ARPPIS

Evaluation of its Impact on National Programmes in Insect Science Research & Education

ARPPIS

The African Regional Postgraduate Programme in Insect Science (ARPPIS)

PROCEEDINGS

of the

International Conference on Capacity Building in Insect Science in Africa: Field Experience and Evaluation of the Impact of ARPPIS

and including

Follow-up of Former DAAD Scholarship Holders' Meeting

The ICIPE World Headquarters
Duduville, Nairobi, Kenya

3–6 December 1990

Z.T. Dabrowski, Editor

The African Regional Postgraduate Programme in Insect Science (ARPPIS)

c/o The International Centre of Insect Physiology and Ecology (ICIPE)

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- *The German Academic Exchange Service (DAAD), Africa Office*
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Introduction

The International Centre of Insect Physiology and Ecology (ICIPE) in partnership with several African universities, currently 22 in number, established since 1983 the African Regional Postgraduate Programme in Insect Science (ARPPIS). This is a 3-year Ph.D. training programme in insect science and related application areas. It is a programme in which scholars register for a Ph.D. degree at an ARPPIS participating university but undertake coursework and project research at the ICIPE. Between 8 and 10 students in earlier times joined ARPPIS each year for the 3-year programme but more recently the enrolment increased to between 10–15. From 1983 to 1991, 86 students from 18 African countries registered in the ARPPIS.

ARPPIS motivates and trains African scientists to investigate the biology, physiology, behaviour, population and chemical ecology of insect 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.

Each student project is undertaken in the ICIPE laboratory and experimental fields; day-to-day supervision is exercised by the ICIPE scientists. However, ARPPIS also fully involves the registering universities by submitting to them twice-yearly progress reports, and by encouraging visits between students and their university advisors. Students visit their universities to present seminars and hold consultations with their supervisors, and university supervisors travel to the 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 the successful submission of a thesis, the Ph.D. degree of the registering university can be awarded.

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 organisations. The ICIPE is particularly gratified and proud to note that all ARPPIS graduates work in Africa. It is with 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 the 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.

In this spirit, the ICIPE organised an International Conference on Capacity Building in Insect Science in Africa: Field Experience and Evaluation of the Impact of ARPPIS, at Duduville, Nairobi, Kenya from 4–6 December 1990 envisaging that this conference would accomplish the following four goals:

1. Establish an enabling scientific information exchange environment for all ARPPIS graduates located in different countries;
2. Foster an effective continental collaboration and interaction among the ARPPIS graduates through the establishment of the proposed ARPPIS scientific network;
3. Use the experience so far gained in the field to improve and enhance the structure and course content of the ARPPIS programme; and
4. Recognise the ARPPIS alumni, so as to enhance a natural linkage between all the ARPPIS graduates as a part of the ARPPIS scientific network.

The regular ARPPIS Annual Scientific Meeting, always held in early December, for ARPPIS scholars still in residence at the ICIPE was included in the conference programme. The second- and third-year scholars presented their papers and chaired the scientific sessions. ARPPIS supervisors, representatives from participating universities, donor agencies, and the ICIPE scientific community were invited to participate in this conference. The conference helped to strengthen rapport between the ARPPIS scholars and the scientific community, and it fostered confidence in themselves as scientists, young as well as mature.

The Conference participants discussed various options in developing a new mechanism to maintain the enthusiasm of ARPPIS graduates for research and teaching until such time as a self-sustaining critical mass of scientists has been trained for each country; otherwise they are likely to drift away from active research, either through loss of motivation or by emigration to foreign laboratories perceived to be centres of excellence. The most efficient and useful means of maintaining the momentum of ARPPIS will be through an ARPPIS scientific network integrated with the Pest Management Research and Development Network (PESTNET).

Nairobi, 1st June 1991

Professor Thomas R. Odhiambo
Director of the ICIPE and Chairman,
ARPPIS Academic Board

Fig. 1. Hon. Peter Oloo Aringo, Kenya Minister for Education (centre) and Professor Thomas R. Odhiambo (right), the ICIPE Director, listening to the Introductory Address given by the DAAD Director, Dr. Christoph Klinge (left) at the Opening Reception, Jacaranda Hotel, Nairobi, 3rd December 1990.

Fig. 2. H.E. the Ambassador of the Federal Republic of Germany (left) and Mr. Hans M. Helfer, Director, DAAD Regional Office for Africa, listening to the speakers at the Opening Ceremony.

Fig. 3. Conference participants in front of the Research and Development Complex, the ICIPE World Headquarters, Duduville, Nairobi.

Introductory Address

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Honorable Minister of Education, Mr. Peter Oloo Aringo, Excellencies, The Director of the International Centre of Insect Physiology and Ecology (ICIPE), Professor Thomas R. Odhiambo, Distinguished guests, Dear former and present DAAD-scholarship holders of the ARPPIS-Programme, Ladies and Gentlemen, it is a great honour for me to welcome you on behalf of the President of the German Academic Exchange Service (DAAD), Professor Theodor Berchem, to this "International Conference on Capacity Building in Insect Science in Africa", which is sponsored by the International Centre of Insect Physiology and Ecology (ICIPE), and the German Academic Exchange Service (DAAD).

I should like to take this opportunity to say a few words on the role and function of DAAD and the significance of this Conference.

DAAD is a joint organisation of the institutions of higher education in the Federal Republic of Germany. It has the function of promoting university relations abroad, especially through the exchange of students and academics; German and foreign scholars, professors and students representing all disciplines from almost every country in the world participate in this exchange.

DAAD is a registered association under private law. Its members are the institutions of higher education represented in the Rectors Conference and their student unions. The Executive Committee, elected by the General Assembly, lays down general guidelines for the activities undertaken by DAAD. Its members are primarily representatives from the academic world.

DAAD operates mainly on the basis of public funding. This is provided largely by the Foreign Office and the Federal Ministries of Education and Science and for Economic Cooperation. The Federal States also contribute to DAAD's budget. Their support, however, consists primarily in ensuring the cooperation of academic staff (employed by the Federal States) with DAAD and in providing study places for foreign students at German institutions of higher education, which are financed by the Federal States. By the way, the number of Federal States has increased in the course of reunification from 11 to 16.

Taking into account needs and interests expressed by its member institutions and its funding bodies, DAAD's activities play an important role in the context of various political fields: foreign cultural policy, international educational policy and development aid policy.

DAAD's Head Office is situated in Bonn. Branch offices are in Cairo, Jakarta, London, Nairobi, New Delhi, New York, Paris, Rio de Janeiro, San Jose, and Tokyo.

Several of you have had personal experience relating to one or the other of DAAD's programmes, mainly of DAAD's In-country, or Third-country, Scholarship schemes, the most important programmes for Africa. Within them DAAD sponsors about 500 scholars for their Master's or Ph.D. studies, around 200 of them in Kenya.

Within the African Regional Postgraduate Programme in Insect Science (ARPPIS), DAAD, until now, has provided more than 30 scholarships (to scholars from 12 African countries). This makes a little less than 50% of the more than 70 scholars (from 17 African countries) within ARPPIS from 1983 up to now. These figures exemplify the importance DAAD attaches to ICIPE and ARPPIS. We know that in the last 8 years of its existence the African Regional Postgraduate Programme in Insect Science has made an important impact in Africa, and we hope that ICIPE will succeed in establishing the planned Master's Course in Insect Science at some selected African universities.

In case the Federal Ministry for Economic Cooperation will give us the necessary funds, we will be prepared to offer some more In-Country, or Third-Country, Scholarships for the planned ARPPIS Master's Programme with the view of promoting the vitally important task of improving human health and increasing food production by tackling the insect pests of tropical Africa.

The pursuit of knowledge is essentially a joint undertaking which embraces all people. For centuries scholars have moved from one place to another. More than ever in history scholars of all countries need to cooperate in order to overcome some of the most urgent problems of the present days.

For 7 years, DAAD has cooperated with ICIPE by offering scholarships to young graduates from African universities for Ph.D. studies.

This Conference should demonstrate that the activities of DAAD do not end once the scholarship has expired. Our organisation tries to maintain regular contacts with former grantees in order to contribute towards a kind of continuing scientific cooperation. We want to help the successful graduates from ICIPE to keep abreast of new developments in their respective fields. Scientific and academic endeavours should not come to an end after one has obtained a degree and got a job.

This Conference organised by ICIPE is one step further in this direction. It was the idea of Professor Thomas R. Odhiambo to invite those former grantees who have reached important positions in their respective fields and to expose them to new trends and methods in insect science.

We are glad that you have followed the invitation and we are proud that so many of the DAAD scholars are doing so well. We hope that in future a network will be formed by former DAAD grantees and other ARPPIS scholars serving as experts in their home countries.

I wish this International Conference on Capacity Building in Insect Science in Africa a full success and I hope it will serve as an example for other conferences or seminars to come.

The Conference Special Lecture

The Conference Special Lecture was delivered by Professor H. Z. Ferenz of the University of Oldenburg (Germany). Professor Ferenz was born on 14th October 1946. He studied ecology, zoology, insect physiology and biochemistry at the University of Cologne (Germany), The Agricultural University at Wageningen (The Netherlands) and the University of California at Los Angeles (USA). Since 1985, he has been Professor of Zoology at the University of Oldenburg (Germany) and in 1987 was appointed the Coordinator of the German Locust Research Programme.

He is well known for his research on biochemistry and physiology of insect reproduction with special emphasis on locust, regulation of juvenile hormone biosynthesis, locust pheromones and locust ecology.

Locust Research in Germany with Special Reference to Locust Oogenesis

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Summary

In view of the recent desert locust plague and the increasing concern about the dangers of environmental pollution and the threat to wildlife and man caused by chemical pesticides used for locust control, a research programme on new alternative and integrated locust control methods was initiated. It is financially supported by the University of Economic Cooperation through the GTZ. German research teams are studying remote sensing and forecasting methods; searching for locust specific pathogens and analysing semiochemicals, especially phase transition pheromones and analogues, and feeding inhibitors. The GTZ started field experiments with *Nosema locustae* and chitin synthesis inhibitors. For all projects, the cooperation with scientists of locust affected countries is sought. Through such cooperation local African expertise shall be strengthened in order to ensure that new environmentally acceptable control methods are developed, that available modern locust and grasshopper control methods are optimally used, and that the locust affected countries will possess the ability to evaluate interventions proposed, for example, by donors.

Furthermore a number of German scientists do basic research on locusts. In one such project, the mechanism of yolk formation in locusts was analysed. A specific yolk protein receptor could be isolated and biochemically characterised. In many aspects, it is similar to vitellogenin receptor systems in other animals and to the low density protein receptor. These studies not only contribute to a better understanding of the process of receptor-indicated endocytosis in general, but also help to find new approaches to control pest locusts.

The Importance of ARPPIS in Capacity Building in Insect Science in Africa: Perspectives and Experiences of ARPPIS Graduates

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Abstract

To compete and survive in a competitive world in the 21st Century, Africa requires highly qualified and trained professionals capable of performing top quality research, formulating policies and implementing programmes essential to economic growth and development.

With the establishment of ARPPIS, the difficulty of training skilled and motivated young African scientists in insect science related disciplines is being solved. Since its inception with the first class in 1983 about 72 scholars have joined ARPPIS. Out of this group 39 have obtained their Ph.D. degree or submitted a thesis and are working in Africa.

A good training programme in the right environment can help reduce the brain-drain of qualified academics and professionals that is haemorrhaging the African economy. With the increasing number of qualified professionals in insect science through the ARPPIS programme, the detrimental economic consequences of insect pests and disease vectors can be alleviated or even eliminated in Africa.

The reality of the marginalisation of the African continent in international relations (political, economic, technical, educational, etc.) is no longer disputed. It is a fact that Belgium, with a population of over 9 million and its small size, has the capacity to create more wealth than a population of 450 million Africans in a territory 1000 times the size of Belgium. Many reasons may be advanced for this phenomenon but it is important to note that since African countries attained independence there has been an increase in poverty and hunger, with a corresponding decline in the standard of living. With the world economic recession and the declining agricultural and food production per capita in Africa, the population of this continent is exposed to even more hardships—famine in Sudan and Ethiopia, wars in Liberia and Rwanda, and a recent coup in Chad. It is known today that the dynamic development of technology (computer science, molecular biology, biotechnology, etc.) and the use of different modern management techniques have bypassed Africa. In order to solve its enormous problems of development, and to survive and compete in a competitive world in the 21st Century, Africa will require highly-qualified and trained professionals to perform top quality research, formulate policies and implement programmes essential to economic

growth and development. The training of professionals with a sufficient level of policy-making, technological and managerial leadership can help resolve some of the problems Africa is facing. With the help of the international donor community various approaches have been considered to train young Africans, with the main objective to make them play a vital role in the development of Africa. Unfortunately, more than 140,000 Ph.D.s, engineers, medical doctors, etc., trained in the developed countries have not come back to serve Africa after finishing their studies. This brain drain is a handicap to Africa because the training of these professionals has cost the poor African farmers, the various African governments and the donor community through international, regional or bilateral accord, a great deal of money. The debt burden incurred while training "the lost professionals" has to be paid, and Africa still does not have enough highly-trained people.

With the establishment of ARPPIS in 1983, the institutional constraint of training skilled researchers in Africa in insect science related disciplines is being solved. This is a joint 3-year Ph.D. training programme for able young researchers of national institutions of OAU member countries between the International Centre of Insect Physiology and Ecology (ICIPE) and the following 15 African Universities: Dschang University Centre, Cameroon; Addis Ababa University, Ethiopia; University of Ghana, Ghana; Kenyatta University and Moi University, Kenya; University of Malawi, Malawi; Anambra State University of Technology, University of Ibadan and Rivers State University of Science and Technology, Nigeria; University of Khartoum, Sudan; University of Sierra Leone, Sierra Leone; University of Dar-es-Salaam, Tanzania; Makerere University, Uganda; University of Zambia, Zambia; and University of Zimbabwe, Zimbabwe (to December 1990).

With more than 85% of the African population working in the agricultural sector, the attacks on their crops and livestock by insect pests or disease vectors can affect their livelihood. Insects can cause enormous economic damage and can sometimes devastate very well-planned national and regional programmes. Through ICIPE and ARPPIS, many of us have come to both appreciate and fear insects. In Africa, insects cause havoc for man, his crops and animals. The following few examples will illustrate the impact of insects.

The tsetse fly, vector of human and animal trypanosomiasis, covers around 10 million square kilometres, an area larger than the USA. The member countries of the Kagera (River) Basin Organisation (Tanzania, Uganda, Rwanda and Burundi) will spend nearly US$ 7 million to fight the tsetse fly and its related disease (trypanosomiasis) because it threatens an estimated 21 million livestock valued at US$ 4.8 billion. The US$ 7 million could be used for other projects, but due to the importance of the problem caused by the insect, the total goes into insect control.

Enormous damage is caused by crop pests. In 1958, Ethiopia lost around 167,000 tons of grain, enough to feed 1 million people for a year due to *Locusta migratoria*. The locust, *Schistocerca gregaria* is another major challenge to Africa as it devastates pasture, crops and vegetation in areas prone to desertification, causing hunger for millions of people. In 1986, to prevent a locust plague in the Sahel region, more than US$ 35 million was used to buy insecticides, to hire airplanes to spray, and to pay the people involved in this campaign by the international community. Nearly 1 million people die every year due to malaria, an insect-borne disease transmitted through the mosquito *Anopheles* spp.

These examples show the importance of insects in Africa and the need for solving problems related to insects. It is therefore important to train people who are concerned with these problems in a proper context, helping the countries in the region to minimise the costs involved in training. The training of young Africans in the field of insect science within ARPPIS enables the trainee to be conversant with advanced integrated pest management.

The motives of the candidates to join ARPPIS varied from the professional to the political. For example, candidate A says he wants to join ARPPIS to acquire techniques which are easy and environmentally safe to control medical vectors and insect pests. He wants to identify and evaluate biological control agents which are indigenous to Africa in order to enable African countries to save their hard-earned foreign currencies from being used to buy pesticides and insecticides.

Candidate B would like to join ARPPIS because she wants to become specialised in the field of insect science in order to train researchers and technicians, and to execute research projects.

Candidate C thinks that her training in ARPPIS will benefit her country.

Candidate D says the training in ARPPIS deals with crucial African problems *in Africa* and, therefore, the ARPPIS programme is the most useful programme for training of Africans in insect science.

Candidate E expressed the wish, that after his training, he will be a valuable counterpart to any foreign expert in the field of insect science sent by his government or international organisations to work in a particular project. He made his point by saying that many projects collapse after the foreign experts leave the country, because the expert usually works alone or with people who do not have enough knowledge of what the expert is doing.

Qualified and skilled Africans can join the ARPPIS programme and this is an important factor. This regrouping of scientists can be used by government or donor agencies to implement projects related to pests and vector control. ARPPIS so far has attracted more than 300 applicants but only 7 to 14 applicants have been taken each year. From 1983 todate 72 scholars from 17 different countries (Benin, Burkina Faso, Chad, Ethiopia, Ghana, Kenya, Malawi, Nigeria, Rwanda, Sierra Leone, Somalia, Sudan, Tanzania, Uganda, Zaire, Zambia and Zimbabwe) have joined the 8 Ph.D. classes.

The ARPPIS programme with course work of six months and 2–3 years research is unique and highly in demand, because of the quality of its graduates. The programme is in the process of helping the African continent, and beyond, to meet the need for insect scientists and to look seriously into the problems associated with insects. The ARPPIS training provides a broad understanding and knowledge of insects in agriculture, veterinary medicine and the environment. ARPPIS taught us the use of integrated pest management (IPM) which, to some extent, is the only way to substantially reduce the insect pest and medical vector population. This fact is making the ARPPIS Programme part of the international effort to help Africa face the challenges of the 21st Century—population growth, depletion of the environment, drought, decrease in agricultural production, hunger, AIDS and vector-borne diseases affecting man and his livestock. At the same time, the 72 ARPPIS scholars played an important part as members of the ICIPE scientific community and were involved in all the ICIPE research programmes (Table 1). All ARPPIS graduates are working in national, regional or international institutions in Africa, thus showing the impact of ARPPIS in research and development in Africa (Table 2).

It should be acknowledged that in spite of some difficulties in registering ARPPIS fellows at the participating universities, the ARPPIS programme has proven itself, thanks to the contributions and efforts of the ICIPE, the various donors and the participating universities. ARPPIS fellows have established themselves in the international scientific circles by their publications and participation in international scientific conferences. The ARPPIS programme shows that competent professionals can be trained *in the South to serve the South.*

Finally, it now seems appropriate to expand the ARPPIS programme by helping the former graduates to start small-scale research projects in their home countries, through funding from various donor countries or organisations, in collaboration with the ICIPE.

Table 1. Attachment of ARPPIS Scholars to ICIPE Research Programmes

Programme/Unit	1983	1984	1985	1986	1987	1988	1989	1990	Total
Crop Pests	3	5		7	2	2	7	4	30
Livestock Ticks	2	1	1		3	1	1	1	11
Tsetse	1	2	3	1	2	2	2	1	14
Medical Vectors	1		2		2	2		2	9
Chemistry/Biochemistry			1			1		1	3
Sensory Physiology						1	1	1	3
Termites	1								1
Locust								4	4
Total	8	8	7	8	9	9	11	14	75

Table 2. Status of ARPPIS Scholar after Graduation in October 1990

Number	Present position	Location
13	Lecturers	Universities
3	Postdoctoral Fellows	ICIPE/ILCA
4	Scientists	PESTNET/FAO/IRLCO
3	Entomologists	Ministries
9	Research Officers	Ministries
4	Scientific Officers	Ministries

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

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Abstract

There are several Pan-African institutions which were created predominantly for pest management. These organisations were established not only for the purpose of pooling resources, but more so in the realisation that insect pests move freely across national borders. Hence, the cooperative effort by a number of countries affected by such pests.

The African Regional Postgraduate Programme in Insect Science (ARPPIS), was established to train high calibre scientists who would cater for the needs of the African continent in the area of pest management. This paper examines the common objectives of the Pan-African institutions and discusses the role that ARPPIS could play in enhancing these objectives for better management of insect pests that continue to ravage African agriculture and inflict heavy toll on human health.

Introduction

There are a number of Pan-African organisations involved in pest management. These include the OAU Phytosanitary Council, the International Centre of Insect Physiology and Ecology (ICIPE), locust control organisations like the Desert Locust Control Organisation for Eastern Africa (DLCO-EA), the International Red Locust Control Organisation for Central and Southern Africa (IRLCO-CSA), and Organisation Commune de la Lutte Autiacridienne et la Lutte Autiaviare (OCLALAV). These Pan-African institutions are necessary because insect pests have been and remain a major constraint to agricultural production and a hazard to human health. Moreover, some of these pests are migratory, necessitating international cooperation to facilitate effective control of the pests. In addition, the institutions act as a pool of resources and expertise. The common features of the programmes of these institutions include:

(1) Pest surveys and control;
(2) Research into appropriate methodologies and technologies for pest management;

(3) Coordination and dissemination of information on the pests; and
(4) Training.

Success of the programmes largely depends on trained manpower, specialised facilities and adequate training.

Pest Surveys and Control

International and regional pest control institutions are best placed to monitor population build-up and movements of migratory pests for the benefit of affected countries as these pests move freely across international borders. Countries affected by such pests have found it appropriate to use the services of regional organisations. Thus, surveys and control of locusts have traditionally been the preserve of these organisations. However, where this kind of cooperation failed, as for example when Organisation Internationale Contre Le Criquet Migrateur Africaine (OICMA) was disbanded, lack of adequate monitoring of locusts and grasshoppers resulted in extensive outbreaks. On the other hand, the continued existence of IRLCO-CSA, which was formed at the end of the last locust plague, has resulted in preventing a repeat of such a plague.

Appropriate Technologies

International and regional organisations have the benefit of a pool of high calibre scientists who have better facilities at their disposal than their counterparts at the national level. The scientists are also better remunerated and, as such, are able to sustain enthusiasm and high output in their work. Appropriate technologies are, therefore, more likely to be developed by these organisations compared to national institutions. However, these institutions need to maintain trained personnel, and programmes such as ARPPIS are, therefore, a vital means to that end.

Coordination of Information

Countries in invasion areas of migratory pests should share information on the movement and population build-up of the pests. However, apart from locusts, information flow on the other pests shared between the same countries is often lacking. International organisations have often tried to facilitate this information flow. In this connection, the Food and Agriculture Organisation has a regular locust bulletin which serves to warn countries in Africa, and others concerned, of the movements of locusts. The IRLCO-CSA also issues periodic pest situation reports to member countries. However, where there is a shortage of manpower, generation of information from the countries is inadequate so that vital information may be missing in these bulletins. Moreover, lack of trained staff may also mean that the farmer who is the end-user of this information does not benefit from the bulletins and such similar early warning systems.

Training

Here is a critical shortage of trained manpower in the area of insect science in Africa. Although the ARPPIS has done a commendable job in addressing itself to this problem it may take many years to significantly reduce the shortage. In the IRLCO-CSA region, it has long been recognised that for the organisation to effectively carry out its mandate of locust plague prevention, there should be national plant protection services. These services need well trained manpower. Unfortunately, the manpower position in a number of IRLCO-CS member countries is not satisfactory. In some of the countries, for example, the plant protection units are one-man units. Such a man is not even adequately trained. It is evident, therefore, that the training needs, in at least the eastern and southern Africa region, are still

substantial, and ARPPIS should seriously consider the requirements of individual countries in admitting students to its M.Sc. and Ph.D. programmes.

At lower levels of training, such as short-term courses, institutions like IRLCO-CS, FAO and DLCO-EA have been involved in in-service training of staff of the plant protection service. The course is naturally heavily biased in favour of migratory pests. An analysis of the country representation on these courses shows that in many instances, the same people attend over and over again. The impact of the training programmes is as such not properly spread out. It is also a reflection on the manpower position in the countries. It appears, therefore, that ARPPIS will continue to have an important role in meeting training needs of the countries in the region, if the farmers are to benefit from development of new technologies in pest management.

ARPPIS and Regional Organisations

Regional organisations like IRLCO-CS have had long established relationships with ministries of agriculture in their member countries. There are periodic fora in which ideas and experiences are exchanged. The basic needs of these ministries in relation to insect pests are therefore known to the organisations. If ARPPIS is to contribute towards solving farmers insect pest problems, closer cooperation may be advisable between its training programmes and these Pan-African institutions. Such cooperation may result in coordination of research effort, and critical review of the relevance of programmes to farmers in Africa.

Conclusion

In the short period that ARPPIS has been in existence, significant, even if modest, contribution has been made to the training needs of the African continent in the area of insect science. This could not have been possible without the cooperation of the universities. However, more success could be achieved if this cooperation could be extended to national and Pan-African organisations which are mandated with pest management.

Acknowledgement

I would like to gratefully acknowledge the useful comments on this paper by Mr. E.K. Byaruhanga, Director of IRLCO-CSA. I wish also to thank Mary Sitali for typing the manuscript.

Strengthening the Role of Women in Education and Research in Africa Through ARPPIS

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Summary

The percentage of women compared to men at the primary school level is about 50% in many African countries, while at university level, women comprise only 20%. When women are considered alone, 70% take art subjects while only 30% take science. The reasons for such a poor performance in female participation in science are discussed, suggestions for the future given, and the role of ARPPIS in enhancing female scientists emphasised.

Meeting Needs of National Programmes in Advanced Training in Integrated Management of Tsetse in Uganda

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Abstract

From its inception in 1983 the African Regional Postgraduate Programme in Insect Science (ARPPIS) has trained seven Ugandans at Ph.D. and one at M.Ph. degree levels, a large number for a single country considering that the programme has admitted 72 students from 17 countries between 1983–1990. In financial terms, Uganda has benefited by over US$ 300,000 in direct training grants from the programme. Some of the ARPPIS graduates based in Uganda are involved in research projects which are funded by the International Foundation for Science (IFS), Sweden. The research equipment supplied under such grants is important in strengthening the scientific capabilities of the national institutions.

Out of the seven ARPPIS graduates, six are involved in crop pest management systems but only one is specialised in vector management, a major drawback in tsetse control activities in Uganda. Although tsetse control forms a department on its own in the Ministry of Animal Industry and Fisheries, it seriously lacks qualified entomologists. Currently there are 14 B.Sc. graduates working in the department and three of these are doing their M.Sc. training in entomology. These scientists are not specialists and they are unable to collect scientific data on the ecology, behaviour, trapping response and the vectorial capacity of the nine tsetse species we have in the country. This fact has limited tsetse control activities in the country to insecticide application only. However, recently, Lancien traps are being used experimentally in sleeping sickness (SS) areas of Busoga.

We have recently carried out surveys in several districts in the country to determine the prevalance of animal trypanosomiasis and the trypanosome species involved. There has been tremendous improvement in the surveillance, detection and treatment of infections in humans, which has led to significant reduction in human SS cases from over 6700 in 1987 to less than 500 in 1989/1990.

ARPPIS Training Programme

From its inception in 1983 the African Regional Postgraduate Programme in Insect Science (ARPPIS) has trained seven Ugandans at Ph.D. and one at M.Phil. degree levels. Out of these, six are involved in crop pest management systems but only one is specialised in vector management (see Table 1). The demand for ARPPIS-trained scientists on the international employment market has been very high. Out of the seven graduates from Uganda, three are working with international research/Pan-African institutions. This is not only a source of pride for the country but most of all it shows that the standard and quality of the academic training offered by the ARPPIS programme is highly competitive.

Tsetse and Trypanosomiasis in Uganda

There are 22 known tsetse species in Africa and, out of these, Uganda has nine species covering over 70% of the country (Kangwagye, 1988a). The most important species is *Glossina fuscipes*, responsible for the transmission of sleeping sickness in the southeastern parts of the country. There is an acute shortage of trained entomologists capable of undertaking scientific research aimed at the control of these tsetse species. The behaviour of *G. fuscipes* in the eastern part of the country has been sufficiently studied by scientists of the Uganda Trypanosomiasis Research Organisation (UTRO) and Kangwagye *et al.* (1988b). There is no scientific data on the relative density and vectorial ability of the other eight species scattered all over the country.

Human sleeping sickness is endemic in the southeast and northwest parts of the country. The incidence of the disease is fairly well known and detailed figures had been given by Mbulamberi (1988, 1989). The incidence of the disease increased from 52 cases in 1976 to over 8400 in 1980 and between 1977–1987, a total of over 34,000 cases were recorded. The disease has been fluctuating with the political and economic situation in the country. The highest cases were recorded in 1979/1980 and 1985/1986, periods when the country was involved in the liberation wars to overthrow the Amin and the Obote/Okello regimes, respectively.

There is no scientific information on the distribution, prevalence and trypanosome species involved in animal trypanosomiasis. But somehow the country is divided into high, medium and low challenge/risk areas. This division is based on the degree of tsetse infestation (which is not fully known), and the amount of trypanocides administered (Sserwadda, 1988). Tsetse relative population density, infection rate and their livestock interaction levels which form the basis for trypanosome challenge are not known. Any degree of challenge based on the doses of trypanocides used in an area is not scientifically acceptable since rich farmers in an area may spend more money on drugs with or without the presence of the disease. We have recently started epidemiological surveys of bovine trypanosomiasis in some parts of the country (Nyeko *et al.*, 1990).

Control Strategies

Trypanosomiasis control in Uganda still relies mainly on insecticide application against tsetse flies and on chemotherapy for the suspected active cases. The ground application and, sometimes, aerial spraying of insecticides are the commonly used control methods, but a limited use of traps is being tried (Kangwagye *et al.*, 1988). Except in the human sleeping sickness areas, the economic aspects of tsetse control are not considered. Besides knowing that an area is infested with tsetse flies, there is no information on the relative or absolute fly density, the infection rate and the host-parasite-vector relationship. Such tsetse control strategies based on non-scientific knowledge is more political and administrative with very little impact on disease control and management.

The introduction of newer and environmentally sound methods like traps and insecticide impregnated targets has been slow in Uganda due to lack of field research information on the efficacy and fly response to these methods. Recently, Lancien traps are being deployed in the sleeping sickness areas of Busoga and the impact of this in combination with other methods on disease control is evidenced by the drastic reduction in the sleeping sickness cases in the region (Mbulamberi, 1990).

Problems

Tsetse control in Uganda is not maximally exploiting newer and environmentally safe control strategies because training of the scientific staff had been neglected. There are several international funding agencies, such as WHO, IAEA, ICIPE, etc., which offer sponsorship to

young scientists from developing countries to pursue higher degrees in medical entomology. These agencies need a letter from the head of a national institution recommending candidates for training. Although most heads of government institutions are aware of these training opportunities, they are usually reluctant to recommend candidates. These officers have deep fears that the young trained scientists will take over their positions. This is a major reason for the shortage of trained manpower in some professional departments in Africa. The ignorance and/or malice of these heads of government institutions result in the loss of millions of dollars in training grants and manpower development.

In several instances, well qualified African scientists are not adequately utilised in planning for national development and disease control strategies. Those officers with basic training but holding responsible positions tend to influence the ministers and permanent secretaries such that planning and disease control ideas are not sought outside their own limited knowledge. In their minds they fear that the well trained scientists with modern and internationally accepted ideas will overshadow theirs. In some cases this attitude has led to the brain drain that deprives African governments of trained scientists.

The ICIPE, under FAMESA or ARPPIS, should take these problems seriously and seek solutions to them. I suggest that ICIPE organise seminars of heads of government institutions and address the need to seek and accept ideas from the trained national scientists for effective disease control benefits in Africa.

References

Kangwagye, T.N. (1988a) Tsetse Control, Past and Present. Integrated Tsetse and Trypanosomiasis in Uganda. Workshop, pp. 9–15.

Kangwagye, T.N.; Oliaka, J.E. and Baguma, G. (1988b) Trapping of and ground spraying against *Glossina fuscipes* in the control of human trypanosomiasis epidemic in N.W. and S.E. Uganda. OAU/STRC, 1989, pp. 413–421.

Mbulamberi, D.B. (1988) Prevalence and Control of Human Trypanosomiasis in Uganda. Integrated Tsetse and Trypanosomiasis Control in Uganda, Workshop pp. 16–22.

Mbulamberi, D.B. (1989) A Review of Human African Sleeping Sickness (HAT) in Uganda. *E. African Med. J.* 66:743–747.

Mbulamberi, D.B. (1990) Uganda Ministry of Health, National Sleeping Sickness Control Programme. *Quarterly Report*, 1990. 16 pp.

Nyeko, J.H.P.; MoiYoi, O.K.; Otieno, L.H. and Ociba, M.P. (1990) Characterization of trypanosome isolates from cattle in Uganda using species-specific DNA probes reveals predominance of mixed infections. *Insect Sci. Applic.* 11:273–280.

Sserwadda, F. (1988) Prevalence and Control of Animal Trypanosomiasis in Uganda, Past and Present. Integrated Tsetse and Trypanosomiasis in Uganda. Workshop pp. 23–30.

Table 1. ARPPIS Fellows from Uganda (1983–1990)

Year	Fellows	Speciality	Present	PD/Grant
1983	S. Kyamanywa	ICPM	PESTNET	IFS
	J.H.P. Nyeko	IVM	UGANDA/PS	IFS
1984	J.W. Bahana	ICPM	IRLCO	–
	M. Ogenga-Latigo	ICPM	UGANDA/MU	IFS
1986	E. Karamura	ICPM	UGANDA/PS	–
1987	J. Ogwang	ICPM	ICIPE	–
1988	C.F. Mugoya	ICPM	ARPPIS	–

Contribution of the ARPPIS Research Project to Tsetse Control in Ethiopia

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Summary

Studies on the epidemiology of African trypanosomiasis were conducted in south-western Ethiopia from 1986–1988. During the study period, flies were trapped and dissected for infection rate determination, aging and blood meal analysis, which was done at the International Laboratory for Animal Diseases (ILRAD). Fly infection rates were significantly correlated ($r = 0.87$, $P < 0.01$) with trypanosome prevalence in the area.

Blood meal analysis results from *Glossina pallidipes* Austen showed that 74% of the feeds in Ghibe and 62% in Tolley were obtained from cattle. Prevalence of trypanosomiasis in cattle was recorded. It was positively correlated with the logarithm of tsetse challenge ($r = 0.71$, $P < 0.01$). Trends in trypanosome infection rates over time were correlated with trypanosome infection. During the project's lifetime, over 20 mid-level, 3 MSc. and 2 DVM students were trained in the project.

Potential for Adopting the ICIPE Tsetse Control Components in Ghana

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Abstract

Tsetse infestation in Ghana constitutes a major constraint on livestock expansion and other socio-economic development of 37% of the total area of 239,400 km^2 held captive by both riverine and *morsitans* species of tsetse. Although the tsetse and trypanosomiasis problems have been known for decades, no serious or sustained effort has been made to control the disease and the tsetse, except for irregular chemotherapeutic interventions.

This paper briefly outlines the tsetse and trypanosomiasis situation in Ghana with emphasis on the previous methods and those that are still being used or being developed to control the tsetse. The potential is discussed for adopting ICIPE's tsetse control components in developing an integrated tsetse control based on the use of odour-baited and insecticide impregnated screens and traps and the sterile insect technique. National commitment and sub-regional cooperation in tsetse control is emphasised.

Introduction

The widespread occurrence of tsetse flies, *Glossina* species, and the consequent incidence of animal trypanosomiasis has long been recognised as a major limiting factor in the livestock development of northern sector of Ghana where 95% of the national herd is located. In certain areas of this region, tsetse infestation has discouraged human settlement and agricultural and industrial activities due to the physical discomfort caused by the high fly densities and the human sleeping sickness, which they also transmit.

Past Tsetse Control Measures

Tsetse control between 1929 and 1949 was effected by both ruthless and selective bush clearing directed against the riverine species *G. palpalis palpalis* (R - D) and *G. tachinoides* (West), reclaiming a total of 1579 km^2 of land for agricultural activities. This was followed by removal trapping and ground residual insecticide application against the savanna species, *G. morsitans submorsitans* and the forest species, *G. longipalpis* (Nash, 1948; Maclennan, 1967). Past control schemes have met with varying degrees of success reflecting not only the operational and technical constraints encountered, but also an incomplete understanding of the ecology and

[1]Previously Ms. Delphina A. Adabie (the 1984 Class)

the behaviour of the species concerned. A sound knowledge of these aspects is a fundamental prerequisite for determining the prospects for successful control eradication. Since the tsetse eradication campaign in 1949, there has not been any concerted and sustained effort made to control tsetse and trypanosomiasis in Ghana. However, in 1979, the government of Ghana and the Federal Republic of Germany (GTZ) embarked upon a joint tsetse research control project which led to the updating of the tsetse distribution map of Ghana north of latitude 8°N. This was then followed by control of tsetse and trypanosomiasis using curative preventive treatment of livestock, rearing and distribution of trypanotolerant breeds of cattle to areas of low to medium tsetse challenge, insecticidal spraying, selective bush clearing, game destruction and erection of effective barriers against reinfestation. This project came to an end in 1983 and surveillance came to a halt.

The government of Ghana in recent years has seriously addressed the tsetse and trypanosomiasis problem with the ultimate aim of eradicating *G.p. palpalis* and *G. tachinoides* in critical areas in the northern sector of the country where 95% of the cattle population of 441, 639 is located. This is to reclaim land for human settlement, crop protection, livestock expansion and other socio-economic development in areas declared as onchocerciasis-free zone, due to a successful *Simulium* (vector of river blindness) eradication campaign undertaken under the executing agency of World Health Organisation (WHO). Various methods have been tried in the past to control/eliminate tsetse flies in Ghana, but the measures have been unsuccessful so alternative means are being investigated. Among possible strategies to be adopted is certainly one which is expected to give the best results because it removes one of the links in the cycle of disease transmission.

However, where eradication is not feasible, local solutions to tsetse and trypanosomiasis involve a combination of several different methods. Sterile Insect Technique (SIT) is being developed in Ghana, and will be used in combination with other environmentally safe control measures as soon as the difficulties involved in making it effective are overcome. Meanwhile, laboratory studies on rearing and radiation of tsetse flies, routine surveillance of tsetse distribution and apparent density, and incidence of trypanosomiasis in cattle and flies in selected areas of northern, upper east and upper west regions of Ghana are continuing.

ICIPE's research on developing an integrated tsetse control approach is based on, among other things, the development of a population model for the main vector of trypanosomiasis in East and Central Africa, *G. pallidipes*, which can be extended to an epidemiological model (Dransfield, pers. commun.); the development of trapping technologies capable of being utilised in control strategies; the use of tsetse pathological agents, such as viruses which have been found to cause sterility in males, and the use of natural enemies to control the tsetse.

Through a multi-disciplinary approach to the study of the population dynamics and the disease transmission in *G. pallidipes* population at Nguruman, Kenya, and the development of a high solution population model (Mutinga, 1986), ICIPE has identified some tsetse control components which have great prospect for their adoption in integrated control of tsetse flies. The components which are worthy of consideration for adoption into the integrated tsetse control programme being developed by Ghana are the deployment of simple and cheap odour-baited traps for tsetse population suppression, and the community participation in tsetse control programmes in their areas. In addition, the two research approaches employed by ICIPE in obtaining their impressive results are worth considering in any research aimed at developing sound strategies in integrated pest vector management.

Potential for Adopting ICIPE's Tsetse Control Components in Ghana

The results of high quality scientific research are there for nations which have the trained manpower and financial and material resources to make use of them. The question

is has Ghana got the potential in terms of staffing, funding and equipment and facilities to adopt ICIPE's tsetse control components. I shall attempt to answer this question along the following lines.

1. *Multi-Disciplinary Team Approach to Tsetse Research*

Presently field and laboratory teams of entomologists, parasitologists, veterinarians etc. in Ghanaian scientific institutions are working in splendid isolation in different habitat types, and this has made it difficult, if not impossible, to use the data from one team to interpret another. Currently a project, which is developing SIT for the control of riverine tsetse flies in Ghana, is adopting the multidisciplinary approach in collecting all data which might be used for the development of both tsetse population and epidemiological models. This is important because in a disease like trypanosomiasis in which vector numbers clearly determine the disease prevalence, an epidemiological model of disease transmission complements the vector population model. Such an approach obviously requires a close cooperation between dedicated scientists and financial and material resources to carry out the research in the most effective manner.

Fortunately for Ghana, the manpower requirements for such a project are available, hence this project is being undertaken by scientists and technical staff from three institutions, namely, National Nuclear Research Institute (NNRI), to which I belong, the Animal Research Institute (ARI) and the Department of Animal Health and Production (DAHP) of the Ministry of Agriculture. Again, there is a National Coordinating Committee which has been instituted with a view of ensuring that tsetse and trypanosomiasis operations are not undertaken in isolation, and that all concerned government services participate in the planning and implementation of relevant tsetse control programme and related follow-up development activities. In addition, there is a National Steering Committee on tsetse control in Ghana which seeks the massive funding required to undertake such long-term programmes.

The professional staff of DAHP, which is in a better position than any organisation and/or institution to undertake such field operations effectively, are all veterinarians who have received some relevant training in tsetse control operations. Some of the middle-level technical staff have undergone field training either in Ghana or elsewhere in Africa to equip them for tsetse control in the field. The field assistants have had considerable on-the-job training in tsetse rearing and control operations involving SIT. In view of the above, the potential for adopting this approach in tsetse research and control is good in terms of the available manpower. The major constraints are lack of basic equipment for tsetse rearing, lack of reliable 4 - wheel drive vehicles, insufficient camping equipment and acute shortage of funds.

2. *Modelling Approach to Tsetse Research*

We hope to adopt a modelling approach in our tsetse research programme. One may ask why build models of tsetse population dynamics and epidemiology of disease transmission? From ICIPE's experience it is abundantly clear that the modelling approach has the following benefits:

(a) it forces thoughts, hypotheses and data to be organised in an efficient and logical manner to achieve the stated objectives in the most cost-effective way;

(b) it exposes gaps in the field data on which future goal-oriented research can be concentrated;

(c) it reveals the relative importance of all relationships thus helping to identify research priorities; and

(d) most importantly, a full model which not only describes, but also explains the study system can be used to predict the effectiveness of various suggested

control strategies, by predicting the impact of different levels of control on key variables such as tsetse population size, animal infection rates, etc.

All these desirable features are worth considering in any search for a vector control strategy based on a thorough understanding of the population ecology and the epidemiology of the disease.

3. *Trapping Technology*

Little work has been done on odour-baited trapping so the behaviour of flies towards baits and traps is not fully established. This is because past limited studies revealed that West African tsetse fly species do not react to odours. Recent advances made in the use of odour-baited traps in tsetse population suppression in Kenya (Dransfield *et al.*, 1986) and Zimbabwe (Vale, 1980; Vale and Hall, 1985) have aroused interest in research in trapping technology in West Africa. In 1989 two projects were initiated in Ghana to develop and improve trapping technology, and to develop formulations which are effective in tsetse control and are environmentally less hazardous. The approach is designed to involve three types of formulations:

(a) Formulation for impregnation of target screens and traps to be used as barriers;
(b) Pour-on formulations for the treatment of tsetse fly host animals; and
(c) Paint-type formulation for treatment of tsetse fly resting places.

Potential for adopting the trapping technology is good in terms of available qualified manpower. Again the major constraints are lack of funds and insufficient equipment and facilities.

4. *Community Participation in Tsetse Control*

People contribute to the tsetse and trypanosomiasis problem by moving themselves and their animals to tsetse infested areas for grazing of their animals or agricultural activities. It is therefore important to obtain the cooperation of the local people in tsetse control operations. To achieve this, various means of communication, including broadcasts, public meetings and posters, must be employed. Such involvement should start right from the research stage to the control stage. It is also necessary to understand the people's social attitudes and cultural values, and the constraints and priorities in the local community. It is equally necessary to establish the traditional knowledge regarding the habit and movement of the flies, as well as methods of avoiding infections and skills used to treat infected persons and animals (Prah, 1989). There must also be a visible demonstration of the gains to be derived in their participation in the control programme.

To adopt the community participation in tsetse control programme in Ghana, there is a need to embark upon extensive public education to train the people how to use the new low-cost, attractive screens and traps. Such a campaign will reduce the loss of targets, traps, etc. during the tsetse control campaign (a situation which was experienced in Nigeria and Burkina Faso). Since these devices do not need sophisticated equipment and highly trained personnel for their application, they offer a real possibility for small intra-country and inter-country control projects with greater prospects of support from the local communities and national government. The major constraints in adopting this approach are inadequate supply of traps/screens, lack of reliable means of transport for deployment of the traps/screens and lack of incentives for field workers.

Problems that Ghana has to overcome to adopt any of the ICIPE's tsetse control components are quite numerous, the most important being the acute shortage of funds and lack of equipment and facilities. It is quite obvious that all African nations with tsetse and trypanosomiasis problems need to strengthen their education and research capabilities, in

order to increase their manpower requirements and their potential for adopting effective tsetse control components being identified by research institutes all over Africa and elsewhere. It is gladdening to note that ICIPE's ARPPIS programme and other short term courses organised by national and international organisations are helping to alleviate the problem of shortage of manpower.

Regional cooperation and pooling resources will be good strategies for solving the problem of poor inter-institutional coordination and shortage of facilities. In view of the fact that Ghana and her neighbours share the same tsetse species, and the fact that tsetse has area-wide distribution, it would be most appropriate and economical to tackle the tsetse problem on a sub-regional and/or regional basis through cooperation to do joint control projects at common borders.

In conclusion, I am very optimistic that the multidisciplinary approach in tsetse research and the community participation in insect control operations would play central roles not only in future integrated tsetse control programmes in Africa, but in other integrated pest management strategies.

References

Dransfield, R.D.; Brightwell, R.; Chaudhury, M.F.; Golder, T.K. and Tarimo, S.A.R. (1986) The use of odour attractants for sampling *Glossina pallidipes* Austen (Diptera: Glossinidae) at Nguruman, Kenya. *Bull. ent. Res.* 76:607–619.

Maclennan, K.J.R. (1967) Recent advances in the techniques for tsetse control. *Bull. Org. Mond Sante.* 37:615–625.

Mutinga, J.M. (1986) The ICIPE's research programme on tsetse and trypanosomiasis. In *Integrated Tsetse Fly Control: Methods and Strategies.* Cavallora, R., ed. 113–115.

Nash, T.A.M. (1948) Tsetse flies of British West Africa. Published for the Colonial Office by His Majesty's Stationery Office 1948, 28–47.

Prah, K.K. (ed) (1989) The Social and Biological Sciences Interface Research Experience at ICIPE: Problems and Prospects. 78 pp.

Vale, G.A. (1980) Field studies of the responses of tsetse flies and other Diptera to carbon dioxide, acetone and other chemicals. *Bull. ent. Res.* 70:563–570.

Vale, G.A. and Hall, D.R. (1985) The use of 1 octen-3-ol, acetone and carbon dioxide to improve baits for tsetse flies. *Bull. ent. Res.* 75:219–231.

Situation Report on Field Experience and Evaluation of the Impact of ARPPIS in Sudan

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Abstract

As one of the ARPPIS first group (1983–1986) graduates from Sudan, my career started as a lecturer of parasitology and invertebrate zoology, first as a part-time lecturer at the School of Hygiene and Environmental Studies at the University of Khartoum, then as a full-time lecturer at Omdurman Islamic University. Omdurman University is a relatively newly established university, and has no proper laboratories or research facilities.

At the School of Hygiene and Environmental Studies, I developed the new curriculum and taught a course on medical entomology and vector management, based on the lecture notes done during my ARPPIS studies and my literature reviews on integrated vector management. For the first time the course was taught as integrated vector management instead of just vector management.

My research in ARPPIS was on leishmaniasis which was a real problem in Sudan when I returned. I have joined a Leishmania group, which was established at that time, at the Medical Research Council including epidemiology, pathology and characterisation. More work is being done on pathology and clinical manifestation of the disease, but the work on epidemiology and characterisation is limited due to the lack of funds. Grants were offered by some agencies and more grants and collaboration are expected from WHO in 1991.

Introduction

As one of the ARPPIS first group (1983–1986), my research was on leishmaniasis. My field experience can be summarised in two areas, both teaching and research.

Teaching Experience

At the School of Hygiene and Environmental Studies, I had the opportunity to set the curriculum and teach a course on medical entomology and vector management. The course was devised into two parts, theory and practical, and the practical included both field and laboratory work, in which I taught all the techniques and methods I had applied during ARPPIS.

The same applies to the Omdurman Islamic University where I teach integrated vector management and parasitology to final year zoology students. The curriculum for the course includes:

1. Introduction to vector-borne diseases;
2. General biology and life cycles of the parasites;

3. Transmission patterns of vector-borne diseases;
4. General biology and life cycles of the vectors;
5. Methods for control; and
6. Epidemiological techniques.

Research Experience

Since the early years of this century, both visceral leishmaniasis (VL), and cutaneous leishmaniasis (CL) have been reported in the Sudan. Much attention has been given to VL. Comprehensive studies were intensified in an endemic area (Upper Nile Province) during the 1960s by the NAMRU-3 group in collaboration with the government of Sudan. The final report of these studies published by Hoogstraal and Heyneman (1969) represents a body of knowledge on VL epidemiology during those years. Up to that time, VL was known to confine itself to the endemic area in eastern central Sudan, but later extended to the north as far as Khartoum; some cases of CL have been recorded in the northern part of the country as reported by Hamza *et al.*, 1976.

Recently, outbreaks of VL and CL have taken place in areas, around and in Khartoum, where they were previously unknown (El Safi *et al.*, 1987). This made leishmaniasis one of the health problems in the Sudan. El Safi *et al.* (1987) have suggested that one cause of the epidemic could be the migration of reservoir hosts during the year of drought followed by rainfall. Accordingly, various species of animals in the area have been screened (rodents and canines). .One Nile rat, *Arvicanthis niloticus* and one genet cat, *Genetta genetta*, were found naturally infected. Although these results are very valid, they are not enough to draw any conclusions about the possible reservoir hosts in the area.

Currently there is concern about refugees from southern Sudan who are migrating northwards to Khartoum. VL is common in these migrants and there is a possibility of the establishment of new epidemics in foci as far north as Khartoum. Although a study by Heyneman (1963) produced evidence that *P. papatasi* was unlikely to transmit VL in the Sudan, this work needs to be confirmed. He used only one isolate and other parasites may not develop in the same way in this sandfly, which is common in the area where refugees are living.

Work is now starting on the isolation and typing (overseas) of as many strains as possible from VL patients. It is strongly suspected that there may be more than one species of parasite responsible for the disease, and one or more of these may be transmitted by *P. papatasi*.

The main objectives of our research are: (1) identification of vector for VL and CL in Sudan; and (2) identification of reservoir hosts for VL and CL in Sudan.

Our first field trip was to Dinder National Park area which is a savanna region, with the objective to identify the species of sandflies present in the area. Before presenting our results it is worth saying that the latest published study for sandflies distribution in Dinder area was done by Quata (1964).

We collected sandflies from termite mounds and from the camp, using light-traps and sticky-traps. The collected flies were taken to the lab and identified by a taxonomist.

The species of the subgenus *Phlebotomus* found to be in the area are: *Phlebotomus duboscqi, P. papatasi, P. orientalis* and *P. martini*. While the species of the subgenus *Sergentomyia* are, *S. africana* complex, *S. antennatus S. schwetzi, S. clydei, S. tiberiadis, S. bedfordi, S. schantideni, S. christophersi, S. squamipleuris, S. dryfussi, S. hunti* and *S. calcaratus*.

We find that *P. duboscqi* was suggested by Laviviere (1959) to be the vector for CL in East Africa and by Qutubudding (1961) to be the vector for CL in Western Sudan. *P. papatasi* was found in very large numbers in Khartoum by Lewis and Kirk (1954) and was found in very small numbers in Dinder during our field survey. *P. martini* was found only in termite mounds

in Dinder area. *P. orientalis*, which is also found in the Dinder area only, is the only proven vector for VL in the upper Nile area in Sudan (Hoogstraal and Hyneman, 1969). As for *Sergentomyia* species, the *Sergentomyia africana* complex were reportedly found away from human settlements, e.g. in parks (Buttiker and Lewis, 1983) and in our case were found to be common in the Dinder area. *S. antennatus* were reported by Lewis and Kirk (1961) to be common in all provinces of Sudan.

Conclusion

In conclusion I cannot find enough words to thank those who made it possible for me to join ARPPIS and to thank even more those who made it possible for us to meet again with ARPPIS. It is my true opinion that ARPPIS has proved to be successful and progressive programme and our gathering today is the evidence for that.

I wish more success and progress for ARPPIS and prosperous future for all ARPPIS scholars.

References

Buttiker, W. and Lewis, D.J. (1983) Insects of Saudi Arabia, some ecological aspects of Saudi Arabian Phlebotomine sandflies (Diptera: Psychodidae) fauna of Saudi Arabia, *Pro. Entomologia*, 5:479–528.

El Safi, S.H.; Peters, W. and Evans, D. (1988) Current situation with regard to leishmaniasis in Sudan, with particular reference to the recent outbreak of cutaneous leishmaniasis in Khartoum. In *Research on Control Strategies for Leishmaniasis*. Proc. Int. Ottawa. IDRC-MR 184E.

Hamza, Y.O.; Abdalla, R.E.; Ahmed, M.A.; Awahab, S.M.; Anur, O.M. and El Hassan, A.M. (1976) Northward spread of visceral leishmaniasis in Sudan. *Trans. R. Soc. Trop. Med. Hyg.* 70:266.

Heyema, D. (1963) Leishmaniasis in the Sudan Republic. 12. Comparison of experimental *Leishmania donovani* infections in *P. papatasi* with natural infection found in man baited *P. orientalis* captures in kala-azar endemic region of the Sudan. *Amer. J. Trop. Med. Hyg.*, 12:735–740.

Hoogstraal, H. and Heyneman, D. (1969) Leishmaniasis in the Sudan Republic. Final epidemological report. *Am. J. Trop. Med. Hyg.* 18:1091–1210.

Lewis, D. J. and Kirk, R. (1954) Notes on the Phlebotominae of the Anglo-Egyptian Sudan. *Ann. Trop. Med. Parasitol.* 48:33–45.

_____. (1951). The sandflies of the Anglo-Egyptian Sudan. *Bull. Entomol. Res.* 41:563–576.

Quate, L.W. (1964) Leishmaniasis in the Sudan Republic. 19. Phlebotomus sandflies of the Paloich area in the Sudan (Diptera: Psychodiadae). *J. Med. Ent.* 1(3):213–263.

Qutubuddin, M. (1961) A description of the hitherto unknown male of *Phlebotomus beischi* Kirk & Lewis with redescription of the female from Sudan Republic. *Ann. Mag. Nat. Hist. S.* 13(3):605–607.

Strengthening National Research on Medical Vectors in Kenya Through ARPPIS

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Abstract

Most African countries have recognised the need to establish both agricultural and medical national research institutions to look into the possible solutions to the problems of food production and disease eradication respectively. Such institutes usually require substantial funding for training and research in order to realise their objectives. This paper discusses the bold steps taken by ARPPIS through ICIPE to contribute towards the education and production of large numbers of high calibre research scientists required to strengthen the national research institutes concerned with medical vectors in Kenya.

Introduction

The education and sustenance of a large number of scientists is an essential step towards initiating and strengthening science oriented development in Kenya. This calls for the creation of a suitable atmosphere for scientific research. The recognition and financial support for the country's intellectuals is the means by which that country can accumulate a stock of technological knowledge and experience necessary for development. Currently the number of high calibre research scientists in Kenya is small, and coupled with the financial constraints, cannot adequately sustain the national research development programme. There is no single African country that can at the moment develop all the requisite scientific and technological capabilities it requires.

This anomaly can be corrected by intensifying high level training at the advanced degree and postdoctoral levels, specifically for Africans in Africa. Highest priority should be given to train young medical entomologists in different vector-borne diseases and different aspects of vector control. In addition to regular courses up to M.Sc. level, workshops and seminars should be organised to give practical field orientation. Young students can also be encouraged to choose science subjects for the development of their future career.

It is with this in mind that ARPPIS was formed, providing a Ph.D. programme to selected qualified students from the following national institutions in Kenya: Kenya Trypanosomiasis Research Institute, Kenya Medical Research Institute, Division of Vector Borne Disease, Kenyatta University and Moi University.

The role of ARPPIS is to facilitate the means through which the African scientists can investigate the biology, ecology, physiology and behaviour of insect vectors that attack man

and cause debilitating diseases, thus reducing productivity. This is when the importance of ARPPIS becomes a reality. ARPPIS provides the necessary physical research facilities in terms of laboratories at ICIPE. Financial support is provided to enable the scholar to carry out his experiments either in the laboratories or the experimental fields. Equipment and chemicals are made available on demand and without delay. Scholars are in close contact with the experienced ICIPE scientific supervisors. ARPPIS also provides the means through which the university supervisors can visit the students while in the field.

Although the number of ARPPIS scholars who have graduated in medical vectors through this system may appear small, the contribution they have made has been immense. Various aspects of medical vectors have been extensively studied ranging from:

(1) Ecology of the various insect vectors, for example
- Sandflies in the Baringo District by Dr. M. Basimike
- Sandflies in the Kitui District by Mr. A. Onyido
- Mosquitoes in the Baringo District by Dr. I. Aniedu
- Mosquitoes in the Kirinyaga District by Mrs. B. Rapuoda
- Tsetse in the Nkuruman area of Kajiado District by Mr. P. Muange, Dr. C. Kyorku, Miss D. Adabie and Mr. S. Siziya
- Tsetse in Rusinga Island by Mr. M.I. Mwangelwa
- Ticks in Kabete by Mrs. E. Mwangi

(2) Biology of vector species: Advanced laboratory research on molecular biology of the vector insects has not been ignored by the ARPPIS scholars:
- Biochemical taxonomy of phlebotomine sandflies by Dr. H. Mahamat
- Molecular characterisation of *Leishmania* species by Mrs. V. Nyambati
- Characterisation of different strains of trypanosomes from different parts of Kenya by Mrs. U. Elneima
- Infestation of tsetse fly with virus like particles by Mrs. R. Sang.

(3) Behaviour
- The mating behaviour of *G. morsitans morsitans* has been studied by Mr. J. Davis-Cole

Out of the above topics, medical vectors have been well covered and we now have two students in the 1990 class, one working on the sensory physiology and behaviour of mosquitoes and the other on the effects of plant juices on sandfly biology.

Impact of ARPPIS on National Medical Vectors Research

The work carried out by ARPPIS scholars provides the national research institutions with baseline data and scientific knowledge. This has given the institutions a stepping stone to leap into the next plan of action—developing strategies of novel control methods. In the national research institutes there is lack of funding to enable the scientists to collect data continuously for over a period of 2 years, as provided for by ARPPIS. Therefore, it is very difficult to determine the general seasonal trend in a population density of a given vector of medical importance and its contribution to the transmission of disease, etc.

The ARPPIS graduates will be further deployed in the national research institutes as research scientists, university lecturers and, in time, as the heads of those institutes.

Table 1. ARPPIS Scholars' Projects on Medical Vectors

Year	Medical Vectors scholars	Per cent in total
1983	5	71
1984	3	37
1985	4	57
1986	1	12
1987	6	66
1988	4	44
1989	3	30
1990	2	14
Total	28	41.4

Table 2. Several ARPPIS Medical Vector Graduates Currently Employed in the Following National Research Institutes in Kenya

KEMRI	Research Scientist	1
Kenyatta University	Lecturers	2
Moi University	Lecturers	3
DVBD[1]	Research Scientist	2
KETRI[2]	Research Scientist	1
KARI[3]	Research Scientist	2
Total		11

[1]Division of Vector Borne Disease
[2]Kenya Trypanosomiasis Research Institute
[3]Kenya Agricultural Research Institute

Strengthening National Agricultural Research on Crop Pest Control in Somalia: Experiences of an ARPPIS Graduate

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Abstract

PESTNET activities in Somalia were officially inaugurated in July 1988 with the posting of a PESTNET Resident Scientist, an ARPPIS graduate, to team up with the national scientists in research strengthening operations on pest management. The project involves conducting collaborative research and training within the agricultural research and extension framework of the Ministry of Agriculture, a task that needs tact in approach and performance, often claimed to be found in persons of authority, long experience and perhaps the aged. In this paper the author examines challenges and experiences of ARPPIS training in meeting research strengthening objectives in Africa with particular interest in Somalia. The paper highlights some research and training results from work conducted by the team to illustrate some advantages and shortcomings of ARPPIS training. The author gives a brief comparison of ARPPIS training versus both training elsewhere and foreign expatriates contributing to the objectives of research strengthening in crop pest control. Finally, the paper discusses how ARPPIS could improve its training to meet the tough challenges of pest management in tropical Africa.

Introduction

Crop protection and pest management research in Somalia is an integral part of the Agricultural Research Directorate of the Ministry of Agriculture (MOA). The Ministry is constituted by the different departments, namely Research Directorate, Agricultural Planning, Agricultural Farm Management Extension and Training (AFMET), and crop protection, as well as a number of semi-autonomous projects, such as the Bay Region Agricultural Deyr Project, etc.

Crop research is conducted under the auspices of the Research Directorate Department with H/A in the MAO, Mogadishu, but functionally located at the Central Agricultural Research Station (CARS) at Afgoye in Lower Shabelle Region. There are also three regional research stations: at Bonka, Jilib and Aburein. The general activities of these stations are fully described in a report by ISNAR, "Development of an Agricultural Research System to serve Somalia", November 1983. At CARS, the major emphasis is on irrigated crops, especially maize, but research is also done on grain legumes, horticulture and fruit trees. The Jilib and Aburein stations function as sub-stations of CARS while at the Bonka Dry Land Agricultural

Research Station (BDARS) the main emphasis is on rain-fed crops, especially sorghum and grain legumes.

Research Strengthening in Somalia

Research at CAR/Afgoye is divided on a commodity basis, namely horticulture, grain legumes, oil crops and fruit trees improvement programmes, within which the following research activities are conducted: breeding, entomology, pathology, soils and farming systems. This station has a long history of research support from many sources, the notable ones being:

1965 – 1969	University of Wyoming
1975 – 1979	Mid-West Universities Consortium for International Agriculture
1979 – Present	UNDP/FAO

Some international centres have also participated in research strengthening at CARS, such as CIMMYT, CIAT and IITA. The ICIPE/Somalia collaborative project (PESTNET Somalia) is the latest of this group.

At Bonka, sorghum is the major research crop, although some work is being done on grain legumes, oil crops and fodder crops. Bonka is a relatively recent station established through the financial and technical support of USAID contracted to Wyoming University, which up to 1988 was responsible for research and training at the station. Presently, the research support from external sources is minimal with only an ICIPE resident team supporting pest management research. IDRC is giving financial support and ICRISAT is collaborating with the Sorghum Improvement Programme.

Challenges and Experiences in Research Strengthening

Research strengthening is a common challenge in almost all of Africa where the financial and manpower resources are constantly limited. African research centres have often been supported through technical aid mostly from external sources, notably Europe, Canada and USA, as well as FAO. They usually bring with them complicated laboratory apparatus and farming implements. Research support in such cases is for short duration (3–5 years) with training counterparts abroad more or less for a similar period. In all cases research activities are conducted by a team of expatriates with little local interaction. Presently, African governments allocate little financial and meagre local expertise who are unable to continue meaningful research once the international support is withdrawn. Such is the case in Somalia.

The episode narrated above has slackened the development of research and hindered the production of meaningful results in tropical Africa, especially Somalia. A review of an approach to research strengthening is overdue and is presented here in the context of ARPPIS/PESTNET/National programme collaboration.

The African Regional Postgraduate Programme in Insect Science (ARPPIS) has over the last few years produced high quality M.Sc. and Ph.D. graduates who would go a long way towards modifying the approach in implementing research support programmes to the continent in terms of expertise and collaboration. For the last two and half years the author, who is one of the first ARPPIS graduates, has been on an ICIPE secondment to the Research Directorate as a team leader in the ICIPE/Somalia collaborative project executed by the African Regional Pest Management R&D Network (PESTNET). He is also an experienced researcher having been at the ICIPE for over 10 years after working in a Kenya national research station for some time. It is against this background that the author will briefly compare the challenges and experiences of research strengthening in Somalia research systems as it fits within the overall objectives of this conference.

The major challenges that face agricultural research in Africa, especially Somalia, are setting research priorities, training, obtaining and maintaining qualified researchers and funding. In Somalia the research priorities are well set, at least as far as the pest management research is concerned. The present research priority aims at finding a lasting solution to insect pests of food crops, especially maize and sorghum. On these crops, the stem borers, namely *Chilopartellus* Swinhoe (Pyralidae, Lepidoptera) and *Sesamia critica* L. (Pyralidae, Lepidoptera), are the major pests, with the former being more predominant in Somalia (Nur, 1978; Lavigne, 1988). The chemical insecticides recommended for the control of these pests have yielded least positive results in terms of crop yields and stem borer control in both experimental plots and the farmers' fields in Somalia.

Because of the limited time for the expatriate community and lack of qualified national researchers in the country, the most logical approach was to find a quick and perhaps easy solution to the pest problems through screening of chemical insecticides against stem borers leading to the recommendation of Basudin 10G and Furadan 5G to be used by farmers on maize and sorghum. It was found that despite this great work, more than 90% of the farmers do not use any chemical insecticide against stem borers despite their awareness of the devastating effects of the pests on the crop. Recent research at CARS and Bonka have shown clearly the need to prioritise the research to meet the long term goals of controlling these pests. Through this work, the following IPM potentials have been elucidated:

1. *Biological Control Agents*

Contrary to some previous reports there are several species of natural enemies of stem borers in Somalia whose potential needs to be assessed and exploited. High mortalities have been found on stem borers due to natural mortality factors and their performance appears better under cowpea-maize inter-cropping than pure maize situations.

2. *Cultural Practices*

Field work in Somalia has shown that farmers use maize stovers for livestock feed and even transport a great bulk for sale in urban and non-cropping areas. This practice removes stem borers from farms ensuring minimal carry-over problem between seasons, a practice previously ignored by previous pest control researchers and extension staff in Somalia. The cultural practice of inter-cropping is an indigenous system to Somali farmers, but farmers need to be shown the best way that would reduce stem borer attack and give better returns. Our evaluation of this technique has given some positive results.

3. *Resistant Varieties*

Recent studies have shown that in Somalia, some local and exotic lines of maize and sorghum are available whose performance is satisfactory in terms of grain yields even under heavy stem borer infestations. But perhaps a more important aspect of yield, the stalks, needs to be considered in evaluating varieties for stem borer resistance in Somalia.

4. *Trapping Techniques*

The practice in Somalia of heaping stovers in farmers' fields after harvest to feed livestock ensures a high concentration of stem borer diapausing at one site. Some of these heaps still remain in their places even after planting, resulting in high borer attack of fresh plants due to high population of moths emerging from the stalks. This practice renders itself suitable for moth trapping by means of pheromones or light trap devices to minimise the number of moths flying into the new crop soon after termination of diapause.

Training is an important investment in agricultural research in Somalia. However, this was done very much at the expense of pest management research. It still remains a challenge that the country should train adequate nationals in this field. Over the last 10 years only three entomologists in Somalia have been trained with M.Sc. degrees and the first Ph.D. graduate is yet to come out of the ARPPIS class. The rest of the entomology staff in the country are either young graduates or technicians and yet the challenge is on them to provide thorough research and implement appropriate pest control methods. Thus the expatriates, though they had highly qualified entomologists amongst them, did not leave behind trained local staff, but rather encouraged the staff to continue insecticide screening even though no meaningful reports have been produced over the years. Also, no trained technicians are available in this field. The relevance of training and expertise is an important challenge to pest management in Somalia. One would not blame expatriates from abroad for their lack of consistency with Somalia's pest control challenges. Clearly they are in a strange world, having trained in a different environment, and they therefore needed further training in tropical agriculture, especially pest management techniques and extension. This consumed time, limiting opportunities for training local staff to enable continuity.

Funding is a major challenge in agricultural research in Somalia. The country allocates annually less than 0.4% of its GADP for agricultural research. Donor agencies and projects fund most of the research activities in Somalia (Somali Gov. Report, 1984). The donations usually come in the form of highly sophisticated and expensive machinery and laboratory equipment. Large consignments of equipment arrived over the last 20 years from different sources and are now out of use. The challenge, therefore, is for the research directorate to prioritise the type of funding and equipment required noting that field research at the national level may not be as expensive as is usually envisaged.

One question needs to be answered—how can a locally trained expert contribute to these challenges and how does ARPPIS contribute to this? In setting research priorities in an African country like Somalia, a locally trained expert is an obvious choice due to their wide indigenous experience and total integration. For a local expert, the concept of "tourism" and inhibitions in traditions and cultures are negated; the local training brings familiarity with pest management problems and ease of selection of relevant research projects. Currently pest management research and technology development requires a total integration approach that often eludes foreign expatriates posted to strengthen research programmes in Africa. ARPPIS trained graduates, all Africans and trained in a typical African atmosphere, are well poised to meet these challenges. Secondly because of the rigorous research work and interaction at the national and international level at the ICIPE, the ARPPIS scholars are well placed to meet these challenges. In terms of training, the time-scale for ARPPIS training is appropriate and, throughout the training programme, the trainees meet with a high concentration of scientists, some of whom are former ARPPIS graduates and technicians. The importance of training others at the national level is in-built and becomes a continuous mandate for a local expert from ARPPIS. In Somalia, for instance, training in pest management R&D has over the last two years been a major priority. ARPPIS trains within a limited budget that conditions the potential experts to conduct research within very limited funding resources characteristic to African research stations. Our experience is that ARPPIS prepares candidates for harsh conditions in selecting research priorities, training and funding, major limiting factors in a country like Somalia.

How to do Better in Future

The ARPPIS will be 8 years old in March 1991 having produced many insect scientists presently participating in pest and vector management throughout Africa. It is fitting that it

should be reviewed for a better future performance. The fact that the programme was African-made deserves praise and both ICIPE and ARPPIS coordinating office merit congratulations for bringing ARPPIS above all expectations. The programme has created a healthy interaction between the Centre and participating universities as well as the various national research centres, all of whom have benefited. The fact that ARPPIS has always recruited from mature and experienced practitioners in national research stations and African universities has made its training more mission-oriented and relevant to its intended clientele. Thus no wonder all its graduates are all engaged in the African continent.

For the future, the strength of ARPPIS may be in examining and improving on the following six aspects for a better performance. Each of these is briefly reviewed below:

1. *Coordination*

ARPPIS has developed with a series of coordination constraints. Todate the programme has been ushered to reality in the hands of four academic coordinators, each with different styles, policies, commitments and efficiency, but also lacking the necessary support staff. In the past some coordinators have assumed a high-handed administrative role at the expense of a facilitating role providing minimum linkages between the scholars, ICIPE advisors and the participating universities. In some cases, coordinations and linkages have been maintained with individuals rather than institutions of higher learning, regardless of whether they had relinquished their positions. This has been observed to create tension within the university authorities to the disadvantage of ARPPIS and its scholars.

2. *Selection*

The ARPPIS Academic Board has done a commendable job in maintaining high standards in its selection procedure. This should be upheld. However, the selection has been biased in favour of certain countries regardless of whether some of these countries have more than adequately qualified insect scientists. This practice presents two problems. Firstly, it has given ARPPIS the least exposure in the disadvantaged regions and provided for a skewed distribution of applicants and hence selection. Secondly, if the programme has to meet its major objective of creating a critical mass of insect scientists and strengthen the national research capacities in the continent an even distribution of this very scarce commodity will not be met easily within the intended short time frame. It may well be by now that some African countries are not aware of the presence of this great training facility in Africa. The programme should avoid admitting too many scholars per cohort and in any case, not more than 15 to ensure maximum interaction, supervision and skill development.

3. *Coursework*

The programme presently meets the intended ARPPIS purpose and may have also expanded over time. However, the over emphasis on a pure textbook academy, which has been the main thrust of some lectures, should be minimised to give way for modern scientific themes and trends in pest and vector management of practical value to Africa, as well as skills in research, data handling and interpretation, which calls for more discussion than direct academic teaching. For this purpose the Academic Board should avoid including in their selection lecturers with no proper academic background in the relevant field.

4. *Projects and Supervision*

The selection of research topics that conforms with the Centre's research activities and that can be supervised by the scientists here is excellent and should be continued. However, scholars should be free to select topics relevant to their national programmes as well as

conduct part of these in their countries. Thus, in cases where a practitioner has been admitted to ARPPIS while having an on-going project, a priority should be given for him to continue such a project or part of it in the thesis work as this may encourage continuity at the national research level.

Although the coordinating office has done its best, the gap between the scholars and some of their advisors at ICIPE and participating universities still remains wide. To provide a healthy interaction and supervision, the gap should be closed and scholars accepted as members of the respective programmes. Their ICIPE supervisors should be aware of the fact that thesis advisory work is part of their daily duties at the Centre and not just an assistance rendered to the ARPPIS.

5. *Postgraduate Follow-ups and Communications*

The proposal of setting up an ARPPIS Network is good news as it will assist in creating the necessary communication and interaction between the graduates which is currently inadequate. The ARPPIS newsletter has not penetrated much into the agricultural sectors, even those in which former ARPPIS scholars are resident, such as Somalia. The newsletter should be the main communication organ of the ARPPIS and should carry not only work done at ICIPE by the scholars but also the research highlights of the graduates in their respective domains as well as advertising opportunities within the programme and other related institutions.

6. *National and International Linkages*

The ARPPIS should strive to place its scholars within the international and national linkages on the continent. The ICIPE communication networks, such as PESTNET, PMDDIS and AAIS, should also be exploited. Further, ICIPE as the father of ARPPIS, should as much as possible use the graduates to facilitate its national and international linkages in areas where such personalities exist. This will give them the necessary responsibility and scientific leadership expected of them.

Acknowledgement

I wish to thank the ICIPE, especially the Director, Professor Thomas R. Odhiambo, for the full support during my time in ARPPIS as a member of its pioneering scholars and for providing me with an opportunity to participate in its national research strengthening activities under PESTNET in Somalia. I am grateful to the ARPPIS Academic Coordinator, Professor Z.T. Dabrowski, for organising this important conference and inviting me to participate. I hope that my contribution will be useful for the future of ARPPIS.

Strengthening National Agricultural Research on Crop Pest Control in Zambia

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Abstract

A number of international organisations are currently involved in developing agriculture in Africa. Each of these organisations is specialised in its own field and has its own approach.

The involvement and contribution of the African Regional Postgraduate Programme in Insect Science (ARPPIS) in collaboration with other programmes such as the African Regional Pest Management Research and Development Network (PESTNET) in strengthening the national agricultural research on crop pests in Zambia has been discussed. The on-going work on training and developing control strategies for maize streak virus (MSV) and its vector, *Cicadulina* leafhopper and a complex of maize stalkborers have been cited as the main areas where ARPPIS graduates and the PESTNET programme are involved.

Introduction

There are 14 international agricultural research organisations operating under the umbrella of the Consultative Group on International Agricultural Research (CGIAR). Each of these organisations is specialised in certain fields and has its own approach towards achieving its goal. Three of the organisations have their headquarters in Africa, the International Institute of Tropical Agriculture (IITA), the International Laboratory for Research on Animal Diseases (ILRAD) and the International Livestock Centre for Africa (ILCA). The other institutes are also very active in Africa at the moment. There are two other none CGIAR international organisations, the International Centre of Insect Physiology and Ecology (ICIPE) and the International Council for Research in Agroforestry (ICRAF), which are also based in Africa. All these institutions need personnel to work in Africa. It is important to involve Africans in solving their own problems. Whereas developed countries are flooded with manpower, Africa still needs well trained personnel in science.

The ICIPE realised the need and importance of having a core of trained manpower in Africa as a prerequisite to its collaboration with the national programmes. In this endeavour ICIPE initiated ARPPIS in collaboration with some African universities. ARPPIS was launched in 1983 and has graduated a number of students with Ph.D. degrees in insect science. Many ARPPIS graduates are now involved in insect pest management research or teaching in the national programmes, international organisations or universities. Training at the Ph.D. level is the most notable activity and contribution of ARPPIS. However, ARPPIS is also involved in strengthening national agricultural research by providing advisory and

consultation backup to its graduates in the field. This paper presents an illustration of how some of the ARPPIS graduates have fitted in an international organisation and are seconded to the national agricultural research programme in crop pests control. An example has been taken from the African Regional Pest Management Research and Development Network (PESTNET) involvement in Somalia and Zambia.

PESTNET

PESTNET is a collaborative project involving 12 African countries in eastern and southern Africa and the ICIPE. The overall objective of the project is to increase food production in the region through economically and ecologically sound management of insect pests. Crops, mainly cereals and legumes, form the bulk of human food requirements. In fact, prediction of famine is often based on the expected harvest of grain. Therefore, PESTNET found it logical to start with crop pests. The project is assisting participating countries to:

(1) test and adopt technologies developed in other places;
(2) develop their own IPM packages by offering a strong backing;
(3) facilitate the information exchange; and
(4) provide training (Omolo, 1988).

PESTNET does not necessarily have to conduct research in the national programmes but it offers backup services. For example, in cases where the national programme does not have adequate staff, it can approach PESTNET to second to them a scientist to perform some specific duties and to train their personnel in that line. Somalia and Zambia are examples.

Collaboration between ARPPIS and PESTNET in Zambia

Zambia has a well developed agricultural research system which is based on commodities, but crop protection is not operating at full strength as are other disciplines like agronomy and plant breeding. Unfortunately one commodity which did not have a fully developed crop protection programme is maize, the staple food. To fill this gap, PESTNET moved in to assist the Ministry of Agriculture in 1988 to:

(1) determine the major pests limiting maize production;
(2) develop and assess pest management strategies for the small scale farmer;
(3) strengthen the scientific capacity of the national programme through training; and
(4) facilitate exchange of information on research and development activities on pest management with other countries participating in the network.

The project is based at Mt. Makulu Central Agricultural Research Station.

To effectively satisfy the third objective, PESTNET sought the assistance of ARPPIS to offer training to the Zambia personnel in order that they might take over the project. One ARPPIS graduate was identified as a candidate, due to his experience, to run the project while Zambians are undergoing training. Ministry of Agriculture has seconded three research officers and six technical officers to form a small research and development team.

When the work started, stalk borers and maize streak virus (MSV), which is transmitted by *Cicadulina* leafhoppers, were identified as the key problems (Okech, unpublished). Host plant resistance, cultural control, biological control and use of natural plant products were selected as the main options for combating the above problems. Implementation of host plant resistance demands development of mass rearing facilities for the target insects to ensure efficient and reliable screening for MSV.

Mass Rearing and Screening of Germplasm

Cicadulina leafhoppers. Knowledge and composition of the species is necessary before establishing a colony of *Cicadulina* because:

(1) if the hoppers are not properly identified and more than one species are caged together, there will be hybridization which leads to sterility and therefore the population will not develop; and

(2) the *Cicadulina* species differ in their vectoral capacity (Okoth and Dabrowski, 1987). It is therefore desirable to select a more virulent species. The ARPPIS Coordinator, Professor Z.T. Dabrowski, a specialist in *Cicadulina*, offered his services in identifying the species and also gave instructions on species recognition and identification. This service has been useful in selecting *C. mbila* for mass rearing. Species distribution of *Cicadulina* in Zambia has been surveyed (Okech *et al.*, unpublished). A mass rearing facility has also been developed and screening maize varieties for MSV resistance started. The resident scientist is now giving on-the-job training to the technical officers on rearing *Cicadulina* and screening for resistance to MSV.

Stalkborers

Survey of the agroecological distribution of stalk borers is complete. The following species of stem borers: *Busseola fusca*, *Sesamia calamistis* and *Chilo partellus* have been identified as the major pest species (Okech *et al.*, 1990). The ICIPE method of rearing *C. partellus* has been adopted. A technical officer has completed a six month training at ICIPE and screening germplasm for resistance to stalk borers has been initiated. ARPPIS is training one scientist at Ph.D. level in host plant resistance to continue the work.

The illustration given above is a good example of how ARPPIS can contribute directly and indirectly in strengthening the capacity of the national programmes in agricultural research. An additional strength of ARPPIS in this field lies in the informal ARPPIS Alumni which is very vital for information exchange and informal consultations among its graduates. An ARPPIS graduate can thus remain in contact with the scientific community.

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I wish to thank Professor Thomas R. Odhiambo, Director of ICIPE for being instrumental in the starting of ARPPIS and PESTNET; Professor Z.T. Dabrowski, the ARPPIS Coordinator, for his keen interest and advice in *Cicadulina* work; and A. Chalabesa, the PESTNET Coordinator, Zambia, for his cooperation with ARPPIS in identifying candidates for training.

References

Okech, S.H.O.; Neukermans L.M.R. and Chinsembu, K.C. (1990) Agroecological distribution of major stalk borers of maize in Zambia. In *Proceedings of the Regional Conference on Appropriate Technology for Pest Management in Southern Africa*, Lusaka, Zambia 4–6 December, 1990.

Okoth, V.A.O. and Dabrowski, Z.T. (1987) Population density, species composition and infectivity with maize streak virus (MSV) of *Cicadulina* spp. leafhoppers in some ecological zones in Nigeria. *Acta ecologia applic.* 8:191–200.

Omolo, E.O. (1988) Commentary. *PESTNET Today* 3(3).

The Relevance of ARPPIS Training for National Agricultural Research Systems: The Kenyan Experience

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Abstract

A cost-effective postgraduate training programme in insect science located in Africa would help in curbing "brain-drain" of highly trained indigenous scientific manpower, increasing food production and improving human and animal health. The African Regional Postgraduate Programme in Insect Science (ARPPIS) Ph.D. programme has successfully combined university facilities for academic tradition and research institutes for research and supervision in Africa and produces graduates with an all-round knowledge of applied insect science. More than a dozen indigenous Kenyans who have been through ARPPIS are teaching at local universities, conducting research in KARI's research centres, sister institutes, ministries, and also working within ICIPE. The limited number of ARPPIS fellowships available to Kenyans could be increased by increasing the number of participating Kenyan universities in the ARPPIS network. KARI scientists are working on insect pests on crops that may not be within ICIPE's mandate, such as maize streak virus (MSV), barley yellow dwarf virus (BYDV), citrus greening disease, cypress aphid and cassava mealybug. Training of KARI scientists working on the above insect pest problems within ARPPIS would require special supervision from CGIAR international institutes, KARI, CAB International Institute of Biological Control, Kenya Forestry Research Institute (KEFRI) and other foreign universities. The intended formation of a Postgraduate School within ICIPE is an excellent idea.

Introduction

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. Even at present, this critical mass of indigenous scientific capability is far from being achieved. In 1980, only 14% of the required 70,000 scientists in Africa was achieved (Odhiambo, 1984).

At the just concluded Commonwealth Meeting of Ministers responsible for research, science and technology, held in November 1990, it was observed that the current brain-drain of highly trained scientific manpower will increase in the future, with adverse effects on developing countries. The cause of this brain-drain is the increasing lack of interest in pure and applied science at postgraduate level and preference for business and administrative

courses offered in some developed countries. Highly trained scientists from developing countries will continue seeking greener pastures in the developed countries.

Applied insect science brings 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 post-graduate training programme in insect science located in Africa helps in curbing the brain-drain, increasing food production and improving human and animal health.

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. ARPPIS is therefore contributing greatly in building and fostering the growth of this scientific capability in insect science and linking it to productive activities.

Since its inception in 1983, the ARPPIS programme has up to date enrolled 72 Ph.D. students from 17 countries and 10 M.Phil. students from 6 countries. I am happy to note that the host country Kenya, which this paper is addressing, had taken the lion's share by taking almost a third of the chances offered. We still look forward to a larger share! The need for more highly trained scientists in our agricultural research system no doubt warrants the expansion of this ARPPIS programme so as to supplement and expedite the output of national public training institutes.

Role of ARPPIS in Sub-Saharan Africa

One cannot overemphasize the need to train more research scientists in insect science. Training on relevant topics in appropriate teaching and relevant environments in Africa is hampered by inadequate resources for teaching and research (Smalley, 1987).

ARPPIS is an outstanding model for a regional postgraduate programme in developing countries. It has successfully combined university facilities for academic tradition and teaching and research institutes for research and supervision. It has catered for the need of young African insect scientists to gain relevant research experience in their own agricultural and ecological systems.

The insect pest and vector problems of Africa and the developing world are peculiar to the countries concerned, yet so many students go outside the tropics for their training (Smalley, 1987). The Kenya Agricultural Research Institute (KARI) is putting a lot of emphasis on training of highly skilled manpower to conduct basic and applied adaptive research to meet the country's demand in increasing food production. However, KARI has had to depend on limited scholarships from ODA (UK), USAID (USA) and CIDA (Canada) to train its scientists at postgraduate level outside the country. The future sustainability of such scholarships is uncertain, with the developed countries also experiencing economic hardships.

ARPPIS collaborates with 15 African universities, using the facilities and scientific staff at ICIPE. This gives national programme scientists and university staff an opportunity to research on pests and vectors of economic importance in Africa. The net result is that ARPPIS graduates are equipped with an all-round knowledge of applied insect science of tropical pests and vectors.

Considering the cost of an ARPPIS fellowship (US$ 45,000), it would be more rational for national governments in Africa to train their insect scientists with ARPPIS, rather than send them for the limited and relatively expensive scholarships in Europe and America. African scientists often go abroad to study topics that have little or no relevance to the African situation.

The Impact of ARPPIS in Kenya

Twenty Kenyans have gone through the ARPPIS Ph.D. programme and two through the IITA/ICIPE-sponsored M.Phil. programme in biological control of crop pests. Kenyan ARPPIS graduates are either teaching in the local universities or conducting research in KARI's agricultural research centres and other government parastatals, e.g. KETRI and ministries, such as the Ministry of Health and Ministry of Livestock Development. Two ARPPIS graduates are working in the implementation of integrated pest management strategies with PESTNET at ICIPE. One ARPPIS M.Phil. graduate has already embarked on the Ph.D. programme and is attached to the Locust Research Programme at ICIPE.

However, this contribution needs to be enhanced to have a significant impact on Kenya's ability to conduct high-level research in applied insect science. It is, however, noted that there is a limited number of fellowships available for Kenyans and that Francophone countries are also being included in the ARPPIS network. This problem could be resolved by increasing the number of participating universities in Kenya. Presently, there are only two universities which register ARPPIS students. In fact, most Kenyan students had to register in another country for their Ph.D. programme.

Besides generating qualified manpower, the project research work being conducted by ARPPIS students has great relevance to our Kenyan situation. Most of the project work is undertaken in Kenya and it directly or indirectly makes available basic and applied information pertaining to the problem being investigated. For instance, a lot of information has been generated regarding biology, ecology and control strategies of one of the introduced cassava pests, cassava green mite, *Mononychellus tanajoa* (Bondar) and it is very useful in designing future management strategies of this pest. This is just one example of many areas in which ARPPIS students have conducted research and I hope more will be done in fields where we are currently experiencing problems.

Training of KARI Scientists in ARPPIS

KARI scientists graduating from ARPPIS would have the advantage of tackling topical issues in insect pest and vector management. This would help in solving some of the urgent problems currently facing our national crop and livestock production. Finding solutions to these problems is in line with the objectives of Sessional Paper No. 1 of 1986, which, together with the 1989–1993 Development Plan, outlined in the goals for agricultural research to include among others, protecting crops and livestock from pests, disease and other environmental hazards.

ARPPIS training should enable KARI scientists to conduct problem-oriented research in the field of crop protection and animal health. KARI is addressing the maize streak virus (MSV) and barley yellow dwarf virus (BYDV), diseases which are transmitted by leafhoppers *Cicadulina* sp and aphids, respectively. Another important disease is the citrus greening disease, a mycoplasma transmitted by the citrus psyllid *Trioza erytreae*. An understanding of the population dynamics of these disease vectors would greatly help in the understanding of the epidemiology of the disease. KARI insect scientists working on the above disease vectors could develop useful ecological data, which would help in formulating integrated pest management strategies, in collaboration with plant pathologists and breeders.

Two introduced insect pests, which require urgent attention, namely the cassava mealybug, *Phenacoccus manihoti* and the cypress aphid *Cinara cypressi*, are currently causing considerable damage. To be able to understand the biology and ecology of these two pests, some serious studies would have to be undertaken, with a view to developing appropriate control measures. KARI would require post-graduate training in these areas hoping that very pertinent information would be collected and applied in their control.

One constraint, however, would be effective supervision of KARI scientists tackling insect pest problems on crops that might not be within ICIPE's mandate. This issue needs to be addressed to ensure that relevant special supervisors are co-opted from CGIAR centres, CAB International Institute of Biological Control, KARI, and foreign universities.

Work on biological control of cassava mealybug and cassava green mite would probably require supervision from both ICIPE and IITA scientists. The CAB International Institute of Biological Control, based at NARC, KARI - Muguga, would play an important role in the supervision of research work on the biological control of the cypress aphid. Kenya Forestry Research Institute (KEFRI) could supervise research work in the development of cypress varieties resistant to the cypress aphid.

For work on insect-transmitted diseases, BYDV, MSV and citrus greening disease, special arrangements would have to be made to identify leading international scientists to supervise KARI scientists intending to conduct their Ph.D. work on the above problem. This would enhance the scope of collaborative research in applied insect sciences between KARI, ICIPE and other relevant research centres and universities.

I do understand that ICIPE is making progress in upgrading the present postgraduate programme to a Graduate School offering Ph.D. degrees. This is an innovative approach which I would support. It is a programme that will increase the opportunities of advanced training and thus supplement government efforts as the ARPPIS programme has already done, in training highly skilled manpower to handle research work in the country.

So, in view of the severe shortage of African entomologists and especially those trained in integrated pest management, the ARPPIS programme deserves complete support from African countries to enable it to expand and sustain the high standard of training it has embarked on.

References

Food and Agriculture Organization (1981) Agriculture Toward 2000. *Economic and Social Development Series* No. 23.

Government of Kenya (1986) Sessional Paper No. 1 of 1986 on *Economic Management for Renewed Growth.* Govt. Printer, Nairobi.

Government of Kenya (1989) *The Development Plan for 1989–93.* Govt. Printer, Nairobi.

Odhiambo, T.R. (1984) Management of Scientific Research in Africa: Problems and Prospects. Rivers State University of Science and Technology, Port Harcourt, Nigeria Public Lectures 1983–1984. pp. 45–46.

Smalley, M.E. (1987) A model for a regional collaborative training programme in insect science. (M.F.B. Chaudhury: Guest Editor) In *Proceedings of the International Conference on Tropical Entomology,* Nairobi, Kenya 31st August – 5th September 1986 Special Issue *Insect Sci. Applic.* 8(4/5/6):943–950.

UNESCO (1964) Final Report of the Lagos Conference, UNESCO and the United Nations Economic Commission for Africa, UNESCO, Paris.

Needs of African Universities for New and Innovative Teaching Methods and Curricula in Insect Science: The Role of ARPPIS and the Nigerian Experience

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Abstract

The role of universities in the training of insect scientists in Africa with particular reference to Nigeria is reviewed. The curricula in most Nigerian universities are unsuitable for the production of the calibre and number of entomologists needed. In recent years there has been a drastic decline in the level of funding of universities, resulting in serious inadequacies in the quality and quantity of equipment and facilities available for effective teaching. There is also severe shortage of suitable textbooks, journals and other materials. All these have led to the graduation of ill-trained, ill-oriented and ill-motivated entomologists by the universities in numbers that are too few to make any significant impact on the enormous insect problems in the country. There is an urgent need, therefore, for the universities to modernise their curricula and improve on their teaching methods and facilities in order to produce indigenous insect scientists who are competent to conduct useful research that is relevant to the needs of the resource-poor local communities around them. The critical role which international research institutes concerned with the proper development and growth of insect science are playing towards the realisation of this need by collaborating with the universities is reviewed. In particular, the achievements of one such collaborative effort — the African Regional Postgraduate Programme in Insect Science (ARPPIS) in the production of well trained entomologists is discussed. Suggestions are also made on the future role of ARPPIS in assisting the universities fulfil their traditional role of producing properly trained, properly oriented and highly motivated entomologists.

Introduction

Experience from many developed countries of the world has shown that the economic growth of a nation is intimately connected with the extent to which it can hold in check, through bold research programmes, the innumerable insect pests which destroy its food crops, seeds, cash crops, stored food, buildings, archives, libraries, livestock and even its human population (Toye, 1976). For any country to develop economically, the inhabitants must have food of high quality and quantity in order to be well fed. Insects are man's greatest competitors for food and entomologists have the arduous and challenging task of preventing insects from robbing man of his food resources.

Insect problems in Africa are many and complex. The tropical environment favours a rapid development and spread of insect pests. Unfortunately there is such a severe shortage

of insect scientists in most African countries that the problems are not being tackled with the urgency and seriousness they deserve. For instance, it was estimated, in 1980, that across the continent there was only one entomologist to 608,000 people (Odhiambo, 1981). The situation has hardly changed appreciably since then and in a continent where insect pests abound and where insect transmitted diseases are a major threat to man's health, it is, indeed, a serious problem. The training of insect scientists and other specialised manpower is essentially the job of universities. But in the current state of educational and scientific development, planners and educators have not accorded any special treatment to the development of insect science in African universities and research institutes. The study of insect science receives even less priority in many of these universities than say history or classics, and university administrators are often not familiar with the term entomology (Kumar, 1987). Entomology is not a separate department in any university in tropical Africa, except one (see below).

The aims of this paper are:

(1) to review the role of universities in the training of insect scientists with particular reference to Nigeria;
(2) to assess the need for the universities to adopt new and innovative methods and curricula in the training of insect scientists; and
(3) to highlight the role which ARPPIS can play in meeting these needs.

The Role of Nigerian Universities in the Training of Insect Scientists: The Current Situation

There are presently 28 universities in Nigeria, only one of which, the Anambra State University of Technology, offers entomology at the undergraduate level as a degree programme. The other Nigerian universities have departments of Biological Sciences, Zoology, Crop Science or Agricultural Biology, depending on the structure of each institution. It is in these departments that entomology courses are taught. Table 1 gives a list of Nigerian universities offering entomology and the two most common entomology-related courses (crop science and zoology) at both the undergraduate and postgraduate levels.

Since entomology is taught as part of a general zoology or crop science course, the emphasis is mostly on topics such as insect morphology and ecology. Incidentally these are the areas in which textbooks abound. Less attention is given to applied aspects of entomology, such as pest management, economic entomology, arthropods of medical and veterinary importance, etc. Thus the graduates of those departments are zoologists, crop scientists, etc., but not entomologists and cannot undertake any meaningful entomological projects without further training. Up to about 1978, most of such further training was done overseas, because there were few universities in the country and opportunities were limited. At the postgraduate level only 5 of the 28 Nigerian universities offer M.Sc./M.Phil. and Ph.D. programme in entomology/applied entomology. The older universities offer these higher degrees in zoology and agricultural science with options for specialisation, including entomology (see Table 1). In the Nigerian university system two Masters' degree programmes are offered, namely M.Sc. and M.Phil. The M.Sc. is usually a one calendar year programme involving 6 months course work and a thesis; the M.Phil. is usually an 18 or 24 month programme involving about 9 months of course work and the remaining period is spent on preparing a thesis. The students must pass the coursework with at least a B (60–69%) average. On the successful completion of the coursework students embark upon individual research projects which are later written up as theses and examined by a board of internal and external examiners. The course outline for the M.Sc. in applied entomology and parasitology of the University of Jos and the M.Phil. in applied entomology of the Rivers State University of Science and Technology (RSUST) are given in Tables 2 and 3 respectively.

Equipment and Books

The greatest problem militating against Nigerian universities in their traditional role of training high level manpower in the sciences generally is insufficient funding. The problem has become so acute in recent years that many Zoology or allied departments cannot afford basic requirements like sweepnets, insect boxes, entomological pins and vials, etc. More sophisticated apparatus and machinery, such as microscopes, incubators, gas chromatographs, computers, etc. are generally lacking because there is no money to buy new ones or even repair and maintain existing ones. In the words of one exasperated undergraduate student, "it is possible to play football in some of our so-called laboratories without fear of breaking anything". This might be an exaggeration, but it underscores the seriousness of the situation because a salient feature of entomology is the relationship between the entomologist and the machine which in many cases has become as important as the relationship between him and the insect.

What has been said of equipment applies equally to books. Knowledge is in such a perpetual state of flux that there can be no alternative to the acquisition of current books and journals (Ikoku, 1985). But today only a few textbooks are available in Nigerian universities for the study of entomology. These include those that are general in scope such as the works of Imms (1965), and Ross (1965) and others that treat specific aspects of the subject, such as Chapman (1971) and Wigglesworth (1972) on physiology and Southwood (1978) on ecology. Most of these were written by foreign experts and based on research carried out in temperate situations. These books are published overseas and are no longer being imported because of the serious foreign exchange problems involved. Students in Nigerian universities are therefore forced to make do with one or two copies of such books still available in the "Reserved" section of their library. The situation is a little better at the undergraduate level because there are a number of new books on tropical entomology that are available, especially in the vital areas of ecology and pest control. Notable examples include Ewusie (1986), Ezueh (1978), Youdeowei and Service (1983) and Kumar (1984). These are few, however, and because most are published overseas, they are not readily available at affordable prices.

Recent Trends

From the foregoing, it is obvious that there is an urgent need for Nigerian universities to modify and modernise their curricula and methods for the training of entomologists if they are to meet the challenges posed by the present situation. A new breed of entomologists needs to be trained using curricula and methods that are responsive to the needs and aspirations of the resource-poor rural communities and based on locally available insects.

Two recent developments serve as a beacon of hope and indicate that concrete efforts are being made in the right direction to remedy the situation. One such development is the establishment of mission-oriented international research institutes in Africa which concentrate their efforts on immediate problems of some relevance to the local communities around them. These institutes include the International Centre of Insect Physiology and Ecology (ICIPE) in Nairobi, the International Institute for Tropical Agriculture (IITA) at Ibadan, the International Laboratory for Research on Animal Diseases (ILRAD) also in Nairobi, etc. Researchers in these organisations respond to the needs of the local subsistent farmers not only by developing crops and improved varieties and increasing yields, but also by generating the appropriate technology for more effective control of agricultural and public health pests. More importantly, in the context of this paper, these institutions regard the training of competent indigenous insect scientists as an important aspect of their mission. They therefore collaborate closely with universities in the training of entomologists. They do this by offering facilities for and supervision of students' projects and by organising training workshops and short-term courses and seminars.

The most outstanding contribution in this respect has been made by ICIPE, which in collaboration with some African universities, established a programme of training African insect scientists at the postgraduate level. This programme, known as ARPPIS, has admitted between 8–15 students into a Ph.D. class annually since its inception in 1983 and todate has graduated about 48 Ph.D.s specialising in various aspects of insect science and drawn from 17 African countries. With about 15 African universities from all parts of the continent currently participating, ARPPIS has taken into consideration the general and peculiar problems besetting these universities in designing its academic and practical programmes. The 3-year Ph.D. programme consists of a compulsory six months course work in several areas: insect systematics, morphology, ecology, pathology and biostatistics, followed by a two and half year period of research and writing a thesis. According to Dr. Smalley, the former Academic Coordinator of ARPPIS, the coursework was introduced because ARPPIS students come from a variety of academic and cultural backgrounds and the courses are intended to set a uniform level of understanding in core areas of entomology, and to orient the students to possible areas of research. He further stated that from experience, ARPPIS has found that most students have a poor background in taxonomy, physiology, biochemistry and biostatistics, implying that the Masters' programmes in most African universities do not present courses of quality in these areas of entomology (Smalley, 1987). In my opinion, and as someone who has gone through the course, these are valid enough reasons to retain the coursework as presently offered. For some of the students in at least some of the courses, this amounts to repeating courses that were successfully completed at the M.Sc. level. But the alternative of allowing each student to take only the subjects in which he is adjudged deficient, as is being suggested in some quarters, would create the serious problem of objectively assessing the level of understanding attained by the students from such a variety of backgrounds by merely looking at the certificates and perhaps the course outline of the various universities.

The philosophy of ARPPIS is to train African insect scientists who can perceive the problems of insect pests and vectors from the farmers' point of view, and who can appreciate and evaluate existing technologies used by the local people in tackling these problems. Armed with this appreciation and scientific training, the ARPPIS graduate is in a position to assist in the development of ecologically sound pest management systems that are readily acceptable, affordable and sustainable by the resource-poor subsistent rural farmer. Three Nigerian universities, the University of Ibadan, Rivers State University of Science and Technology and the Anambra State University of Technology, participate in ARPPIS and not less than 10 Nigerians have either completed or are at various stages of completing the ARPPIS Ph.D. programme.

The second recent development which gives hope for the emergence of well-trained and well-oriented entomologists in Africa is the development of new and more innovative curricula by some individual universities. The M.Sc. course in Applied Entomology and Parasitology at the University of Jos and the M.Phil. course in Applied Entomology at Rivers State University of Science and Technology have already been mentioned. The M.Phil. in Biological Control course at Rivers State University of Science and Technology was run in collaboration with ICIPE as an integral part of ARPPIS between 1985 and 1989. The students do their nine month course work at RSUST before proceeding on a nine months field work/ project at ICIPE. This course is being phased out at RSUST to be replaced by a similar one to be mounted in the proposed ARPPIS M.Sc. sub-regional centre to be located in Ghana (Egwuatu, pers. commun.).

At inception in 1980, the Anambra State University of Technology, ASUTECH, introduced a B.Sc. degree in applied biology with options for specialisation in parasitology and entomology, among others. In 1985 a separate Department of Parasitology and Entomol-

ogy was created, making ASUTECH the first and thus far the only Nigerian university that offers entomology and parasitology as a degree course at the undergraduate level. And it is very gratifying to note that the course has been gaining in popularity since inception. For example, the pioneer class which graduated in 1990 had 10 students while the present final year class has 18 students. ASUTECH also runs a postgraduate diploma as well as M.Sc. and Ph.D. courses in parasitology and entomology with options for specialisation in agricultural pest management or public health parasitology/entomology. The curricula for these courses were designed to correct the shortcomings of the older universities. Thus the applied aspects of entomology are emphasised. The academic programmes for the B.Sc. and M.Sc. are given in Tables 4 and 5 respectively.

The Role of ARPPIS

ARPPIS is already playing a leading role in the training of insect scientists in Africa. Less than 8 years after its inception it has admitted 72 Ph.D. holders who are thoroughly grounded in all aspects of entomology. This gives an average of about 10 graduates per annum and at this rate, the programme will saturate the continent with entomologists before long. The M.Phil. programme is gradually expanding and may soon reach the same level of graduate outputs as the Ph.D. programme.

The proposed ARPPIS network, designed to keep the ARPPIS alumni in close and constant contact with one another and with the programme itself, is yet another innovation that will help in consolidating the impressive achievements being recorded by ARPPIS. The network will reduce the isolationist tendency shown by African scientists. This attitude, caused mainly by lack of funds for travelling and communication, denies the scientists the opportunity of sharing information and doing joint projects.

ARPPIS is also influencing the universities, especially those participating ones, to adopt more innovative methods and curricula for their own training programmes. This is so because the ARPPIS Academic Board is made up mostly of senior academic staff of participating universities. Their experiences on the Board are bound to influence their contribution and decisions in their own institutions. Besides, a good number of the ARPPIS students are university staff who return at graduation to share their experiences with their students and colleagues. In this connection, it is gratifying to note that the two Nigerian universities mentioned above (RSUST and ASUTECH) are closely associated with ARPPIS and were greatly influenced by it when designing their own programmes. Professor R. Kumar, who is probably the longest serving member of the ARPPIS Academic Board, was the Dean of the Postgraduate School and Head of the Department of Biological Sciences at RSUST when the innovative M.Phil. course in applied entomology was introduced and affiliated with ARPPIS. Also, Professor R. Egwuatu, who has been a member of the ARPPIS Academic Board since 1986, was the Dean of the Faculty of Applied Biological Sciences when the Department of Parasitology and Entomology was created and played a major role in drawing up its academic programmes. I am proud to say that since my return to ASUTECH after graduating from ARPPIS, I have been pursuing the ideals of this young department with total commitment, strongly convinced that it is the best in Africa. As more and more ARPPIS graduates get involved in university teaching and administration in the future, the role of ARPPIS in influencing curricula of African universities in the training of insect scientists will be more prominent.

One other area in which ARPPIS should play a leading role is tackling the acute shortage of adequate textbooks for the study of entomology in Africa. At present, entomologists in Africa are faced with the choice of either attempting to adapt textbooks written for temperate situations to their local situations or to teach theoretically about temperate entomology (Okwakol and Tukahirwa, 1987). The role of ARPPIS in redeeming this situation

could best be played by the proposed ARPPIS Alumni Association or Network. This body should organise seminars and workshops on a regular basis on various aspects of insect science. Small groups of members, according to interest and areas of specialisation, should be commissioned to produce textbooks from the proceedings of such workshops. The textbook by Youdeowei and Service (1983) based on the ICIPE/UNEP group training courses is a good example of what is being suggested here. The assistance and collaboration of ICIPE and other international research institutions involved in insect sciences in Africa should be sought so as to facilitate the translation and incorporation of their research results into such books.

Table 1. Nigerian Universities Offering Entomology, Zoology and Crop Science at Various Degree Levels

Course	University	Level
Entomology	Anambra State University of Technology	G
	Imo State University	P
	University of Jos	P
	University of Lagos	P
	Rivers State University of Science and Technology	P
Zoology	Tafawa Balewa University, Bauchi	U
	Ahmadu Bello University	G
	Bayero University, Kano	G
	Bendel State University	G
	University of Calabar	U
	Federal University of Technology, Yola	U
	University of Ibadan	G
	University of Ilorin	G
	University of Jos	U
	University of Lagos	G
	Lagos State University	G
	University of Maiduguri	G
	University of Nigeria	G
	Obafemi Awolowo University	G
	Ogun State University	U
	Ondo State University	U
	University of Port Harcourt	G
	Rivers State University of Science and Technology	U
	University of Sokoto	G
Crop Science	Tafawa Balewa University, Bauchi	U
	Ahmadu Bello University, Zaria	G
	Federal University of Agriculture, Makurdi	U
	Anambra State University of Technology	U
	Federal University of Technology, Minna	G
	Federal University of Technology, Yola	U
	University of Ibadan	U
	University of Ilorin	G
	University of Maiduguri	G
	University of Nigeria, Nsukka	G
	Rivers State University of Science and Technology	G
	Ondo State University	U

Key: U = Undergraduate level only
G = Undergraduate and postgraduate levels
P = Postgraduate level only

Source: *Commonwealth Universities Yearbook*, 1990 Edition

Table 2. M.Sc. Course Work in Applied Entomology and Parasitology at the University of Jos

Code	Title	Credit Load
Zoo 501	Biostatistics and Field Experimentation	3
Zoo 502	Insect Taxonomy, Biology and Physiology	4
Zoo 503	Insect Behaviour and Population Dynamics	4
Zoo 504	Protozoology	4
Zoo 505	Helminthology	4
Zoo 506	Pest and Disease Management	8

Source: *University of Jos Academic Programme* 1977/1978 Session

Table 3. M.Phil. Course Work in Applied Entomology at Rivers State University of Science and Technology, Port Harcourt

Course no.	Title	Units
Semester 1		
Bio 600	Principles and Practice of Pest Management	2
Bio 601	Systematics of Insects	3
Bio 602	Insect Pests of Stored Products and Their Control	2
Bio 603	Research Methodology	2
Bio 604	Morphology and Physiology of Insects	5
Bio 605	Statistical Methods in Biology	3
Bio 606	Computer Programming	2
Semester 2		
Bio 607	Vectors of Medical and Veterinary Importance in Nigeria	2
Bio 608	Toxicology and Application of Insecticides	2
Bio 609	Biology, Systematics and Management of Plant Pests in Nigeria	3
Bio 610	Ecology of Terrestrial Insects	4
Bio 611	Ecology of Freshwater Insects	3
Bio 612	Language for Scientists	2

Source: Kumar (1987)

Table 4. Academic Programme for the B.Sc. degree of the Department of Parasitology and Entomology of Anambra State University of Technology

Course Code	Title	Total Credit
Year 1		
Bio 101	General Biology	3
Bio 102	General Biology	3)2nd
PAE 160	Introduction to Parasitology and Entomology	2)Semester
Year 2	*1st Semester*	
Bio 210	Basic Animal Biology	4
PAE 250	Basic Entomology	2
PAE 241	Basic Parasitology	2
	2nd Semester	
Bio 215	General Genetics	2
Bio 211	Basic Plant Biology	3
BCH 101	Introductory Biochemistry	3
MCB 110	Introductory Microbiology	3
ICH 211	General Organic Chemistry	2
		13
Year 3	*1st Semester*	
Bio 301	General Ecology	3
Bio 330	Comparative Physiology of Vertebrates	3
Bio 331	Cytogenetics	3
STA	Sampling Theory and Method	3
PAE 340	Parasitology I	4
PAE 351	Insect Biology, Systematics and Physiology	4
PAE 302	Taxonomy and Evolution of Animals	2
		21
	2nd Semester	
PAE 303	Population Ecology	3
PAE 332	Introductory Histological Techniques	3
BCH 370	Bio-instrumentation	3
PAE 346	Immunology	3
PAE 363	Parasitology and Entomology Techniques	3
PAE 345	Introductory Parasite Epidemiology	3
PAE 364	Insect and Parasite Ecology	3
		21
Year 4	*1st Semester*	
PAE 441	Chemistry and Toxicology of Pesticides	3
PAE 433	Plant Nematology	4
PAE 415	Pathobiology	
PAE 450	Economic Entomology	4
STA 472	Statistical Methods in Epidemiology	2
PAE 499	Project	4
PAE 401	Seminar	
		1
		18
	2nd Semester	
PAE 441	Parasitology II	3
PAE 451	Arthropods and Arthropod-borne Diseases	4
PAE 453	Pest Management	4
PAE 445	Human Ecology and Parasitic Infections (Sanitation and Diseases)	3
PAE 442	Chemotherapy and Control of Parasitic Diseases in the tropics	4
PAE 499	Project	4
		22

NB: The common university and inter-faculty courses usually taken in years 1 and 2 have been omitted in these tables.

Table 5. Academic Programme for the M.Sc. Degree of the Department of Parasitology and Entomology of Anambra State University of Technology

Code	Title	Total Credit
1st Semester		
PAE 641	Medical Microbiology and Protozoology	2
PAE 642	Advanced Helminthology	2
PAE 653	Arthropods of Medical and Veterinary Importance	3
PAE 644	Physiology and Biochemistry of Parasites	3
PAE 605	Research Methodology	2
PAE 651	Insect and Mite Ecology	3
PAE 652	Systematics of Insects	2
PAE 654	Principles and Practice of Pest Management	2
		19
2nd Semester		
PAE 643	Advanced Immunology	2
PAE 647	Research Techniques in Parasitology	2
PAE 645	Epidemiology	2
PAE 607	Biostatistics	3
PAE 656	Biology, Systematics and Management of Pests	3
PAE 657	Stored Products Entomology	3
PAE 609	Projects	15
		30

References

Chapman, R.F. (1971) *The Insects — Structure and Function*. 2nd ed. New York.

Ewusie, J.Y. (1986) *Elements of Tropical Ecology*. London:Elms.

Ezueh, M.I. (1978) *An Introductory Economic Entomology for Nigeria*. Ethiopia Publishing Corp. Benin City: University of Nigeria. 25pp.

Ikoku, C. (1985) An address on the Occasion of the Silver Jubilee and 21st Convocation Ceremony of the University of Nigeria, Nsukka.

Imms, A.D. (1965) *A General Textbook of Entomology*. New York: Methuen.

Kumar, R. (1984) *Insect Pest Control with Special Reference to African Agriculture*. Edward Arnold, London.

Kumar, R. (1987) University Training of Entomologists, especially Taxonomists in Tropical Africa. *Insect Sci. Applic.* 8(4/5/6): 927–935.

Odhiambo, T.R. (1981) Insect Pests. In *Proc. of the Symp. on the State of Biology in Africa*. International Bioscience Network, Accra Ghana pp. 112–123.

Okwakol, M.J.N. and Tukahirwa, E.M. (1987) The development of books and other resource materials for training tropical entomologists. *Insect Sci. Applic.* 8 (4/5/6):951–953.

Ross, H.H. (1965) *A Textbook of Entomology*. New York:Wiley.

Smalley, M.E. (1987) A model for a regional collaborative training programme in the insect sciences. *Insect Sci. Applic.* 8:943–949.

Southwood, T.R.E. (1978) *Ecological Methods with Particular Reference to the Study of Insect Populations*. 2nd ed. London:Chapman and Hall.

Toye, S.A. (1976) The role of entomology in the economic development of Nigeria.*Ent. Soc. Nig. Occasional Publ.* No. 18, 3–10.

Wigglesworth, V.B. (1972) *The Principles of Insect Physiology*. Chapman and Hall, London.

Youdeowei, A. and Service, M.W. (1983) *Pest and Vector Management in the Tropics with Particular Reference to Insects, Ticks, Mites and Snails*. London and New York:Longman.

Needs of African Universities for New and Innovative Teaching Methods and Curricula in Insect Science: The Role of ARPPIS—Kenyan Experience

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Summary

Curricula for insect science in Kenyatta University includes the following disciplines: (a) medical entomology; (b) veterinary entomology; (c) agricultural entomology; (d) marine entomology; and (e) closely related arthropods, e.g., spider mites, ticks, etc. Specialised courses are given on such areas as (a) parasitology (vector biology); (b) immunology; (c) biochemistry; (d) food science and (e) crop protection.

There is a need to improve both research and teaching for the undergraduate and graduate students in Kenya. ARPPIS curricula covers all these areas required by the Kenyan universities and it is important that the Kenyan universities collaborate with the ICIPE and other universities (especially in Africa) on new and innovative methods of teaching insect science.

ARPPIS graduates re-joining universities bring new ideas in terms of techniques, approaches and skills in modern teaching and research. ARPPIS scholars are taught by the best lecturers available at the participating universities and the ICIPE. Through the regular presentations during the ARPPIS Annual Scientific meetings and seminars, the ARPPIS scholars test their communication skills. The ARPPIS graduates employed by the Kenyatta University are involved in lecturing and practicals for undergraduate and graduate students, as well as supervision of the research projects of undergraduate, M.Sc. and Ph.D. students.

The Kenyan universities, based on the experience of Kenyatta University, are requiring more funds for research and teaching at all levels for both trained technicians and lecturers. There is inadequate support for journals, equipment and chemicals for research.

More ARPPIS students should be taken from universities in order to strengthen insect science programmes at the African universities. The ARPPIS network should provide a regular postdoctoral programme to expand the ARPPIS graduates' exposure to the international community of scientists outside Africa.

The Need of African Universities for New and Innovative Teaching Methods and Curricula in Insect Science: The Role of ARPPIS and the Ugandan Experience

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Abstract

The African Regional Postgraduate Programme in Insect Science (ARPPIS) has so far made an impressive contribution towards capacity building in insect science in Africa. ARPPIS will continue to do the same in producing young scientists capable of providing scientific leadership, a role which should be particularly felt in African universities. In this paper the contributions and challenges of ARPPIS in relation to university education in insect science are discussed.

Introduction

Let me start by expressing how pleased I am to participate in this First International Conference on Capacity Building in Insect Science in Africa. I particularly welcome this occasion to meet with my friends and colleagues from Africa who have passed and those going through ARPPIS. To the "protestants" (that is how we, the pioneers used to call ourselves) this is a special occasion because we will be able to assess whether our suggestions, as guinea pigs, towards the evolution of ARPPIS were effective. I feel most honoured by the ARPPIS Coordinator for the invitation to address this meeting.

The theme chosen for this event, "Field Experience and Evaluation of the Impact of ARPPIS" is highly relevant to all of us; to you the administrators and god-fathers of ARPPIS; to you the consortium of universities supporting ARPPIS; to us who successfully passed through ARPPIS and are now working; and to our donors. We shall focus our attention on the contributions and problems of ARPPIS. After all, we all have one global ambition—the advancement of insect science and agricultural technology for purposes of increasing agricultural productivity.

I wish to record my sincere appreciation to the Director of ICIPE, Professor Thomas R. Odhiambo, for the vision in establishing ARPPIS; this was an innovative institutional approach to manpower generation on the continent.

My compliments also go to ICIPE for staging this event. It comes at a strategic moment—seven years after inception and with at least three batches of graduates already in the field. It therefore provides an opportunity for looking back and taking stock when it is not yet late. In this conference, we should be assessing ARPPIS' achievements so far and asking ourselves:

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- Has ARPPIS done the job assigned to it?
- Has ARPPIS produced the manpower required for effective pest management take-off in Africa?
- Has ARPPIS made a positive impact in Africa?

Perhaps more important, however, than looking back is the need to look forward and see how ARPPIS is posed to face the future. We, therefore, need to ask ourselves:

- What are the challenges of ARPPIS for tomorrow?
- Is ARPPIS ready to face them?
- How is ARPPIS to be adjusted to its programme and its priorities enhanced?

You will agree with me that I do not have the ability nor the capacity to discuss all the above aspects. I will therefore, concentrate mainly on those aspects of ARPPIS which I think are relevant for my university in evolving new and innovative teaching methods for insect science.

Past Achievements of ARPPIS

In order to appreciate the contribution of ARPPIS to my university it is important to have a historical background of the manpower trend in the university. When the so-called economic war was declared, all lecturers of entomology in the university, who were all expatriates, were asked to leave. This led to serious shortages in teaching manpower. The university responded by strengthening the staff development programme which was encouraging young graduates to go in for lectureship, by quickly getting them scholarships to go to developed countries for higher degrees.

The programme served well but had one in-built disadvantage, that those trained in those countries found it difficult to re-orient themselves towards the Ugandan (African) needs and priorities. This has had two main impacts. Firstly, the graduates from abroad find themselves more comfortable working in developed countries whose problems are familiar, hence encouraging the brain-drain phenomenon. Secondly, the graduates, at the time of their creative growth and innovation, are exposed to principles and problems of developed systems, so that those who come to teach in our university just perpetuate the same principles, which are just not suitable for our situation.

Therefore the most significant contribution of ARPPIS to Makerere University is the production of potential lecturers with African experience. Presently, in the Faculty of Agriculture, two out of the three lecturers of entomology are ARPPIS graduates. In a nutshell, the following are the achievements of ARPPIS:

- Provided facilities and training for young scientists in Africa within a relatively short time;
- Provided Ph.D. graduates who have a better understanding of insect pest problems of Africa and are therefore more suitable to tackle them;
- In a fairly short time, ARPPIS has produced graduates who have demonstrated efficiency and confidence in their work;
- ARPPIS is producing graduates with a diversity of contacts in many African countries. This is an essential asset for collaboration, especially amongst university dons, on past African insect pest problems;
- Although the number of graduates may appear small, it is already giving a breathing space, as it is solving the immediate problem of trained manpower in insect science.

This impact, as you will agree with me, is impressive. Let me now turn to ARPPIS' future challenges.

Future Challenges of ARPPIS

The future challenges of ARPPIS are directly related to the total future needs of Africans. Thus ARPPIS must be able to produce graduates capable of increasing food production at a rate commensurate with that of human population growth. With the increasing human population pressure on our natural resources, more refined pest management systems will have to be developed to reduce any yield loss to insect pests. New technologies which combine high productivity with environmental sustainability are needed. In short ARPPIS will have to produce graduates who are more sophisticated than ourselves, capable of generating ecologically and economically sound pest management technologies for all environments (favourable or unfavourable).

In my view, therefore, the following are the future challenges of ARPPIS, and I think they are the same for my university:

- Production of scholars who are able to develop, supervise and execute pest management technologies;
- Production of scholars with ability to identify problems and find solutions;
- Production of scholars with ability to monitor effects of pest management systems on the environment;
- Production of scholars who are ready to exploit the potentials of new scientific fields, like genetic engineering, molecular biology, computer science, etc., and combine them with locally available technologies;
- The scholars should be capable of carrying out meaningful research independently, and also train other young scientists to ensure sustained development;
- But above all, production of scholars who are self-motivated and who have faith in their profession.

The challenges to ARPPIS appear great indeed. But the professional potential within ICIPE and the consortium of universities is equally impressive; it is a matter of tapping it. Let me now talk about the structural adjustments that may be required to enable ARPPIS to meet the above challenges.

Meeting the Challenges

In order to meet the challenges we need to look at the present training system and identify areas that are lacking. The courses being offered by ARPPIS were indeed sound and conformed to the objectives, nevertheless, there is still room for improvement both in quality and quantity.

There needs to be qualitative improvement in the courses of insect taxonomy, and comparative morphology. The insect taxonomy course does not seem to be well received by the medicine-based scholars. Most of them tend to consider it as either irrelevant or new. It would perhaps be ideal if the course was taught on a professional basis, in which case the medicine-based scholars would concentrate on taxonomy and morphology of hematophagous insects, while the crop-based students would concentrate on phytophagous insects and their natural enemies. This kind of optional treatment could also apply to other courses, and I believe would increase returns to each course.

The insect ecology course also requires qualitative improvement. It ought to be taught in a way that reflects on its relevance in agricultural systems. It did not prepare scholars of the 1983 class in the field pest management ecology. There is need to adjust. The mechanisms of such adjustment can be discussed in an approproate forum.

The biometrics and computer courses were definitely very good and relevant. But the computer course should be extended beyond mere analysis of variance and regressions. Scholars should be introduced to as many ways of computer utilisation as possible.

It is, at this juncture, important to mention courses which have been left out. In my opinion the following courses ought to be taught if ARPPIS is going to have an even greater impact: Pesticide application, management and residue monitoring and economic entomology, concepts and principles.

Thorough knowledge of pesticide application and management is important in judicious use of chemicals. Therefore, ARPPIS which is supposed to produce entomologists who are environmentally conscious, ought to graduate with the appropriate knowledge of pesticides.

All future ARPPIS scholars should be equipped with basic tools of identifying pest problems and designing and executing control tactics individually or in combination. Such tools include methods of determining economic injury levels, economic thresholds and population density/host relationships. Furthermore the strategy of IPM should be taught and discussed in greater detail to enable scholars to understand the tools necessary for designing IPM systems. As it is now the implementation of IPM appears to be an abstract on the African continent.

I wish to propose that research management, a non-entomological course, should be added to the ARPPIS curriculum. Research in my university, and perhaps others, is poor, due partially to lack of appropriate research management skills. ICIPE, through FAMESA, offers this kind of training, which would be highly useful to ARPPIS scholars.

Finally, I wish to point out that lecturers and scientists in ARPPIS may give their best training and the courses may be adjusted but the scholars may not be innovative, simply because of lack of faith in themselves. So far this has not been a problem, but it is a thought that should be kept in mind.

Post-Training Scientific Needs of ARPPIS Graduates

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Summary

ARPPIS graduates are confronted with a variety of problems in their capacities as insect scientists. More often than not they are expected to solve problems in fields of knowledge outside their areas of specialisation. In most cases they have to accomplish their tasks with minimum resources. To meet these expectations, the following salient scientific needs pertinent to the post-ARPPIS training course will be discussed: (i) the need to provide courses and individual study projects in as many scientific areas as possible relating to the field of one's study; (ii) the importance of improvisation of working tools; (iii) the need for effective communiction, and (iv) tolerance to high levels of frustration.

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The Need to Enhance the ARPPIS Scientific Network

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Abstract

Africa is facing a brain-drain away from the continent which is robbing her of her best young scientists. Similarly, many talented scientists in Africa are leaving their disciplines to engage in sectors of the economy which presently enjoy a better work environment and support. No regional training programme in the developing world which offers high quality education, and seeks to improve manpower will succeed unless serious attention is paid to some form of continuing career support.

ARPPIS now recognises the need for a further long-term objective—the development of a scientific network which will provide both financial and intellectual support to its graduating scholars, thereby creating for them an environment more conducive to research and teaching and which will, as a result, encourage them to remain in their professional specialisation in Africa and confront the insect pest and vector problems of the continent. The close interaction of the ARPPIS Scientific Network with the Pest Management Research and Development Network (PESTNET) is proposed.

Introduction

In 1950 the average population growth rate in Africa was reported to be 2.1% per year and it rose to 3.0% in 1980. However, the average growth rate in agricultural production was reported to be between 1.8–2.0% per year between 1970–1985. Yet an average growth rate of above 3.0% per year is needed to cope with the rate of population growth. These facts are stated to indicate the desperate food production situation in Africa and to point out the amount of effort that is needed to correct the situation.

Increasing agricultural and livestock productivity is absolutely essential for the future well-being of African societies and can be only achieved through vigorous agricultural research. The research must be based on indigenous human resources capable of developing systems that are environmentally sustainable and economically viable for the country and the farmers. It is well known that technical assistance by itself has failed, over the last quarter century, to create the necessary conditions for sustainable agriculture in Africa. Time and again, the history of science-oriented transformation of societies has shown that the development of indigenous human capital, dedicated to the long-term tasks of the national development goals and motivated by incentives to reach the highest levels of excellence and relevance, has proved a pivotal factor in sustaining such transformation (Odhiambo, 1987).

Human Resource Development for Insect Science

Africa is suffering from a serious scarcity of qualified indigenous professionals with the critical skills necessary to carry out effective national development (Moock, 1984). The strengthening, and even the basic maintenance, of national agricultural research programmes over the next three decades will require many more scientists with relevant postgraduate training in agricultural and rural social science disciplines. Although considerable investment, especially during the 1960s, has been made in African universities to develop programmes that prepare undergraduates to enter the work force, many agricultural postgraduate programmes have received relatively little attention from the international donor community in the late 1970s and throughout the 1980s. As Eicher (1990) has stated, if the cycle of overseas training is to be broken, there is a need for coordinated investments in developing both national and regional capacity in research and postgraduate training. The role of the international donor community in strengthening Africa's agricultural universities and postgraduate programmes is vital.

The ICIPE has responded to this need by establishing ARPPIS as a novel approach to postgraduate education. The programme attempts to cut across the existing boundaries within higher education, and to seek effective answers to the problems that are limiting the training of African insect scientists in Africa. The aim of ARPPIS is to contribute significantly to the strengthening and building up, within Africa, of the capacity for scientific research in insect science including its application to integrated pest and vector management. The long-term objectives of ARPPIS are:

(1) to provide high-level training in the insect sciences;
(2) to nurture and strengthen scientific leadership in Africa in the field of insect science and its application to practical problems; and
(3) to establish a network of well trained young insect scientists capable of tackling the pest and vector problems of Africa. These young scientists will also be future collaborators with the ICIPE for testing and developing new and innovative approaches to the major pest and vector problems of the continent.

From 1986 onwards, there was a class completing their research work and submitting theses to their registering university every year. There are therefore automatically an expanding community of ARPPIS scientists across Africa. The question before ARPPIS at this stage of development is whether the programme should only train insect scientists for the Ph.D. degree and then just allow them to leave the Centre or evolve a structure to provide the community of ARPPIS scientists with continuing career support and if so, what the nature of that support should be.

ARPPIS scholars, trained for 3 years at this recognised centre of excellence in insect science in the tropical world having very rigorous quality-centered systems monitored by the ICIPE management as well by international donors and the Governing Council, have different attitudes to research from their colleagues who have not had the opportunity to travel for training. These differences in experience and outlook have made it difficult for the ARPPIS scientists to settle back into their home working environment. African universities and national programmes lack the equipment and support necessary to maintain the enthusiasm and momentum which ARPPIS instils into its students (Table 1).

Recently a questionnaire was circulated among ARPPIS graduates of the 1983–1985 classes that confirmed that after returning to their home institutions, they have faced the following serious problems common to university and research institution staff:

(1) scientific isolation;
(2) degradation of research equipment;
(3) the retention of staff; and

(4) deterioration of the libraries.

These factors are causing a brain-drain away from Africa, which is robbing her of her best young scientists. Similarly recent studies by ISNAR and SPAAR (1987) showed that many talented scientists in Africa are leaving their disciplines to engage in sectors of the economy which presently enjoy a better work environment and support due to several important factors:

(1) existence of an international market for sciences, as well as a competitive local market. Agricultural researchers are highly mobile, and unless agricultural research managers in Africa pay special attention to changing local, national, regional and international market conditions, many productive scientists in the 40–50 year age bracket will move on to better opportunities, particularly in externally funded programmes; and

(2) attrition rates in excess of 7% are the normal rather than the exception in Africa, as compared with 3–4% in research services in industrialised countries. These high rates imply that the entire pool of researchers and technicians in many national agricultural research systems has to be replaced every 14 to 16 years. These turnover rates obviously undermine the productivity of research programmes, where continuity is required, and increase the need for training, particularly overseas, with the consequent heavy cost (ISNAR/SPAAR, 1987).

It is our deepest belief that ARPPIS must be sensitive to these difficulties and seek to maintain the enthusiasm of its scientists for research and teaching until such time as a self-sustaining critical mass of scientists has been trained in each country. Otherwise they will drift away from active research either through loss of motivation or by emigration to foreign laboratories perceived to be centres of excellence. The most efficient and useful means of maintaining the momentum of ARPPIS will be through an ARPPIS scientific network. No regional training programme in the developing world which offers high quality education, and seeks to improve manpower will succeed unless serious attention is paid to some form of continuing career support.

ARPPIS Scientific Network

ARPPIS now recognises the need for a fourth long-term objective—the development of a scientific network which will provide both financial and intellectual support to its graduating students, thereby creating for them an environment more conducive to research and teaching and which will, as a result, encourage them to remain in their professed specialisation *in Africa* and confront the insect pest problems of the continent. Through the establishment of an ARPPIS Scientific Network, ARPPIS will make a positive effort to limit the brain-drain of young African scientists and so further its aim of training the next generation of scientific leaders in insect science for African national programmes. The network will contribute towards the establishment of a viable and self-confident community of insect scientists in Africa.

The facilities and programmes of the ARPPIS Scientific Network will be offered to all students graduating from the formal training, and will be available as required during the first 3 years or so after graduation in the following areas:

(1) *Postdoctoral Awards Scheme.* Purchasing of small items of equipment for essential spare parts for the repair of equipment, for reference publications or for travel back to the ICIPE on agreed study visits;

(2) *Postdoctoral Fellowship in Resource Management and Administration.* Three–six months training to improve the research management and skills of ARPPIS graduates involved in organisation, supervision and control of vital resources

essential for effective national research progress in agriculture and health related research institutions; and to improve the resource management maintaining diversified cropping systems and plant and animal species in Africa by implementing integrated pest management programmes under minimal *and only necessary* use of chemicals;

(3) *ARPPIS Travel Fund.* Travel within the network to visit other members of ARPPIS involved in similar research programmes, or to attend workshops and conferences within Africa, and, under special circumstances, elsewhere in the world.

(4) *Preparation of Manuscripts for ARPPIS Scientists.* Support will be given for the complete preparation of a manuscript; to pay any page charges involved and to purchase reprints.

(5) *Preparation of a Resource Base of Teaching Materials for ARPPIS Scientists who are University Faculty Members.* Seventeen of the 72 students in the 1983–1990 ARPPIS classes are university members of staff. A well-trained and well-equipped teacher is in a position to make a significant multiplicative impact on manpower through further teaching. The ARPPIS scientific network will offer its university faculty members the opportunity to use well designed teaching materials to enhance their effectiveness as teachers.

Embracing ARPPIS Scientific Network into PESTNET Activities

The African Regional Pest Management R & D Network (PESTNET) for Integrated Control of Crop and Livestock Pests has been initiated by the ICIPE in 1987 with the following principal objectives:

(1) generation and application of scientific information and methodologies which can be adapted in pest management in Africa;

(2) the exchange of scientific information and expertise between participating institutions;

(3) testing of methodologies, technologies and information for validity in different ecological zones of Africa; and

(4) creation of human capital for developing, validation and implementation of pest management technologies suitable for various ecological and socio-economic conditions.

PESTNET is currently subscribed to by 18 countries in Eastern and Southern Africa but it will be expanded to cover the whole of Africa and to expand to the tropical regions of Asia and South America.

One mechanism of assuring interactive R&D within the network was through placing four resident scientific teams in selected countries representing regions or agroecological zones in Zambia, Somalia, Kenya and Rwanda. Three PESTNET resident scientists have been selected from the ARPPIS graduates: Drs. J.B. Okeyo-Owuor, S.H. Okech and S. Kyamanywa.

In order to involve more countries of Africa, the PESTNET will create four regional centres for specific agroecological and climatic zones. The PESTNET zonal representative will act as a coordinator of research, training and information in pest management for the countries in the zone. In each country there will be a programme director who coordinates the activities within the country.

The national programmes of the Network will be strengthened in a number of ways:

(1) execution of more cost-effective, efficient and appropriate research by collaborating with other members of the network, dividing research tasks, benefiting from results obtained elsewhere, and facilitation of exchange of research information and materials;

(2) human-resource development by providing long-, intermediate- and short-term training; and

(3) enlarge the current awareness of IPM by providing relevant scientific information, training and extension materials, and profiles of institutions, scientists and projects working in pest management.

PESTNET organises regular methodological workshops, annual research conferences and seminars in addition to specialised courses for practitioners.

It is our hope that ARPPIS graduates will be more involved in the execution and expansion of PESTNET. Due to their advanced Ph.D. training and later experience after returning to their home institutions, they are well prepared for active participation in sharing research experiences in methodology and techniques in pest management. The ARPPIS graduates will have a chance to interact with their colleagues from other national research programmes, agriculture and veterinary faculties of the universities and extension service. They also may be involved as the resource staff for national training workshops organised by individual countries, in order to strengthen national capabilities.

PESTNET has also initiated some activities in collaboration with universities in the region, to bring them closer to the national agriculture research systems. Our approach in gaining participation of university faculty in research and IPM technology development processes has been only recently confirmed by other groups of experts from universities and international organisations (Anon 1991; and in press).

It has been recognised that universities have played and will continue to play an important role in the evolution of NARS and the overall national development. However, in most developing countries, universities are generally recognised mostly for their role in teaching and training (human resource development) and not so much for their contribution to the mainstream of national agricultural research. Often universities are not perceived as integrated parts of the NARS (Anon, 1991).

PESTNET wishes to change this perception by involving the faculty and staff in mission-oriented projects in developing new strategies for pest management and strengthening their M.Sc. programmes in insect science.

References

Anonymous (1991) The Role of Universities in National Agricultural Research Systems. Highlights of an FAO Expert Consultation, 12–22 March 1991, Research and Technology Division FAO, pp. 1–16.

Anonymous (in press) Recommendations. *Proceedings of the Seventh General Conference on Agricultural Research and Development in Africa*, 10–16th June 1991, Nairobi, Kenya.

Eicher, C.K. (1990) Building African Scientific Capacity for Agricultural Development. *Agricultural Economics*, 4:117–143.

ISNAR/SPAAR (1987) Guidelines for Strengthening National Agricultural Research Systems in Sub-Saharan Africa, Special Programme for African Agricultural Research, World Bank, Washington, DC pp. 1–28.

Moock, J.L. (1984) Overseas training and national development objectives in Sub-Saharan Africa. *Comparative Education Review*, 28: 211–239.

Odhiambo, T.R. (1987) Welcoming and Opening Address. In *Eastern and Southern Africa Agricultural Research Review*, World Bank 1985–86; World Bank, Washington DC. pp. 101–106.

Perception of the ARPPIS graduates regarding the availability of funding for their research projects

Availability of funds	Comment	Institution	Country
NO	I am interested in carrying out research, but funds are not at the moment available	University	Kenya
NO	Lack of funds and equipment	University	Kenya
NO	I need some support very urgently especially for field work and equipment	University	Kenya
YES	Adequate for the present research project	KARI	Kenya
NO	Since 1989 I have been operating on a small grant from IFS	Research	Kenya
NO	Research grants through ARPPIS would go a long way in assisting our work	Research	Kenya
NO	–	Research	Kenya
NO	I would be pleased to present a detailed proposal if a grant would be available	Research	Kenya
NO	–	University	Nigeria
NO	–	Research	Sudan
NO	The major constraints being under-funding and lack of research/teaching facilities	Research	Ghana
NO	–	Research	Tanzania
NO	Support in the form of funds is not available for teaching staff	University	Tanzania
NO	I have to formulate research proposals and submit to international donors for funding to be able to do any research work	Research	Zambia
Partial	IFS grant provides some assistance	Research	Uganda
Partial	A donor supports major experimental expenses	Research	Uganda
Partial	Some donors provide small grants to mission-oriented research at the university	University	Uganda
YES	–	PESTNET	Kenya
YES	–	PESTNET	Ethiopia
YES	–	PESTNET	Somalia
YES	–	PESTNET	Zambia

DAAD Support for the ARPPIS Programme and Scientific Network

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The German Academic Exchange Service (DAAD) since 1983 has contributed to the ARPPIS Ph.D. programme by providing a number of in-country scholarships for participants of various African countries. We are particularly proud to be associated with this important programme because it is one of our main objectives to assist African universities and research institutions in their endeavours towards capacity building and towards regional scientific cooperation.

We will therefore try to do our very best to be able to continue to provide support to the ARPPIS Ph.D. programme in the years to come as far as our financial means allow.

For the 1991/1992 intake, an additional 5 scholarships have already been made available for this programme. DAAD, with the assistance of the German Ministry of Economic Cooperation (BMZ), which finances the in-country scholarship programme, has, in addition, made provisions to also sponsor the up-coming ARPPIS Masters Programme by giving a number of these scholarships to students who do Master's courses in insect science in the ARPPIS sub-regional centres from 1992 onwards.

It should be mentioned that within the framework of the DAAD In-country Scholarship scheme, we can provide in certain cases some additional assistance on special request such as:

- *Additional research funds* can be granted in case the normal research allowance which is part of the respective scholarship is not sufficient. Applications from the scholarship holders should be supported by their academic supervisor and directed to DAAD head office in Bonn either through the DAAD Regional Office for Africa in Nairobi or, in countries other than Kenya, through the respective German Embassy. In some few cases, because of very limited funds available, young staff members who are employed with the institutions where they are doing their Ph.D. courses and therefore do not need a scholarship to cover their living can apply for a research grant to complete a doctoral or postdoctoral research project. Applications for such research grants should be discussed in advance with the DAAD office in Nairobi.
- On recommendation of their supervisors and the department, DAAD scholars can apply for a *short-term research visit* (2–6 months) to a German University or research institute either during their Master's or Ph.D. courses or shortly afterwards to carry out a research project in case they are invited by a German professor, under the condition that DAAD sponsors the visit. DAAD is in the position to cover travel and subsistence costs. Application forms are available with the DAAD office in Nairobi.

- German professors can be sponsored by DAAD if they are invited by a department to carry out visiting lectureships (1–3 months) and if the inviting institution contributes to the costs of such visits by giving the German professor a honorarium or accommodation. DAAD can take over travel and contribute to the subsistence costs. Applications should be directed to DAAD head office through the representative German Embassy or, in Kenya, through the DAAD office in Nairobi (P.O. Box 14050).

By giving this assistance DAAD endeavours to encourage contacts with German universities, research institutions and individual scientists and to foster scientific cooperation between African and German scientific institutions.

Executive Summary

1. The International Centre of Insect Physiology and Ecology (ICIPE) together with a consortium of 22 African Universities have established the African Regional Post-graduate Programme in Insect Science (ARPPIS). ARPPIS is a 3-year Ph.D. degree programme in insect science. The scholars register at an ARPPIS participating university but undertake coursework and a research project at the ICIPE. Between 10 and 15 scholars join ARPPIS each year and a total of 86 from 18 countries have enrolled in the programme since its inception in 1983, including the 1991 ARPPIS class.
2. ARPPIS motivates and trains African scientists to investigate the biology, ecology, physiology and behaviour of insect pests and vectors that attack man, his crops or his livestock in Africa and that so often devastate national development programmes. For many years little impact has been made in the fight against these insect pests because Africa has lacked trained manpower, particularly indigenous manpower.
3. ARPPIS is uniquely equipped to meet this need because it provides training in Africa, for African scientists, on the insect pests and vectors of the African continent. ARPPIS is, therefore, an African response to the needs of the continent. It harnesses together the expertise of both African universities and the ICIPE.
4. From 1986 onwards, there was an 8–9 member ARPPIS Scholars' Class completing their research work and submitting a thesis to their registering university every year. There is automatically, therefore, an expanding community of ARPPIS scientists across Africa. The question before the ARPPIS organisers was whether the programme should only train insect scientists for the Ph.D. degree and then just allow them to leave the Centre or, whether ARPPIS should evolve a structure to provide the community of ARPPIS scientists with continuing current support and if so, what the nature of that support should be.
5. For this reason, the ICIPE organised this conference. The following eighty-five (85) participants attended: ARPPIS present classes (27); ARPPIS graduates (24); the ARPPIS Academic Board (15); DAAD donor agency (3); the Netherlands Organisation for International Cooperation in Higher Education (2); management of national research institutions (2); visiting international scientists (4); and ICIPE scientists and administrators (8). The conference discussed the impact of the ARPPIS programme on human resource development for national programmes and universities in Africa. The participants exchanged their own experiences since returning to their home institutions and made recommendations to strengthen the network of the ARPPIS graduates.
6. Eleven ARPPIS graduates from the 1983–1987 classes and 15 of the present ARPPIS 1988–1990 classes whose fellowships were sponsored by DAAD participated in the Conference.
7. The regular ARPPIS Annual Scientific Meeting held annually in December was included in the conference programme. The second- and third-year scholars presented their papers and chaired the scientific sessions. ARPPIS supervisors, representatives from participating universities and donor agencies and the scientific community were invited to participate in this meeting. The meeting helped to establish rapport between the ARPPIS scholars and the scientific community, and fostered confidence among them as scientists.

8. The conference confirmed that ARPPIS graduates are in popular demand for employment as lecturers in universities; researchers and research managers in national agricultural research systems; and in international organisations. The ICIPE was particularly gratified to note that all ARPPIS graduates work in Africa; and is proud of that achievement. The ARPPIS programme has therefore, in the first 8 years of existence, made an important impact in Africa.

9. The main discussion during the conference concentrated on the development of new mechanisms which permit ARPPIS graduates to remain active and productive scientists in Africa. They are the leaders in the vitally important tasks of improving human health and increasing food production by tackling the insect pests of tropical Africa, in most cases under serious financial constraints, in intellectual isolation and without adequate governmental support.

10. The following recommendations were made:
    (i) That wherever possible 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;
    (ii) That ARPPIS is partially fulfilling a need for training scientific leadership in insect science in Africa and should be supported and expanded. Efforts to move into French and Portuguese speaking countries should be intensified;
    (iii) That wherever possible ARPPIS scholars should carry out their field research in their own country to help fill data gaps in such areas. This is especially important in ecological studies;
    (iv) That collaborative linkages between ARPPIS and Pan-African organisations involved in pest management be strengthened by the establishment of academic exchange programmes;
    (v) That 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 countries;
    (vi) That the existing funding for small research grants be better publicised during the scholars last year, and that the ARPPIS secretariat actively assist each graduating scholar to obtain funds if so required;
    (vii) That a network of ARPPIS graduates 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 data base, available to ARPPIS graduates, and the potential sources of funding of postgraduate research; and
    (viii) The regular meetings of ARPPIS graduates should be institutionalised.

11. The conference received an enthusiastic response from the ARPPIS graduates.

12. The conference was sponsored by DAAD and ICIPE and the ICIPE Organising Committee wishes to express its profound appreciation to the German Academic Exchange Service (DAAD) for supporting this new and critical activity in following up the ARPPIS graduates.

13. The proceedings of the conference will be published as quickly as possible.

ZTD
14th March 1991

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