Masters Degree Programmes in Insect Science at selected universities.

*Agree* to cooperate through sharing of resources in establishing the Masters Degree in Insect Science in Africa as part of an ARPPIS network which consists of African universities and the *icipe*; it being fully understood that the proposed Degree Programme, is a programme of the host university, in collaboration with the participating institutions.

*Agree* and declare that in order to fulfil the objectives of this programme, the following are decided:

- The Masters Degree Programme in Insect Science in Africa be established in accordance with practices of the ARPPIS Academic Board over the last 9 years and be implemented within the regulations of the host university;
- The appointment of a Sub-Regional Coordinator for the programme be undertaken by the host university;
- The establishment of a Sub-regional Inter-University Consultative Group (IUCG) be established, with representation of each participating institution;
- The degree be awarded by the host university;
- The General Council to coordinate the enlarged ARPPIS Network to be established by the ARPPIS Academic Board in consultation with the IUCGs.

*Recognising* that the host university will commit substantial resources to the programme, we: *recommend* an active policy to raise additional funds solicited from sources within Africa and from Agencies for International Cooperation through the combined effort of all the participating institutions (host university, participating universities, ARPPIS and *icipe*); and finally, *endorse* the proposal to establish a Consortium of Donors to support the enlarged network of the African Regional Postgraduate Programme in Insect Science (ARPPIS), which includes the Sub-Regional Centres, the ICIPE Graduate School, and the coordinating mechanisms.

Juja, Kenya  
Wednesday, 7th August 1991.

# EXHIBIT 2

## The ARPPIS Annual Calendar

Dates	Activity
Mid January	Call for project titles from universities and <i>icipe</i> Programmes
1st week of February	First Meeting of the Board
15th February	Call for Concept Notes on the Thesis Research Proposals
1st week of March	Public announcement and call for fellowship applications
15th March	Deadline for submission of full thesis proposal Concept Notes
3rd week of March	Second Meeting of the Board
March–April	Committee meetings of the board to evaluate Concept Notes
30th April	Deadline for receiving Fellowship applications
3rd week of May	Third Meeting of the Board
1st June	Award of Fellowships to successful applicants
1st September	Reporting date for new ARPPIS class
	Deadline for receiving Annual Progress Reports from ARPPIS scholars
2nd week of September to end of October	Annual series of ARPPIS coursework
3rd week of September	Fourth Meeting of the Board
1st week of December	Presentation of thesis proposals by new scholars
2nd week of December	Fifth Meeting of the Board



# EXHIBIT 3

## Agreement on the African Regional Postgraduate Programme in Insect Science (ARPPIS)

### *Preamble*

WHEREAS the mandate of the International Centre of Insect Physiology and Ecology (hereinafter referred to as 'the *icipe*') is the development of suitable insect pest and vector management strategies for resource poor rural communities in tropical and subtropical developing countries; and to strengthen their scientific and technological capacity through graduate training and collaborative research;

WHEREAS the *icipe* has a team of international scientists, including those from developing countries; and has established a reputation for academic and research excellence in its area of operation;

WHEREAS the African universities are accredited and internationally recognised institutions of higher learning situated within Africa; and have the national mandate for a long-term commitment to human resources development through graduate and postgraduate training;

WHEREAS the African universities are desirous of enhancing the education and training of a young scientific leadership in insect science and pest and vector management for sustainable development, both at national and regional levels; and having the intellectual capacity to make a significant contribution towards the achievement of these objectives;

WHEREAS the research and other higher education institutions are willing to support the *icipe* and African universities towards the education and training of a young scientific leadership in insect science and pest and vector management for sustainable development both at national and regional levels;

WHEREAS the African Regional Postgraduate Programme in Insect Science (ARPPIS) is a collaborative training programme between the *icipe*, participating African universities in the field of postgraduate training in insect science and pest and vector management and non-universities; and is a new approach to training through an interactive scientific network designed to enhance the quality and cost-effectiveness of postgraduate education and training in these insect-related fields in the African region;

WHEREAS the *icipe* and the universities inspired by their common objectives and intent, and in accordance with the general terms of participation of African universities in ARPPIS agreed upon at the Bellagio Planning Conference in September 1981 and at Juja in 1991;

NOW, THEREFORE, the Vice Chancellors of the participating universities and the *icipe* cognisant of the significant role that ARPPIS has continued to play since inception in the training and development of African scientists in insect science, recognising the potential contribution of research and other higher education institutions towards the ARPPIS, and

cognisant of the need to establish a sustainable mechanism to support the ARPPIS hereby agree to participate in the ARPPIS network as collaborating partners under the Terms of collaboration in the following ARTICLES:

### **ARTICLE 1: Use of terms**

**"AAB"** shall mean the ARPPIS Academic Board established under Article 5 of this Agreement.

**"Agreement"** shall mean this Agreement on the ARPPIS.

**"ARPPIS"** shall mean the African Regional Postgraduate Programme in Insect Science.

**"CVC"** shall mean the Council of Vice Chancellors established under Article 3 of this Agreement.

**"icipe"** shall mean the International Centre of Insect Physiology and Ecology

**"Research and Higher Education Institution member"** shall mean a national or international institution engaging in agricultural, health and environmental research or in a related activity, including funding agencies.

**"University"** shall mean an institution of higher learning recognised as such by a national government and granted authority, powers and charters to offer undergraduate, graduate and postgraduate degrees regardless of whether the institution receives funding from public or private sources.

### **ARTICLE 2: Objectives**

The objective of the ARPPIS network shall be to carry out postgraduate training in insect science and pest and vector management; through an interactive scientific network designed to enhance the quality and cost-effectiveness of postgraduate education and training in these insect-related fields in the African region.

### **ARTICLE 3: Council of Vice Chancellors**

- (a) It is hereby established a Council of Vice Chancellors ("CVC") which shall be the highest decision-making organ of ARPPIS.
- (b) The CVC shall comprise all Vice Chancellors or Rectors or Presidents of all member universities of the ARPPIS and the Director General of *icipe*.
- (c) The Council of Vice Chancellors shall provide broad policy direction and framework and support to the ARPPIS network.
- (d) The CVC shall also be responsible for establishing, guiding, giving direction on sustainable funding of the ARPPIS network and its activities.
- (e) The CVC meet at least once a year.
- (f) The CVC shall on its first meeting make rules and regulations to the procedure of its meetings.

### **ARTICLE 4: ARPPIS Academic Board ("AAB")**

- (a) It is hereby established the AAB.
- (b) The AAB shall be the technical body to oversee the implementation of this Agreement as well as programmes of the ARPPIS.
- (c) The AAB shall from time to time consider applications from non-universities wishing to sign unto this agreement and recommend for their membership to the CVC.

- (d) The AAB shall comprise nominees of the Vice Chancellor or President or Rector of the universities and members of the *icipe* Board of Training and Postgraduate Studies. The nominees of the Vice Chancellor or President or Rector of the universities shall be individuals in charge of the universities' directorate of postgraduate training or, the deans of the faculties or schools of science, or the heads of the departments in charge of insect science and shall also act as focal point for the ARPPIS programme at the universities.
- (e) Where deemed necessary, the AAB shall incorporate nominees from non-university members of the ARPPIS network.
- (f) The AAB shall convene at least once a year.
- (g) The AAB may from time to time appoint committees to enable it effectively discharge its duties.
- (h) The ARPPIS Network Coordinator shall act as the Convenor of the AAB, coordinate its meetings and activities and facilitate the implementation of its decisions.

### **ARTICLE 5: ARPPIS Secretariat**

- (a) It is hereby established an ARPPIS Secretariat.
- (b) The ARPPIS Secretariat shall be based at the *icipe*.
- (c) The chief executive of the ARPPIS Secretariat shall be the ARPPIS Network Coordinator.
- (d) The Secretariat's function is to ensure proper coordination of the ARPPIS with a view to achieving its objectives.
- (e) The ARPPIS Secretariat shall also serve as the Secretariat of the CVC.

### **ARTICLE 6: Sub-regional Centres**

- (a) In order for the ARPPIS to effectively meet its objectives the CVC on the recommendation of the AAB shall appoint and or designate selected member universities from time to time as Sub-regional Centres offering Masters Degree Programmes in insect science taking into account the already existing Sub-regional Centres established pursuant to the Juja Declaration.
- (b) The Sub-regional Centres so designated shall as much as possible be distributed geographically equitably within Africa.
- (c) Each member university shall upon executing the instrument of signature of this Agreement be informed by the ARPPIS Secretariat of the Sub-regional Centre that the university shall identify itself with for purposes of training of ARPPIS Master Degree Programmes in insect science.
- (d) The functions of the sub-regional centres shall be to carry out the mandate as outlined in the Juja Declaration.
- (e) The ARPPIS Secretariat may from time to time delegate its coordination functions to the Sub-regional Centres insofar as the administration of Masters Degree programmes in insect science is concerned.

### **ARTICLE 7: Undertakings**

1. Sponsorship and Registration of Candidates for Staff Development
  - (a) That the universities shall screen candidates, both from the universities as well as from the national programmes of the country, to the ARPPIS;



- (b) That the Universities shall register candidates for their degrees under the ARPPIS programme; that such candidates shall register through the specified procedure of particular universities;
- (c) That from time to time, candidates registered at the University under the ARPPIS programme, having satisfied the tuition requirements of the University, shall receive research training at *icipe*, the University or other research and higher education institution.

## 2. Faculty Appointment and Recognition

- (a) That selected staff from the University shall be appointed as Visiting Scientists to the *icipe* or research and higher education institution and to the ARPPIS for purposes of lecturing, student research supervision or collaborative research projects.
- (b) That selected scientific staff from the *icipe* or research and higher education institution shall be appointed to honorary academic positions in the University according to the University's procedures.
- (c) That any member of one institution who is on honorary appointment to the other institution will be treated under the same academic, administrative and financial regulations of the host institution.

## 3. Understanding on Cost-Sharing

- (a) That in the spirit of collaboration, and in view of the need to keep programme costs within training fellowship levels, the *icipe* and the University shall cooperate in minimising the costs of training in ARPPIS;
- (b) That the *icipe* shall directly meet the costs incurred by it in implementing the programme; that such costs would include:
  - (i) student research and computer costs including fieldwork;
  - (ii) thesis preparation costs;
  - (iii) research supervision fees;
  - (iv) student book allowance and stationery expenses;
  - (v) student stipend, medical and living allowances; and
  - (vi) programme administration.
- (c) Further, that the University shall not charge the *icipe* fees equivalent or similar to the same costs already incurred directly by the *icipe* in respect of ARPPIS candidates registered with the University.
- (d) That the *icipe* shall pay university fees in respect of
  - (vii) registration fees
  - (viii) tuition; and
  - (ix) thesis examination fees.

However, where the student is a member of faculty of the university and is on staff development training, the University shall waive all fees except for registration and thesis examination.

- (e) That subject to the provisions of the fellowship, scholarship or grant the *icipe* shall pay for transport to and fro (by air, land or sea) and subsistence allowance, for university supervisors visiting ARPPIS, and for ARPPIS students visiting the university for seminars and thesis defence; and that the university shall when and where available, provide the student with hostel/guest house accommodation at reduced cost.

- (f) That the University shall fully sponsor the participation of the Vice-Chancellor's nominee at the AAB meetings held annually, at any venue declared by the AAB.

### ***ARTICLE 8: Rules governing ARPPIS Scholars***

A scholar under ARPPIS shall be subject to the rules and regulations of the university where he or she is registered for a degree as well as the rules and regulations of the institution where he or she is conducting research.

### ***ARTICLE 9: Intellectual Property***

- (a) A member university or research and higher education institution member is hereby required to enact an institutional intellectual property policy.
- (b) The ARPPIS Secretariat where called upon, shall provide technical assistance to the member university or research and higher education institution member to enable it enact institutional intellectual property policies.
- (c) The intellectual property policy and laws that shall govern a scholar's work shall be those of the university where the scholar is registered and the country the university is situated and of the institution where the scholar is conducting research and the country the institution is situated.
- (d) The intellectual property in a scholar's work may also be subject to conditions that may be attached to the donor or funder of the scholar's work.
- (e) Prior to registration of an ARPPIS scholar at a university, intellectual property rules that will govern the scholar's work and research shall be discussed and agreed on between the scholar, the university and the institution where the scholar will receive research training.

### ***ARTICLE 10: Technical and Scientific Collaboration***

The parties are free to enter into agreements and understandings on collaboration on technical and scientific activities beyond the scope of this agreement. However, such further agreements or understandings shall be the subject of arrangements separate and distinct from this Agreement.

### ***ARTICLE 11: Settlement of Disputes***

- (a) The parties shall endeavour to interpret this Agreement on the ARPPIS in a mutually supportive manner.
- (b) Where disputes occur, the parties shall resort to methods of conciliation and mediation and should this fail, by arbitration.

### ***ARTICLE 12: Amendments to the Agreement***

The Parties may, from time to time by mutual consent amend, modify, add to or delete any sections, phrases or words in this Agreement.

### ***ARTICLE 13: Entry into force***

This Agreement shall enter into force immediately upon the ARPPIS Secretariat receiving instruments of signature from 10 Parties.

### **ARTICLE 14: Signature**

- (a) Signature of this Agreement by the eligible Parties shall be by the Party intending to sign this Agreement depositing an instrument of signature with the ARPPIS Secretariat in the form attached in the Schedule to this Agreement.
- (b) Upon receipt of an instrument of signature from an eligible Party, the ARPPIS Secretariat shall inform in writing, all the other Parties that shall have previously signed this Agreement.

### **ARTICLE 15: Repeal of Previous Agreement**

Upon entry into force of this Agreement all other previous agreements between *icipe* and any of the Parties for collaborative participation on the ARPPIS shall be deemed to be repealed.

### **ARTICLE 16: Withdrawals**

- (a) At any time after one year has lapsed from the date on which this Agreement has entered into force, a Party may withdraw by giving written notice to the other party through the ARPPIS Secretariat.
- (b) Any such withdrawal shall take effect upon expiry of one year after the date of its receipt by the ARPPIS Secretariat.

### **ARTICLE 17: Authentic Texts**

The original of this Agreement, of which the English, French, Arabic and Portuguese texts are equally authentic, shall be deposited with the ARPPIS Secretariat.

#### **Instrument of Signature**

[To be signed by the Vice Chancellor, President or Rector of University, Director General of *icipe* or the executive head of a research and higher education institution]

### **Signature**

WHEREAS the Agreement on the African Regional Postgraduate Programme in Insect Science was concluded at [place] on [date], NOW THEREFORE, I, [name and title of the Vice Chancellor, President or Rector of University, Director General of *icipe* or the executive head of a research and higher education institution] declare that the [name of institution], having considered the above mentioned agreement accedes to the same and undertakes faithfully to perform and carry out the stipulations therein contained.

IN WITNESS WHEREOF, I have signed this instrument of signature at [place] on [date]

[Signature].....

In the presence of [witness].....

# EXHIBIT 4

## List of ARPPIS Participating Universities in Order of Date of Signing Revised Memorandum of Agreement

SN	Name of university	Region	Year of admission	Date of signing new MoU	Name(s) of participating department (s)	Name(s) of representative(s) in ARPPIS Academic Board
1	University of Ibadan	West Africa	1996	February 1996	Crop Protection and Environmental Biology	Prof. A. Odebiyi
2	University of Pretoria	Southern Africa	1996	February 1996	Zoology and Entomology	Prof. C. Scholtz
3	University of Malawi	Southern Africa	1996	April 1996	Biology	Dr V. W. Saka, Meya P. Kalindekafe, Dylo Pemba
4	Moi University	East and North-Eastern Africa	1996	April 1996	Zoology	Prof. ole Karei, Prof. W. Wanjala
5	University of Zimbabwe	Southern Africa	1996	May 1996	Biological Sciences	Dr B. N. Dube, Dr A. Mtambara-Mabveni, Dr Peter Chinwada
6	Assiut University	North Africa	1996	May 1996	Zoology	Dr S. H. Ismail
7	Nnamdi Azikiwe University	West Africa	1996	June 1996	Applied Entomology	Prof. R. I. Egwatu
8	University of Khartoum	East and North-Eastern Africa	1996	June 1996	Crop Protection	Prof. I. El Khidir
9	Enugu State University	West Africa	1996	June 1996	Biotech and Pest Management Centre	Dr E. D. M. Umeh
10	University of Ghana, Legon	West Africa	1996	August 1996	Crop Science	Prof. K. Afreh-Nuamah
11	Kenyatta University	East and North-Eastern Africa	1996	September 1996	Zoology	Dr Eunice Kairu, Dr Sammy Kubasu, Prof. Jones Mueke
12	Rivers State University of Science and Technology	West Africa	1996	September 1996	Biological Sciences	Prof. B. A. Okwakpam
13	Ahmadu Bello University	West Africa	1996	September 1996	Parasitology and Entomology	Prof. Rowland I. S. Agbede
14	Ogun State University	West Africa	1996	November 1996	Biological Sciences	Dr V.A. Awoderu
15	Jomo Kenyatta University of Agriculture and Technology	East and North-Eastern Africa	1997	May 1997	Zoology	Dr Hellen Kutima
16	Haramaya University	East and North-Eastern Africa	1997	May 1997	Plant Science	Dr Mengistu Hulluku, Dr Tadele Tefera
17	University of Nairobi	East and North-Eastern Africa	1997	June 1997	Zoology	Dr Richard Mukabana, Prof. Pokariyal, Dr Billy Ogana
18	University of Cape Coast	West Africa	1997	June 1997	Entomology and Wildlife	Dr Mary Botchey
19	University of Zambia	Southern Africa	1997	July 1997	Dir Research and GS	Prof. A. A. Siwela, Dr Zulu
20	University of Gezira	North Africa	1997	July 1997	Zoology	Prof. I. Khidir

SN	Name of university	Region	Year of admission	Date of signing new MoU	Name(s) of participating department (s)	Name(s) of representative(s) in ARPPIS Academic Board
21	Egerton University	East and North-Eastern Africa	1997	July 1997	Zoology	Prof. Moses K. Limo
22	University of Dschang	Central Africa	1998	March 1998	Zoology	Dr M. R. Mohmoud
23	Addis Ababa University	East and North-Eastern Africa	1998	April 1998	Biology	Dr Kifle Dagne, Dr Dawit Abate
24	Sokoine University of Agriculture	East and North-Eastern Africa	1999	June 1999	Zoology	Prof. B. S. Kilonzo, Prof. Robert Machangú
25	Makerere University	East and North-Eastern Africa	1999	September 1999	Zoology	Prof. John Kaddu
26	The National University of Rwanda	East and North-Eastern Africa	1999	November 1999	Agriculture	Prof. Dan Rukazambuga
27	Maseno University	East and North-Eastern Africa	2005	March 2005	Zoology	Prof. Dominic Makawili
28	North-West University	Southern Africa	2005	September 2005	School of Environmental Sciences and Development	Prof. Johnnie van den Berg
29	Gulu University	East and North-Eastern Africa	2005	September 2005	Faculty of Science	Prof. Nyeko Pen-Mogi
30	University of Namibia	Southern Africa	2005	November 2005	Biology	Prof. Godwin Kaaya
31	University of Mauritius	Southern Africa	2005	April 2006	Biosciences	Prof. Daneshwar Puchooa
32	University of Lome	West Africa	2006	June 2006	Agriculture	Prof. Yawovi M. D. Gumedzoe
33	University of Dar es Salaam	East and North-Eastern Africa	2007	March 2007	Chemistry	Prof. Mayunga H. H. Nkunya
34	University of Bukavu	Central Africa	2008	March 2008	Biology	Dr Jean-Berckmans Muhigwa
35	Michael Okpara University of Agriculture	West Africa	2008	September 2008	Not specified	Not specified

# EXHIBIT 5

## ARPPIS Doctoral Training Database (1983–2008)

SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
1	Richard Bagine	Kenya	UNEP/SIR	M	1983	Biosystematic studies of the termite genus <i>Odontotermes</i> with special reference to Kenya	Environmental Health	Makerere University	1986	Research Scientist, NMK
2	Wadeda Forawi	Sudan	DAAD	M	1983	Studies on leishmaniae of lizards	Human Health	University of Khartoum	1989	Programme Manager, Friedrick Ebert Stiftung, Khartoum, Sudan
3	Samuel Kyamanywa	Uganda	DAAD	M	1983	Ecological factors governing insect pest populations in maize and cowpea crop mixtures with special reference to the bean flower thrips <i>Megalurothrips sjostedii</i>	Plant Health	Makerere University	1989	Professor and Dean, Faculty of Agriculture, Makerere University, Uganda
4	Abdel Latif	Sudan	DAAD	M	1983	Host relationships of the ticks <i>Amblyomma variegatum</i> in cattle and rabbits	Animal Health	University of Khartoum	1986	Senior Lecturer, University of Pretoria, RSA
5	Barnabas C. Njau	Tanzania	icipe	M	1983	Studies of the resistance acquired by rabbits experimentally infested with <i>Rhipicephalus evertsi</i>	Animal Health	University of Dar es Salaam	1987	Senior Lecturer, University of Dar es Salaam, Tanzania
6	John H. Pen-Mogi Nyeko	Uganda	DAAD	M	1983	The influence of mode of transmission of <i>Trypanosoma congolense</i> on the stability and induction of resistance to Samorin	Animal Health	Makerere University	1987	Vice Chancellor Gulu University, Uganda
7	Suleman H. Okech	Kenya	SIR	M	1983	Colonising responses in <i>Maruca testulalis</i> to different cowpea cultivars in relation to their resistance or susceptibility	Plant Health	Rivers State University of Science and Technology	1987	University Registrar, JKUAT, Kenya
8	J.B. Okeyo-Owuor	Kenya	icipe/IFAD	M	1983	Population ecology of the legume pod borer <i>Maruca testulalis</i> in relation to its natural enemies on cowpea in western Kenya	Plant Health	University of Dar es Salaam	1988	Associate Professor and Dept. Head, Environmental Studies, Moi University, Kenya
9	Delfina Gomez Adabie	Ghana	SIR	F	1984	Pupal ecology and the role of predators and parasitoids in natural population regulation of <i>Glossina pallidipes</i> at Nguruman, Kenya	Animal Health	University of Ghana	1989	Director, BNRI, Ghana
10	John Bahana	Uganda	DAAD	M	1984	Bioecological studies on <i>Dentichasmias busseolae</i> (Hymenoptera: Ichneumonidae) the parasitoid of <i>Chilo partellus</i> and its potential for biological control	Plant Health	Makerere University	1990	Consultant, Kampala, Uganda
11	U.M. El Neima	Sudan	FF/icipe	F	1984	Characterisation of different parasitism in tick resistant strains of <i>Trypanosoma congolense</i> collected from the Lambwe Valley western Kenya and Nguruman area, Maasailand, Kenya	Animal Health	University of Khartoum	1989	Research Officer, Ministry of Agriculture, Khartoum, Sudan

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SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
12	Leonard M. Kantiki	Malawi	EEC	M	1984	Studies of some aspects of the biology and feeding behaviour of <i>Eldana saccharina</i> Walker (Lepidoptera: Pyralidae) on one maize and one sorghum cultivar	Plant Health	University of Malawi	1987	Deceased
13	Charles Maranga	Kenya	icipe	M	1984	Studies on <i>Rhipicephalus appendiculatus</i> Neumann immunity in goats	Animal Health	Kenyatta University	1989	Director General, International Focus on Environment, Nairobi, Kenya
14	John Nderitu	Kenya	USAID	M	1984	Responses of the common bean ( <i>Phaseolus vulgaris</i> ) cultivars to beanflies (Diptera: Agromyzidae)	Plant Health	Kenyatta University	1990	Senior Lecturer Department of Plant Science, University of Nairobi
15	M. Ogenga-Latigo	Uganda	FF	M	1984	The influence of some cultural practices and aphid natural enemies on the infestation of the common bean ( <i>Phaseolus vulgaris</i> ) by the bean aphid ( <i>Aphis fabae</i> )	Plant Health	Makerere University	1990	MP and Leader of Opposition, Parliament Uganda
16	John F. Omollo	Kenya	SIR	M	1984	The biology and host parasite relationships of an entomogenous nematode, <i>Panagrolaimus</i> sp.	Plant Health	Kenyatta University	1991	Deceased
17	I.G. Aniedu	Nigeria	SIR/OAU	M	1985	Ecology of malaria vectors in relation to an irrigation scheme in Baringo District, Kenya	Human Health	Rivers State University of Science and Technology	1989	Deceased
18	Mulenda Basimike	DRC	DAAD	M	1985	Studies on the factors affecting the distribution and abundance of phlebotomine sandflies in a leishmaniasis endemic focus in Baringo District, Kenya	Human Health	Rivers State University of Science and Technology	1989	Senior Lecturer, Kenyatta University, Nairobi
19	Charles Kyorku	Ghana	DAAD	M	1985	Trapping studies on <i>Glossina longipennis</i> Cortie at Nguruman, South Western Kenya	Animal Health	University of Ghana, Legon	1990	Lecturer, Biological Sciences, University of Developmental Studies, Tamale, Ghana
20	Getachew Tikubet	Ethiopia	ILCA/OAU	M	1985	The ecology of <i>Glossina</i> spp. and trypanosomiasis challenge in South Western Ethiopia	Animal Health	University of Sierra Leone	1996	Research Scientist, icipe, Addis Ababa, Ethiopia
21	Bob Wishitemi	Kenya	UNDP/icipe	M	1985	Induction of immunity in sheep to <i>Rhipicephalus appendiculatus</i> Neumann antigens	Animal Health	Kenyatta University	1989	Deputy Vice Chancellor (Research and Extension), Moi University, Eldoret, Kenya
22	Baldwyn Torto	Ghana	DAAD	M	1985	Allelochemicals from <i>Sorghum bicolor</i> that stimulate feeding by larvae of the stemborer <i>Chilo partellus</i>	Plant Health	University of Ghana	1988	Principal Scientist, icipe, Nairobi
23	Macharia Gethi	Kenya	DAAD	M	1986	The effect of intercropping resistant and susceptible cowpea cultivars with maize, and time of planting on infestation and damage by the legume pod borer, <i>Maruca testulalis</i>	Plant Health	Kenyatta University	1992	Director, KARI-Embu Regional Research Centre, Kenya
24	Eldad Karamura	Uganda	IITA/ABCP	M	1986	Studies on the orientation, feeding behaviour and development of the cassava green spider mite <i>Mononychellus tanajoa</i> (Acari: Tetranychidae)	Plant Health	Makerere University	1991	Regional Coordinator, INIBAP IPGRI, Kampala, Uganda

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SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
25	Munene wa Macharia	Kenya	DAAD	M	1986	Crop losses in maize caused by the maize stem borer <i>Busseola fusca</i> Fuller (Lepidoptera: Noctuidae) in the Rift Valley, Kenya	Plant Health	Moi University	1990	Senior Research Officer, KARI- Njoro, Kenya
26	Eliaineny M. Minja	Tanzania	DAAD	F	1986	Studies on the effect of intercropping sorghum and cowpea on the population pattern of the stemborer complex	Plant Health	University of Dar es Salaam	1990	Consultant, Integrated Pest Management Arusha, Tanzania
27	Peter K. Muange	Kenya	SIR	M	1986	Factors affecting the pupal distribution and mortality in a natural population of <i>Glossina</i>	Animal Health	University of Sierra Leone	1992	Deputy Head, Dept of Zoology, Moi University, Eldoret, Kenya
28	Florence M. Ndonga	Kenya	IITA	F	1986	Population dynamics of the cassava green spider mite <i>Mononychellus tanajoa</i> in relation to its natural enemies	Plant Health	Kenyatta University	1994	Head, Entomology Department, Maseno University, Maseno, Kenya
29	Marcellian A. Njau	Tanzania	DAAD	M	1986	Endocrinology of development and reproduction in maize stem borer <i>Busseola fusca</i> Fuller (Lepidoptera: Noctuidae)	Plant Health	University of Dar es Salaam	1990	Lecturer, University of Dar es Salaam, Tanzania
30	John O. Davies-Cole	Sierra Leone	DAAD	M	1987	Some aspects of the maturing behaviour of <i>Glossina morsitans morsitans</i> Westwood and <i>Glossina pallidipes</i>	Animal Health	University of Sierra Leone	1992	Consultant, USA
31	Hassane Mahamat	Chad	DAAD	M	1987	The biochemical taxonomy of phlebotomine sandflies (Diptera: Psychodidae) in Kenya	Human Health	University of Sierra Leone	1992	Monitoring and Evaluation Expert, PATTEC Coordination Office
32	Samuel K. Mbogo	Kenya	RF	M	1987	Induction of resistance to ticks by the immunisation of their hosts with the commercially available moulting hormone, and other ticks antigens	Animal Health	University of Sierra Leone	–	Research Officer, KARI, NVRC, Muguga, Kenya
33	Thomas N. Murega	Kenya	IITA/ ABCP	M	1987	Genetic incompatibilities among populations of the cassava green spider mite complex <i>Mononychellus</i> spp. (Acarina: Tetranychidae) and their implications for the taxonomy of the mite	Plant Health	Rivers State University of Science and Technology	1990	Deceased
34	Mwangelwa I. Mwangelwa	Zambia	FF	M	1987	The ecology and vectorial capacity of <i>Glossina fuscipes fuscipes</i> on Rusinga Island and along the shores of Lake Victoria	Animal Health	University of Zambia	1992	Director (Operations), Zambezi Livestock and Lands Ltd, Mongu, Zambia
35	Esther N. Mwangi	Kenya	FF	F	1987	The ecology of non-parasitic stages of <i>Rhipicephalus appendiculatus</i> and other ticks of livestock and the role of predators, parasites, pathogens and climatic factors in the regulation of natural populations	Animal Health	Kenyatta University	1991	Consultant, Nairobi, Kenya
36	James Ogwang	Uganda	IITA/ ABCP	M	1987	The survival of <i>Nosema</i> sp. under field conditions and its effects on the reproductive potential of <i>Chilo partellus</i>	Plant Health	Rivers State University of Science & Technology	1990	Head, Biological Control Unit, NARO, Namulonge, Uganda
37	Hezron Oranga	Kenya	icipe	M	1987	Stochastic modelling of the impact of tick infestation on cattle productivity under natural field conditions on Rusinga Island	Animal Health	Moi University	1996	Deceased

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SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
38	Mukolo Taguma Chumwa	Zambia	FF/PEW	F	1988	Contribution and inheritance of the major components of resistance in certain maize cultivars to stemborer <i>Chilo partellus</i>	Plant Health	Kenyatta University	1993	Research Officer, Mt. Makulu Research Station, Zambia
39	S.M. Kheir	Sudan	DAAD	M	1988	Mechanism of cutaneous reactions in cattle infested with <i>Rhipicephalus appendiculatus</i>	Animal Health	University of Khartoum	1992	Head, Entomology Department, Animal Resources Research Corporation Khartoum, Sudan
40	Charles Mugoya	Uganda	DAAD	M	1988	The feeding behaviour of <i>Maruca testulalis</i> larvae on cowpea ( <i>Vigna unguiculata</i> )	Plant Health	Rivers State University of Science and Technology	1992	Programme Manager, Biotechnology, ASARECA, Entebbe, Uganda
41	Angus Onyido	Nigeria	DAAD	M	1988	The ecology of <i>Sergentomyia gamhiani</i> : A vector of leishmaniasis in Kenya	Human Health	Rivers State University of Science and Technology	1992	Research Officer, Federal Ministry of Health, National Arbovirus and Vectors Research Branch, Enugu, Nigeria
42	Beth A. Rapuoda	Kenya	FF	F	1988	Ecological and behavioural studies of mosquito species in the Mwea Irrigation Scheme, with special emphasis on <i>Anopheles arabiensis</i>	Human Health	Kenyatta University	1996	Research Officer, KEMRI, Kisumu
43	I. Abu Zinid	Sudan	icipe	M	1988	Predation of tsetse in the vicinity of traps used for the control of <i>Glossina pallidipes</i> Austen	Animal Health	University of Khartoum	1992	Programme Officer, CARE International, Nairobi, Kenya
44	E. El Badawi	Sudan	DAAD	M	1989	Inheritance and combining ability of resistance to sorghum shootfly <i>Atherigona soccata</i> , and spotted stemborer, <i>Chilo partellus</i> , in sorghum	Plant Health	University of Khartoum	1993	Research Scientist, ARC, Wad Medani, Sudan
45	Dorcas S. Bawo	Nigeria	DAAD	F	1989	The role of sensory receptors in mating and oviposition behaviour of <i>Maruca testulalis</i> (Geyer)	Plant Health	Rivers State University of Science and Technology	1993	Lecturer, Rivers State University of Science and Technology, Port Harcourt, Nigeria
46	Rosetta Bob-Manuel	Nigeria	DAAD	F	1989	Effect of an entomopathogenic fungus, <i>Hirsutella thompsonii</i> Fisher (Fungi Imperfecti), on dynamics and control of cassava green mite (CGM) <i>Mononychellus tanajoa</i> (Bondar) (Acari: Tetranychidae)	Plant Health	Rivers State University of Science and Technology	1993	Lecturer, Biology Department, Rivers State College of Education, Port Harcourt, Nigeria
47	Francis Nwilene	Nigeria	DSO/PEW	M	1989	Population density and dispersal pattern of green spider mite <i>Mononychellus tanajoa</i> , with special reference to the potential of the predatory mite, <i>Iphiseius degenerans</i> , as biological control agent	Plant Health	Rivers State University of Science and Technology	1993	WARDA Liaison Scientist/Principal Scientist, Africa Rice Centre (WARDA)
48	Alliy Saidi Singano Mbwana	Tanzania	BMZ	M	1989	Investigation of the host range, survival control of <i>Pratylenchus goodeyi</i> (Sher & Allan) on banana	Plant Health	Kenyatta University	-	Officer-in-charge and National Banana Research Coordinator, Agricultural Research Institute Maruku, Bukoba, Tanzania
49	A. Nur Duale	Somalia	PEW	M	1989	Biology of <i>Pediobius furvus</i> and its biological potential against cereal stemborers	Plant Health	Rivers State University of Science and Technology	1993	Resides in Australia, occupation unknown

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SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
50	Henry K. Kiara	Kenya	DAAD	M	1989	Membrane bound proteins of the midgut of <i>Amblyomma variegatum</i> Fabricius, 1794 (Acarina: Ixodidae) proteins responsible for induction of immune protection of the host against infestation of homologous and heterologous species	Animal Health	Rivers State University of Science and Technology	1994	Research Officer 1, KARI, VRC - Kabete, Nairobi, Kenya
51	Boaz E.M.A. Uronu	Tanzania	BMZ	M	1989	The effect of plant resistance and cultural practices on population densities of banana weevil <i>Cosmopolites sordidus</i> (Germar) and on banana yield	Plant Health	Kenyatta University	1993	Senior Research Officer, TPRI, Arusha, Tanzania
52	Kenneth Kambona Oyugi	Kenya	DSO	M	1990	Physiological aspects and biocontrol of <i>Beauveria bassiana</i> (Deuteromycetes: Fungi Imperfecti) on the desert locust, <i>Schistocerca gregaria</i> (Orthoptera: Acrididae)	Animal Health	Moi University	1996	Regional Agricultural and Policy Advisor, USAID, Nairobi, Kenya
53	Dorington O. Ogoyi	Kenya	DAAD	M	1990	Changes in lipophorin structure and function during phase transition in <i>Schistocerca gregaria</i> (Forsk.) (Orthoptera: Acrididae)	Animal Health	University of Nairobi	1996	Lecturer, University of Nairobi, Kenya
54	Eucharia U. Kenya	Nigeria	icipe	F	1990	Mechanisms for selective toxicity of newly isolated strains of <i>Bacillus thuringiensis</i> (Berliner)	Plant Health	Rivers State University of Science and Technology	1995	Chairman, Department of Biochemistry, Kenyatta University
55	Audrey R. Mabveni	Zimbabwe	UNESCO/ DSO	F	1990	Characteristics and comparison of cellular and humoral immune responses of cereal stem borers and legume pod borers to some bacterial infections	Plant Health	University of Zimbabwe	2001	Private Industry
56	Richard Z.Uzakah	Nigeria	NORAD	M	1990	Reproductive biology, behaviour and pheromones of the banana weevil, <i>Cosmopolites sordidus</i> Germar (Coleoptera: Curculionidae)	Plant Health	University of Ibadan	1994	Agriculture Manager, Shell Oil, Port Harcourt, Nigeria
57	Sylvain Coffi Dossa	Benin	DAAD	M	1990	Studies of the effects of parasitism in tick resistant cattle using <i>Amblyomma variegatum</i>	Animal Health	University of Ghana	1990	Scientist, Institut National des Recherches Agricoles du Benin, Cotonou, Benin
58	Solomon Gebre	Ethiopia	DAAD	M	1990	Studies on the role of natural resistance in stabilising tick population in Ethiopia	Animal Health	University of Addis Ababa	1993	Team Leader, Immunology and Microbiology, National Animal Health Research Centre, Ethiopia
59	Samuel K. Meresa	Ethiopia	DAAD	M	1990	Some aspects of the ecology and vectorial capacity of <i>Glossina tachinoides</i> Westwood (Diptera: Glossinidae) in South Western Ethiopia	Animal Health	University of Addis Ababa	1995	Head, NTTIC, Ministry of Agriculture, Ethiopia
60	Muhinda Mugunga	DRC	DSO	M	1990	Effect of plant diet on selected aspects of biology and parasites infectivity of phlebotomine sandflies	Human Health	Rivers State University of Science and Technology	1994	Lecturer, National University of Rwanda, Butare, Rwanda
61	Joseph Kayitare	Rwanda	icipe	M	1990	Infestation by the beanfly <i>Ophiomyia</i> spp. (Diptera: Agromyzidae) on <i>Phaseolus vulgaris</i> and its control with cultural practices	Plant Health	University of Ghana	1993	Deceased

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SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
62	Mohammed Ahmed Salim	Sudan	icipe	M	1990	Transovariable transmission and reproductive parameters in the desert locust, <i>Schistocerca gregaria</i> (Orthoptera: Acrididae) infected with a protozoa <i>Malamoeba locustae</i>	Plant Health	University of Khartoum	1994	Lecturer, University of Khartoum
63	Elizabeth O. Oladimeji	Nigeria		F	1990	Was discontinued on failing coursework				
64	Leonard O. Nwoke	Nigeria	DAAD	M	1990	Odour attractants for tropical mosquitoes	Human Health	University of Ibadan	1994	Private business
65	Dona Dakouo	Burkina Faso	DAAD	M	1990	Haemocytic response in the desert locust <i>Schistocerca gregaria</i> (Forsk.) (Orthoptera: Acrididae) infected by the protozoa <i>Malamoeba locustae</i> (King & Taylor) (Protozoa: Amoebidae)	Plant Health	University of Abidjan	1995	Senior Scientist, Institut d'etudes et de Recherches Agricole (INERA) Station de Farako-ba, Bobo-Dioulasso, Burkina Faso
66	Bekele Jembere Adgeh	Ethiopia	DAAD	M	1991	Effects of use of some <i>Ocimum</i> plant species and their essential oils on some storage insect pests	Plant Health	University of Nairobi	1996	Senior Lecturer, Biology Department, Addis Ababa University
67	Samuel Idrissa Kamara	Sierra Leone	DAAD	M	1991	Effect of host semiochemicals on the behaviour of <i>Maruca testulalis</i> (Geyer) (Lepidoptera: Pyralidae)	Plant Health	University of Sierra Leone	1994	Research Officer, Rice Research Station Freetown, Sierra Leone
68	Susan W. Kimani-Njogu	Kenya	DSO	F	1991	Morphological and biochemical systematics of the <i>Cotesia</i> parasitoid complex (Hym. Braconidae)	Plant Health	University of Nairobi	1995	Research Scientist, National Museums of Kenya, Nairobi
69	Jedidah Kongoro	Kenya	UNDP	F	1991	Susceptibility of tsetse ( <i>Glossina</i> spp.) to trypanosome infection in relation to midgut trypsin-like enzymes and other molecules	Animal Health	Kenyatta University	1998	Lecturer, Kenyatta University, Nairobi, Kenya
70	Sika Kutua	DRC	UNDP	M	1991	Behavioural responses of <i>Rhipicephalus appendiculatus</i> Neuman 1901 to host and non-host semiochemicals	Animal Health	Kenyatta University	1997	Deceased
71	Jacob C. Mbapila	Tanzania	DSO	M	1991	Comparative seasonal adaptation of <i>Cotesia flavipes</i> (Hymenoptera: Braconidae) to <i>Chilo partellus</i> (Lepidoptera: Pyralidae) on the Kenyan coast	Plant Health	University of Dar es Salaam	1997	Deceased
72	Githiri S. Mwangi	Kenya	DAAD	M	1991	Inheritance and linkage studies with isoenzymes and morphological characters in aphid resistant/susceptible cowpea cultivars	Plant Health	University of Nairobi	1995	Senior Lecturer, Dept. of Crop Science, University of Nairobi, Nairobi, Kenya
73	Adele Ngi-Song	Cameroon	DAAD	F	1991	Chemical ecology of host finding behaviour in <i>Cotesia flavipes</i> (Cameron) and <i>Cotesia sesamiae</i> (Cameron)	Plant Health	University of Ghana	1997	Consortium National de Formation en Sante (CNFS), Ottawa, Canada
74	Edward O. Omollo	Kenya	DSO	M	1991	Cloning and sequence analysis of the genes that encode the delta endotoxin of novel <i>Bacillus thuringiensis</i> strains, effective against tsetse flies ( <i>Glossina morsitans morsitans</i> ) and army worms ( <i>Spodoptera exempta</i> )	Animal Health	University of Nairobi	1997	Lecturer, Ohio State College

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SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
75	Emil Rwekika	Tanzania	NORAD	M	1991	Feeding allelochemicals for the banana weevil, <i>Cosmopolites sordidus</i> Gemar	Plant Health	University of Nairobi	1999	Lecturer, University of Dar es Salaam
76	Joseph Magyembe-Mwesigwa	Uganda	BMZ	M	1992	Interaction effects of banana weevil <i>Cosmopolites sordidus</i> Gemar and nematodes in bananas	Plant Health	Makerere University	1999	Research Officer, Ministry of Agriculture, Uganda
77	Joseph Alfred Sumani	Zambia	DSO	M	1992	Biology of the banana weevil on rhizomes or different banana varieties and types and also mechanisms of resistance	Plant Health	University of Zambia	1998	Research Officer, Luapula Regional Research Station, Mansa, Zambia
78	Charles J.H. Mutinda	Kenya	UNDP/DAAD	M	1992	Genetic variability and responses to selection for <i>Chilo partellus</i> (Swinhoe) resistance in a maize ( <i>Zea mays</i> L.) population	Plant Health	University of Nairobi	1997	Research Scientist, KARI, NARC-Muguga, Nairobi
79	Habte Tekie	Ethiopia	DSO	M	1992	Biological effects of neem seed derivatives on the management of maize stalk borer <i>Busseola fusca</i> (Fuller) in pest management	Plant Health	University of Addis Ababa	1999	Lecturer, Addis Ababa University
80	Sekouba Bengaly	Mali	DSO	M	1992	Cellular and humoral immune responses of the tropical bont tick <i>Amblyomma variegatum</i> F. and brown ear tick <i>Rhipicephalus appendiculatus</i> (Ixodidae: Acari) to pathogens	Animal Health	Ahmadu Bello University	1996	Research Officer, Vet Labs, Bamako, Mali
81	Freddie Masaninga	Zambia	EU	M	1992	Adaptation of <i>Trypanosoma congolense</i> types to different hosts and transmission by <i>Glossina</i> species	Animal Health	University of Zambia	1997	Scientific Officer, Tropical Diseases Research Centre (TDRC), University of Zambia
82	Ibrahim S.T. Jalloh	Sierra Leone	DAAD	M	1992	Pheromone and plant odour perception in <i>Busseola fusca</i>	Plant Health	Rivers State University of Science and Technology	1998	Research Officer, Ministry of Agriculture Natural Resources & Forestry, Sierra Leone
83	Yousif O.H. Assad	Sudan	icipe	M	1992	The role of host plants in maturation of the desert locust <i>Schistocerca gregaria</i> (Forsk.) (Orthoptera: Acrididae)	Plant Health	University of Gezira	1995	Assistant Professor, University of Gezira, Wad Medani, Sudan
84	Arop Leek Deng	Sudan	IFAD	M	1992	Studies on the factors that influence phase dynamics of the desert locust <i>Schistocerca gregaria</i> (Forsk.)	Environmental Health	University of Khartoum	1996	Lecturer, Egerton University, Njoro, Kenya
85	Mohamed Ali Bob Mohamed	Sudan	DAAD	M	1992	Influence of additives and ultra violet protectants on <i>Bacillus thuringiensis</i> for control of <i>Chilo partellus</i> infesting some sorghum cultivars	Plant Health	University of Gezira	1995	Manager, Plant Protection Dept. Al-Khalidiah Agricultural Co. Ltd. Riyadh, Saudi Arabia
86	Bakari Kaoneka	Tanzania	DSO	M	1992	Acaricidal properties of active principals from <i>Commiphora swynertoni</i> Burt and one Meliaceae species against the brown ear tick <i>Rhipicephalus appendiculatus</i> Neuman	Animal Health	Moi University	1998	Research Officer, TPRI, Arusha, Tanzania
87	Margaret Nabasiye	Uganda	DSO	F	1992	Statistical inference on pest resistance indices: Implications for selection in crop plants	Plant Health	Makerere University	1997	Senior Lecturer and Associate Dean, Fac. of Agriculture, Makerere, University, Kampala, Uganda

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88	Edward Kinyua Nguu	Kenya	DAAD	M	1992	Effect of host blood and its digestive products on trypanosome differentiation in tsetse fly <i>Glossina morsitans</i>	Animal Health	University of Nairobi	1997	Lecturer, University of Nairobi, Kenya
89	Timothy T. Epidi	Nigeria	DAAD	M	1992	Mechanisms of resistance in selected sorghum genotypes to the spotted stem borer, <i>Chilo partellus</i> (Swinhoe) (Lepidoptera: Pyralidae)	Plant Health	Rivers State University of Science and Technology	1996	Lecturer, Rivers State University of Science and Technology, Port Harcourt, Nigeria
90	Abakar H. Mahamat	Chad	DSO	M	1993	Isolation of trypanolysis/trypanoglutinin and assessment of their use in the interruption of trypanosome differentiation	Animal Health	University of Sierra Leone	1997	Director of Research, OMS, Djamena, Chad
91	Hatem A.F. Mohammed	Egypt	IFAD	M	1993	Morphometric and molecular comparisons of two isolated populations of the desert locust <i>Schistocerca gregaria</i> (Orthoptera: Acrididae)	Plant Health	Ain Shams University	1996	Lecturer, Ain Shams University, Cairo, Egypt
92	Kiarie Mwangi Kega	Kenya	UNDP/WB	M	1993	Yield losses in maize crop due to interaction of environmental factors and stemborer attack	Environmental Health	Kenyatta University	1998	Research Officer, KARI, Mtwaapa, Kenya
93	Abdoulaye Niassy	Senegal	IFAD	M	1993	Studies on some factors mediating the interaction between <i>Schistocerca gregaria</i> (Forsk.) and <i>Locusta migratoria migratoriodes</i> (Reich & Farnalre) in relation to phase polymorphism	Environmental Health	University of Ghana	1997	Deceased
94	J.J. Randriamananoro	Madagascar	DAAD	M	1993	Mechanisms of resistance in maize ( <i>Zea mays</i> ) in maize stalk borer <i>Busseola fusca</i> Fuller (Lepidoptera: Noctuidae)	Plant Health	Rivers State University of Science and Technology	1996	Research Officer, Bureau d'Etudes, Developpement Rural et Environmental, Madagascar
95	Esther Sebitosi	Uganda	DSO	F	1993	Genetics of tsetse flies from different ecological zones in Kenya	Animal Health	Ahmadu Bello University	1998	Researcher, ILRI, Nairobi, Kenya
96	Hellen Kutima	Kenya	DSO	F	1993	Biochemical interactions between trypanosomes and haematophagus insects other than <i>Glossina</i>	Animal Health	JKUAT	2002	Lecturer, JKUAT, Nairobi
97	Ameri Ibrahim Tawfik	Egypt	IFAD	M	1993	Interaction between pheromones and hormones in phase dynamics of the desert locust, <i>Schistocerca gregaria</i> (Forsk.)	Environmental Health	Assiut University	1996	Lecturer, Entomology Department, Faculty of Science, Assiut University, Egypt
98	Godwin M. Zimba	Malawi	DAAD	M	1994	Synthesis of lectin-trypsin complex and its role in <i>Trypanosoma brucei</i> differentiation in tsetse fly, <i>Glossina</i> sp.	Animal Health	University of Malawi	1998	Deceased
99	Zipporah Njagu	Kenya	DAAD	F	1994	Role of the monitor lizard ( <i>Varamis niloticus</i> ) in trypanosome epidemiology	Animal Health	Kenyatta University	1998	Lecturer, Kenyatta University, Nairobi, Kenya
100	Fanuel A. Demas	Namibia	DAAD	M	1994	Mechanisms of location of <i>Amblyomma variagatum</i> and other ticks by the parasitoid <i>Ixodiphagus hookeri</i>	Animal Health	University of Zimbabwe	1998	Research Officer, Ministry of Environment and Tourism, Namibia
101	Vivian C. Ofomata	Nigeria	DAAD	F	1994	Investigations into the mechanisms of displacement of <i>Chilo orichalcociliellus</i> Strand by <i>Chilo partellus</i> (Swinhoe) (Lepidoptera: Pyralidae) on the Kenya coast	Plant Health	Nnamdi Azikiwe University	1998	Lecturer, Nnamdi Azikiwe University, Awka, Nigeria

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SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
102	Mohammed N.S. Salaam	Egypt	DAAD	M	1994	Comparative evaluation of <i>Cotesia flavipes</i> and <i>Cotesia sesamiae</i> (Hymenoptera: Braconidae) for the management of <i>Chilo partellus</i> (Lepidoptera: Pyralidae) in Kenya	Plant Health	Kenyatta University	1998	Information not available
103	Jean-Berkmans B. Muhigwa	DRC	DAAD	M	1994	Behavioural responsiveness of <i>Glossina fuscipes</i> Newstead (1910) to visual cues and host odours, with particular reference to the lizard	Animal Health	University of Khartoum	1998	Dean, Faculty of Sciences (Biology), University of Bukavu, Bukavu, R.D. Congo
104	Syprine Akinyi	Kenya	EU	F	1994	Reproductive behaviour of <i>Glossina fuscipes fuscipes</i> (Diptera: Glossinidae)	Animal Health	Kenyatta University	1998	Lecturer, Kenyatta University, Nairobi, Kenya
105	Rosebella O. Maranga	Kenya	DAAD	F	1995	Innovative control methods for <i>Amblyomma variegatum</i> (Fabricius, 1994)	Animal Health	Jomo Kenyatta University of Agriculture and Technology	1999	Senior Lecturer, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya
106	MaryAnne Groepe	South Africa	DAAD	F	1995	Effect of synthetic pyrethroid cattle dips on non-target beneficial dung insects	Environmental Health	University of Pretoria	1999	Lecturer, University of Pretoria, Republic of South Africa
107	Jenard Patrick Mbugi	Kenya	DAAD	M	1995	Movement of stemborers, <i>Busseola fusca</i> Fuller (Lepidoptera: Noctuidae) and <i>Chilo partellus</i> Swinhoe (Lepidoptera: Pyralidae) moths between wild and cultivated habitats	Plant Health	Kenyatta University	1999	Lecturer, Zoology Dept., Kenyatta University, Nairobi, Kenya
108	Atem Garang Malual	Sudan	DAAD	M	1995	The effect of plant density on gregarisation of desert locust <i>Schistocerca gregaria</i> (Forsk.)	Plant Health	University of Khartoum	1999	Visiting Scientist, <i>icipe</i> , Nairobi, Kenya
109	Sunday Ekesi	Nigeria	DAAD	M	1995	Variability of pathogenic activity of entomogenous fungi (Hyphomycetes) towards the legume flower thrips <i>Megalurothrips sjostedti</i> (Trybom) (Thysanoptera: Thripidae) and their potential for biological control	Plant Health	Ahmadu Bello University	1999	Research Scientist, <i>icipe</i> , Nairobi, Kenya
110	Esther Kioko	Kenya	IFAD	F	1995	Biodiversity of wild silkmths (Lepidoptera) and their potential for silk production in East Africa	Environmental Health	Kenyatta University	1999	Research Scientist, <i>icipe</i> , Nairobi, Kenya
111	Eunice A. Misiani	Kenya	DAAD	F	1995	Role of arthropod vectors in the transmission of lumpy skin disease in cattle	Animal Health	Kenyatta University	2004	Deputy Director, Department of Health, Pretoria, South Africa
112	Deolinda S. Pacho	Mozambique	DAAD/GTZ	F	1996	Biology of tomato leafminers in Kenya	Plant Health	University of Pretoria	2000	Director of Research, Ministry of Agriculture, Maputo, Mozambique
113	Linus Gitonga	Kenya	DAAD	M	1996	Biotechnology of thrips in French bean growing systems	Plant Health	JKUAT	1999	Lecturer, JKUAT, Nairobi, Kenya
114	Nicholas Gikonyo	Kenya	DAAD	M	1996	Semiochemical basis of nonpreference in some wild animals by the <i>Glossina morsitans</i> group of tsetse	Animal Health	University of Nairobi	2000	Lecturer, Kenyatta University, Nairobi, Kenya

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SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
115	Josephine Songa	Kenya	Rocketeer Foundation	F	1996	Distribution importance and management of stem borers (Lepidoptera) in maize production systems of semi-arid Eastern Kenya with emphasis on biological control	Plant Health	Kenyatta University	1999	NDFRC - Katumani, Machakos, KARI, Kenya
116	Sleshi G. Weldesemayat	Ethiopia	DAAD	M	1997	Insect pests of <i>Sesbania sesban</i> with a focus on <i>Mesoplatys</i> beetle as a potential pest in improved fallow technology in southern Africa	Environmental Health	Kenyatta University	2001	ICRAF, Zambia
117	Vincent O. Oduol	Kenya	DAAD	M	1997	Genetic biodiversity in banana weevil <i>Cosmopolites sordidus</i>	Plant Health	University of Nairobi	2001	Lecturer, University of Nairobi, Kenya
118	Abera T. Haile	Ethiopia	DAAD	M	1997	Potential of egg parasitoid in control of pest Lepidoptera on export vegetable crops in Africa	Plant Health	Kenyatta University	2002	Director, Crop Research Amhara Region Agricultural Research Institute (ARARI), Bahir Dar, Ethiopia
119	Serigne T. Kandji	Senegal	DAAD	M	1997	Studies on the role of agroforestry practices on the biodiversity of sap dwelling nematodes: Case of improved fallows in western Kenya	Environmental Health	Kenyatta University	2002	Lecturer, Université de Thies, Senegal
120	Samira A. Mohamed	Sudan	DAAD	F	1997	Biological control of fruit flies with particular attention to fruit fly parasitoids	Plant Health	University of Gezira	2003	Visiting Scientist, <i>icipe</i> , Nairobi, Kenya
121	Dorothy W. Masinde	Kenya	DAAD	F	1998	Impact of farmer participation on technology, adoption and diffusion: An assessment of a collaborative project in Trans Nzoia, Kenya, on the use of fodder host plants for the control of stem borers in maize	Social Science	University of Nairobi	-	Associate Director, Centre for Sustainable Rural Livelihoods, Kampala, Uganda
122	Hassan Mohamud	Somalia	DAAD	M	1998	Stem borers host plants interactions in striga infested/uninfested hosts and their semio-chemical basis	Plant Health	Kenyatta University	2003	Postdoctoral Fellow/Scientist, <i>icipe</i> , Mbita, Kenya
123	Emana G. Degaga	Ethiopia	DAAD	M	1998	Optimization of parasitoid release strategy against cereal stem borers in Ethiopia	Plant Health	Kenyatta University	2002	Research Scientist, EARO, Addis Ababa, Ethiopia
124	Ivy G. Nzuma	Zimbabwe	DAAD	F	1998	Study on bio-ecology and environmentally sound control of red spider mites on tomatoes in Zimbabwe	Environmental Health	University of Zimbabwe	Not yet	Lecturer, University of Zimbabwe, Harare
125	Mochlach Moses Brandford	Ghana	DSO	M	1998	Physiological and genetic diversity in populations of the larval parasitoid <i>C. sesamiae</i>	Plant Health	University of Cape Coast	2001	Visiting Scientist, <i>icipe</i> , Nairobi, Kenya
126	Anne Akol	Uganda	DSO	F	1998	Bio-efficiency and non-target interaction of neem formulations in control of key pests of French bean and snowpeas	Plant Health	Makerere University	2002	Lecturer, Makerere University, Uganda
127	Laila Abubakar	Kenya	DAAD	F	1998	Molecular characterisation of the factors involved in the development of trypanosomes in the tsetse midgut	Animal Health	University of Nairobi	2003	Lecturer, University of Nairobi, Kenya

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SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
128	Ibrahima Sarr	Senegal	DAAD	M	1998	Studies on bio-ecology and environmentally sound control of red spider mites on tomato in Kenya	Environmental Health	Kenyatta University	2003	Research officer, SARDR, Senegal
129	Levi Wekesa	Kenya	DSO	M	1998	Assessment of impacts of land use activities on indicator insect assemblages in the Taita Hills forest complex	Environmental Health	Moi University	N/A	Deceased while still student
130	Washington Ayiemba	Kenya	DSO	M	1999	Ecological monitoring and sustainable utilisation of butterflies at Arabuko-Sokoke forest, Kenya	Environmental Health	Kenyatta University	2003	Research Scientist, Nature Kenya, Malindi Kipepeo Project
131	Bernard Achero Okech	Kenya	DSO	M	1999	Vector competence of African malaria vectors	Human Health	Kenyatta University	2004	Unknown
132	Susan Dimbi	Zimbabwe	DAAD	F	1999	Evaluation of the potential of entomopathogenic fungi for the management of the African tephritid fruit flies <i>Ceratitis capitata</i> (Wiedemann), <i>C. rosa</i> var. <i>fasciventris</i> Karsch and <i>C. cosyra</i> (Walker) on mango in Kenya	Plant Health	Kenyatta University	2003	Research officer, Tobacco Research Board, Zimbabwe
133	Sidi Ould Ely	Mauritania	DSO	M	1999	Relative oviposition preferences of solitary desert locusts on different <i>Heliotropium</i> spp. and their semiochemicals basis	Plant Health	University of Khartoum	2004	Senior Researcher, CNLA
134	Cherif Kane	Mauritania	DSO	M	1999	Optimisation of the use of phenylacetone nitrile in enhancing susceptibility of gregarious nymphal desert locust, <i>Schistocerca gregaria</i> (Forsk.) to insecticides and pathogens	Plant Health	Kenyatta University	2004	Research Scientist, Desert Locust Control, Mauritania
135	Maxwell Billah	Ghana	DSO	M	1999	Biosystematics of <i>Psytallia</i> species complex (Hym: Braconidae), parasitoids of Tephritidae	Plant Health	University of Ghana	2005	Lecturer, University of Ghana, Legon
136	Peter Chinwada	Zimbabwe	DAAD	M	1999	Partial niche partitioning and complementarity of stemborer parasitism by <i>Cotesia sesamiae</i> and mechanisms of seasonal carryover in unimodal rainfall climatic zones as typified by Zimbabwe	Plant Health	Kenyatta University	2003	Senior Entomologist, Tobacco Research Board, Zimbabwe
137	Alfred Ochieng	Kenya	DSO	M	1999	Cowpea ( <i>Vigna unguiculata</i> ) cp DNA pollination and risk assessment linked to the future release of genetically transformed cowpea breeding lines	Environmental Health	University of Nairobi	–	Unknown
138	Pontiano Nemeye	Uganda	DSO	M	1999	Distribution and macro-ecology of two indigenous African fruit flies <i>Ceratitis cosyra</i> and <i>C. rosa</i> in Kenya, Tanzania and Uganda and their implications for strategies and tactics of fruit fly management in Africa	Plant Health	Makerere University	2006	Banana Agronomist Biodiversity Institute, Rwanda
139	Leunita A. Sumba	Kenya	DAAD	F	2000	Pre-oviposition behaviour of the African malaria mosquito, <i>Anopheles gambiae</i>	Human Health	Egerton University	2004	Research Officer, Kenya Water Institute
140	Rudo Sithole	Zimbabwe	DSO	F	2000	Studies on comparative fitness of African parasitoids of the diamondback moth (DBM)	Plant Health	University of Zimbabwe	2005	Executive Director, AFRICOM, Nairobi

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SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
141	Mathew Bett	Kenya	DSO	M	2000	Integrated use of synthetic and natural repellents for tsetse management	Animal Health	Moi University	–	Assistant Lecturer, Moi University, Kenya
142	Frederick N. Baliraine	Uganda	DAAD	M	2000	Analysis of genetic diversity of fruit fly populations in Africa for improved management	Plant Health	University of Nairobi	2004	Postdoctoral Fellow, University of California, USA
143	Yonas Feleke	Ethiopia	DSO	M	2000	Cowpea ( <i>Vigna unguiculata</i> ) cp DNA polymorphism as a tool to assess gene-flow directions between cultivated and wild	Environmental Health	Kenyatta University	–	Unknown
144	Geshawbeza Ayalew	Ethiopia	DAAD	M	2000	Population ecology of DBM and its parasitoids in Ethiopia	Plant Health	Kenyatta University	2004	Research Entomologist, Ethiopian Institute of Agricultural Research
145	Aklilu Seyoum	Ethiopia	DSO	M	2000	Evaluation of mosquito repellent and insecticidal plants and plant product for control of mosquitoes	Human Health	Kenyatta University	2003	Medical Entomologist, Centre for National Health Development, Ethiopia
146	Alioune Toure	Senegal	DSO	M	2000	An assessment of the use of botanical extracts and pheromones for the off-host and on-host control of <i>Amblyomma variegatum</i> tick	Animal Health	Kenyatta University	2005	Technical Advisor, Ministry of Livestock, Senegal
147	Janet Theresa Midega	Kenya	DAAD	F	2001	Distribution patterns, gene flow and dispersal capabilities of anopheline mosquito species at three ecological zones along the Kenyan coast	Human Health	University of Ghana	2009	Research Scientist, KEMRI, Kenya
148	Charles Aura Midega	Kenya	DAAD	M	2001	Impact of habitat management on abundance and activity of maize stemborer natural enemies and biodiversity of arthropods and soil fauna in Africa	Plant Health	Kenyatta University	2005	Postdoctoral Fellow, <i>icipe</i> , Mbita
149	Andrew Kalyebi	Uganda	DAAD	M	2001	Assessment of some performance attributes of selected indigenous <i>Trichogramma</i> species	Plant Health	Kenyatta University	2004	Sericulture Development Consultant, JICA Sericulture Programme
150	Daniel Ndem Amin	Cameroon	DAAD	M	2002	Functional analysis of the midgut lectin gene of <i>Glossina austeni</i>	Animal Health	Kenyatta University	2006	Postdoctoral Fellow, Karolinska Institute, Sweden
151	Melaku Wale	Ethiopia	Dutch	M	2002	Ecology and biologically based management of cereal stemborers on maize and sorghum in the Amhara state of Ethiopia	Plant Health	Kenyatta University	2006	Research Officer, Amhara Agricultural Research Institute, Ethiopia
152	Catherine W. Gitau	Kenya	Dutch-SII	F	2002	Geographical variation in the developmental success of <i>Cotesia sesamiae</i> Cameron (Hymenoptera: Braconidae) on <i>Busseola fusca</i> Fuller (Lepidoptera: Noctuidae)	Plant Health	Kenyatta University	2006	Postdoctoral Fellow, Charles Stuart University, Australia
153	Ester Innocent	Tanzania	Sigambar	F	2002	Bioprospecting for botanical larvicides and repellents for the control of malaria	Environmental Health	University of Dar es Salaam	2008	Research Fellow, Muhimbili University of Health and Allied Sciences

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SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
154	Hortance Manda	Cameroon	Singerberg	F	2002	Plant-feeding behaviour and effect of plant diets on the African malaria vector <i>Anopheles gambiae</i> fitness	Human Health	Kenyatta University	2006	Postdoctoral Fellow, <i>icipe</i> , Mbita
155	Teddy Matama Kauma	Uganda	Dutch	F	2002	Role of wild host plants in population dynamics of cereal stemborers and associated natural enemies in Uganda	Plant Health	Kenyatta University	2006	Deceased
156	Domingos Cugala	Mozambique	Dutch	M	2002	Impact assessment of natural enemies on stemborer populations and maize yield in Mozambique	Plant Health	Kenyatta University	2006	Assistant Lecturer Eduardo Mondlane University
157	Fiaboe Kouma Mokpokpo	Togo	DAAD	M	2002	Studies of potential predators of tomato red spider mite <i>Tetranychus evansi</i> (Baker & Pritchard) for possible introduction as biocontrol agents in Africa	Plant Health	Kenyatta University	2007	Banana Entomologist, IITA-Uganda
158	Charles Kihampa	Tanzania	DAAD	M	2003	Characterisation and assessment of anti-mosquito natural products from Tanzanian botanicals	Environmental Health	University of Dar es Salaam	2008	Assistant Lecturer, USDM
159	Anderson Kipkoeh	Kenya	DAAD	M	2003	The socio-economic impact assessment of biological control of cereal stemborers in maize growing belts of eastern and southern Africa	Plant Health	Moi University	2008	Lecturer, Moi University
160	Salome Guchu	Kenya	DAAD	F	2003	Allelochemical mechanisms of <i>Striga</i> suppression by <i>Desmodium</i>	Plant Health	University of Nairobi	2008	Science Officer, Ministry of Higher Education, Science and Technology, Kenya
161	Ohaga Spala Oduor	Kenya	DAAD	M	2003	Host location behaviour of <i>Glossina swynnertoni</i> and development of baits	Animal Health	Kenyatta University	2009	Programmes Officer, IMPACT, Kisumu
162	Bruce Anani Yaovi	Togo	DAAD	M	2003	The importance of indigenous egg parasitoids in the population dynamics of cereal stemborers in East Africa and its implication for the release of the western egg parasitoid species <i>Telenomus isis</i> Polaszek (Hymenoptera: Scellionidae)	Plant Health	Kenyatta University	2008	Unknown/unemployed
163	Esther Mwhaki Njuguna	Kenya	DAAD	F	2003	Economics of habitat management strategies in maize and livestock production by controlling stemborers and striga weed in mixed farming systems	Plant Health	University of Nairobi	2009	Research Officer, KARI
164	Joseph Mumo Mwangangi	Kenya	NIH	M	2003	Environmental, agricultural and ecological factors that regulate vector productivity and diversity in the Mwea Rice irrigation scheme in Kenya	Human Health	Kenyatta University	-	Research Officer, KEMRI
165	Eric B. Kouam	Cameroon	DAAD	M	2004	Cowpea ( <i>Vigna unguiculata</i> ) gene pool organisation and wild-crop complex dynamics	Environmental Health	Kenyatta University	2009	Unknown/unemployed
166	Norber Mbahin	Cameroon	DAAD	M	2004	Population dynamics, dispersal, parasitism and predation aspects of <i>Anephe panda</i> (Boisduval) in Kakamega forest, Kenya	Environmental Health	Kenyatta University	2008	Assistant Lecturer, University of Dschang, Cameroon

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SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
167	Steven Ger Nyanjom	Kenya	Dutch-SII	M	2004	Characterisation of tsetse olfactory receptor proteins associated with repellency; the use of functional genomics and ligand-protein binding studies	Animal Health	Jomo Kenyatta University of Agriculture and Technology	Expected 2010	Assistant Lecturer, JKUAT
168	David Bugeme	DRC	Dutch-SII	M	2004	The potential of pathogenic fungi in the control of economically important spider mite species	Plant Health	Jomo Kenyatta University of Agriculture and Technology	2008	Lecturer, University of Lubumbashi, DRC
169	David Mwangi	Kenya	Dutch-SII	M	2004	Mechanism of fungus-avoidance behaviour of termites and identification of the mediating signals	Plant Health	Jomo Kenyatta University of Agriculture and Technology	2009	Unknown/unemployed
170	Simon Muriu	Kenya	DAAD	M	2004	Impact of vector control on malaria transmission in a riceland ecosystem	Human Health	University of Nairobi	2009	Science Officer, Ministry of Higher Education, Science and Technology, Kenya
171	Susan Sande	Kenya	DAAD	M	2004	Honey bees and forest conservation: A case study of Arabuko Sokoke forest, Kenya	Environmental Health	University of Pretoria		Extended studentship
172	Ivan Rwomushana	Uganda	DAAD	M	2004	Bioecology of the new invasive <i>Bactrocera invadens</i> (Diptera: Tephritidae) and its interaction with indigenous fruit fly species	Plant Health	Kenyatta University	2008	Consultant, Agro-Enirolink Consult, Kampala
173	Bonaventure Aman	Kenya	Kirkhouse Trust	M	2005	Biological control of the larger grain borer	Plant Health	North West University, South Africa	2009	Extended studentship
174	Duna Mallafiya	Nigeria	DAAD	M	2005	Assessment of the diversity, ecological preference and potentials of natural enemies associated with indigenous lepidopteran stemborers in Kenya	Plant Health	Kenyatta University	2009	Assistant Lecturer, University of Maiduguri, Nigeria
175	Lefulesele Lebesa	Lesotho	DAAD	F	2005	Control of blister beetles on <i>Desmodium</i> spp. by understanding visual cues and chemical ecology	Plant Health	University of Pretoria	Not yet	Research Officer, Agriculture Research Department, Lesotho
176	Fathiya Mbarak	Kenya	DAAD	M	2005	Comparative studies on the morphological and genetic diversity of a new <i>Bactrocera</i> species in its aboriginal home and in Africa	Plant Health	Kenyatta University	Not yet	Assistant Lecturer, Kenyatta University
177	Henri Tonnang	Cameroon	DAAD	M	2005	Modelling of parasite-host system dynamics and its application to diamondback moth fluctuations	Plant Health	University of Nairobi	2008	Postdoctoral Fellow, Institute of Resource Assessment, Dar es Salaam
178	Meshack Obonyo	Kenya	DAAD	M	2005	Basis of host recognition by the larval endoparasitoids <i>Cotesia flavipes</i> and <i>Cotesia sesamiae</i>	Plant Health	North West University	Not yet	Science Officer, Ministry of Science and Technology, Kenya
179	Ken Okwae Fening	Ghana	DAAD	M	2005	Species diversity of wild silk moths in Mwingi District forests, the biology of <i>Gonometa</i> spp. (Lepidoptera: Lasiocampidae), its population patterns and survival on host plant species	Environmental Health	Kenyatta University	2008	Scientific Officer, Crops Research Institute, Ghana
180	Khogali Izzeldin Idris	Sudan	DAAD	M	2005	Development and evaluation of habitat management strategies for sorghum- and millet-based farming systems for drier areas of northern Africa	Plant Health	University of Gezira	Not yet	Extended studentship, Research Assistant, University of Gezira

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SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
181	Faith J. Toroitich	Kenya	Dutch-SII	F	2005	Assessment of the biodiversity of African tetranychid mites using conventional and molecular taxonomic methods	Plant Health	North West University	Not yet	Extended studentship, unemployed
182	Felix Nchu	Cameroon	Dutch-SII	M	2005	Development of formulations and delivery systems for entomopathogenic fungi and botanicals for control of <i>Amblyomma variegatus</i>	Environmental Health	University of Pretoria	2008	Postdoctoral Fellow, University of Cape Town, South Africa
183	Sabina Wachira	Kenya	Dutch-SII	F	2005	Identification of oviposition semiochemicals of <i>An. gambiae</i> and exploration of their potential in control	Environmental Health	Jomo Kenyatta University of Agriculture and Technology	Not yet	Research Officer, KEMRI, Nairobi
184	Abdullahi Yusuf	Nigeria	Dutch-SII/DAAD	F	2006	Entomopathogens: A component of leafminer management	Plant Health	University of Pretoria		Assistant Lecturer, Kaduna State University, Nigeria
185	Eric Frimpong	Ghana	Dutch-SII	M	2006	Farmer training, social capital and diffusion of information: The case of IPM in Kenya	Technology Dissemination	University of Cape Coast		Assistant Lecturer, University of Cape Coast, Ghana
186	Fikira Saidi Kimbokota	Tanzania	Dutch-SII	F	2006	Molecular characterization of honeybees <i>Apis mellifera</i> populations in North and East Africa	Environmental Health	University of Dar es Salaam		Assistant Lecturer, University of Dar es Salaam, Tanzania
187	Harrison Githenga Kibogo	Kenya	DAAD	M	2006	Behavioural and chemical ecology of oviposition by the mango-infesting fruit fly, <i>Ceratitis cosyra</i> (Walker) (Diptera: Tephritidae)	Plant Health	Jomo Kenyatta University of Agriculture and Technology		Research Technician, ILRI
188	Loma Migiro	Kenya	DAAD	F	2006	Landscape management of wild pollination services in cocoa production systems in Ghana	Environmental Health	North West University		Research Officer, KEPHIS
189	Nigat Bekele	Ethiopia	DAAD	F	2006	Semiochemicals involved in termite raiding by the ponerine ant <i>Pachycondyla analls</i> (Hymenoptera: Formicidae) in Kenya	Plant Health	Egerton University		Research Officer, ILRI
190	Robert Musundire	Zimbabwe	DAAD	M	2006	<i>Liriomyza</i> spp., invasive pests in Kenyan horticulture: Distribution, host plants and role of natural enemies	Plant Health	University of Pretoria		Lecturer, Midlands State University, Zimbabwe
191	Alice Murage	Kenya	DAAD	F	2007	Gene mapping of cowpea ( <i>Vigna unguiculata</i> (L.) Walps)	Plant Health	Egerton University		Research Officer, KARI
192	Chrysantus Tanga-Mbi	Cameroon	DAAD	M	2007	Bioecological studies on downey snowline mealybug (DM), <i>Rastrococcus iceryoides</i> and its associated natural enemies in Tanzania	Environmental Health	University of Pretoria		Assistant Lecturer, University of Buea, Cameroon
193	Felix Ernest Appiah	Ghana	DAAD	M	2007	Evaluation of two introduced parasitoids against <i>Ceratitis</i> species and their interaction with indigenous parasitoids	Environmental Health	University of Ghana		Unemployed
194	Mary Njeri Kifuko-Koech	Kenya	DAAD	F	2007	Study on relative efficacy and economics of dissemination pathways for developing optimal expansion strategies for 'push-pull' technology in eastern Africa	Technology Dissemination	Moi University		Research Officer, KARI
195	Mebeaselsie Andargie	Ethiopia	DAAD	M	2007	Kenyan horticulture: Distribution, host plants and role of natural enemies	Plant Health	Kenyatta University		Assistant Lecturer, Alemaya University, Ethiopia

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SN	Name of scholar	Country of origin	Sponsor	Sex	Class	Title of thesis	Research focus	Registering university	Award of degree	Last known career status
196	Amanuel Tamiru	Ethiopia	DAAD	M	2008	Stemborer oviposition induced defence volatiles in maize and their effect on egg parasitoids	Plant Health	Kenyatta University		Researcher, Melkassa Research Institute, Ethiopia
197	Ayuka Fombong	Cameroon	DAAD	M	2008	Behaviour-modifying chemicals for hive beetles to improve bee health	Environmental Health	University of Nairobi		Unemployed
198	Donald Kachigamba	Malawi	DAAD	M	2008	Behavioural biology and ecosystem service of stingless bees species in relation to habitat change in Kakamega rain forest, Kenya	Environmental Health	Jomo Kenyatta University of Agriculture and Technology		Research Officer, Chitedze Research Station, Malawi
199	Evans Odhiambo Obura	Kenya	DAAD	M	2008	Host-marking behaviour in four fruit fly species infesting mango in Africa	Plant Health	Egerton University		Unemployed
200	Didi Serge Kiatoko Nkoba	DRC	DAAD	M	2008	Behavioural biology of selected stingless bee species in relation to pollination services and honey production	Environmental Health	Kenyatta University		Assistant Lecturer, University of Kinshasa, DRC
201	Peris Amwayi	Kenya	DAAD	F	2008	Determination of insect vector of Napier stunt phytoplasma, screening for sources of resistance and evaluating alternative fodder as livestock feed	Plant Health	University of Pretoria		Part-time Lecturer, Egerton University, Kenya
202	Saliou Niassy	Senegal	DAAD	M	2008	Stemborers oviposition induced defence volatiles in cultivated and non-cultivated grasses and their effect on egg and larval parasitoids	Plant Health	Jomo Kenyatta University of Agriculture and Technology		Assistant Lecturer, Cheik Anta Diop University, Senegal

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