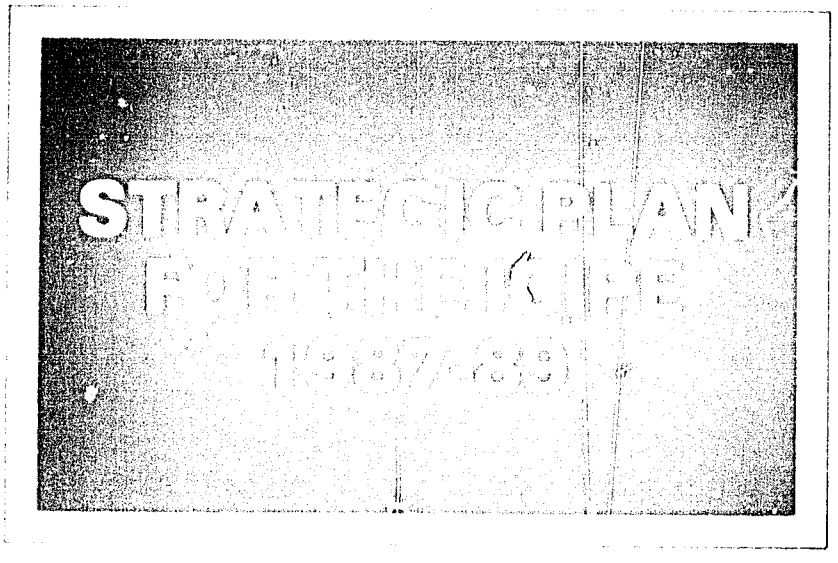
ICIPE

THE INTERNATIONAL CENTRE OF
INSECT PHYSIOLOGY AND ECOLOGY



FINAL EDITION

NAIROBI, MAY 1987

THE INTERNATIONAL CENTRE OF INSECT
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STRATEGIC PLAN FOR THE ICIPE, 1987 - 1989

FINAL EDITION

NAIROBI, MAY 1987

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ABBREVIATIONS

ABN	-	African Biosciences Network (coordinated by ICSU)
AGRICOLA	-	Agricultural On-Line Access
AGRIS	-	International Information System for Agricultural Sciences and Technology
ARPPIS	-	African Regional Postgraduate Programme in Insect Science
ARCT	-	African Regional Centre for Technology, Dakar, Senegal
BAE	-	Bionomics and Applied Ecology (within ICIPE's Crop Pests Research Programme)
BCSU	-	Biostatistics and Computer Service Unit (within ICIPE)
CAB	-	Commonwealth Agricultural Bureaux
CBRU	-	Chemistry and Biochemistry Research Unit (within ICIPE)
CGIAR	-	Consultative Group on International Agricultural Research
CIMMYT	-	Centro International de Mejoramiento de Maiz ya Trigo
CREFPHY	-	Le Centre Regional de Formation Phytosanitaire de Yaoundé
CSIRO	-	Commonwealth Scientific and Industrial Research Organization, Australia
DANIDA	-	Danish International Development Agency
DIGC	-	Duduville International Guest Centre (within ICIPE)
EEC	-	European Economic Community
FAMESA	-	Financial and Administrative Management of Research Projects in Eastern and Southern Africa
FTR	-	First Triennial Review (1983)
FAO	-	Food and Agriculture Organization of the United Nations
GEME	-	Groupe d'Etude et de Recherche en Microscopie Electronique
GTZ	-	Deutsche Gesellschaft fuer Technische Zusammenarbeit

ABBREVIATIONS (cont'd)

HFSRU	-	Histology and Fine Structure Research Unit (within ICIPE)
IABU	-	Insect and Animal Breeding Unit (within ICIPE)
IAEA	-	International Atomic Energy Agency of United Nations
ICIPE	-	The International Centre of Insect Physiology and Ecology
ICRAF	-	International Council for Research in Agroforestry
ICRISAT	-	International Crops Research Institute for the Semi-Arid Tropics
ICSU	-	International Council of Scientific Unions
IDRC	-	International Development Research Centre, Ottawa, Canada
IFPRI	-	International Food Policy Research Institute, New York, USA
IGCS	-	International Guest Centre System (within ICIPE)
IITA	-	International Institute of Tropical Agriculture
ILCA	-	International Livestock Centre for Africa
ILRAD	-	International Laboratory for Research on Animal Diseases
IMRT	-	Insect Mass-Rearing Technology (within ICIPE)
IPM	-	Integrated Pest Management
IPS	-	International Professional Staff (within ICIPE)
IRRI	-	International Rice Research Institute
IUBS	-	International Union of Biological Sciences
KARI	-	Kenya Agricultural Research Institute
KETRI	-	Kenya Trypanosomiasis Research Institute
KREMU	-	Kenya Rangeland Ecological Monitoring Unit
MBU	-	Molecular Biology Unit (within ICIPE)
MCSS	-	Medical Clinical Services Scheme (within ICIPE)

ABBREVIATIONS (cont'd)

MEDLINE	-	MEDLARS On-Line: Medical Literature Analysis and Retrieval System
MPFS	-	Mbita Point Field Station (within ICIPE)
OTU	-	Outreach and Training Unit (within ICIPE)
PDF	-	Postdoctoral Research Fellow
PDU	-	Planning and Development Unit (within ICIPE)
PRIP	-	Plant Resistance to Insect Pests (within ICIPE's Crop Pests Research Programme)
R & D	-	Research and Development
R, D & D	-	Research, Development and Demonstration
RDI	-	R & D Institute
SGI	-	Sponsoring Group for the ICIPE
SPRU	-	Sensory Physiology Research Unit (within ICIPE)
STR	-	Second Triennial Review (1986)
TCDC	-	Technical Cooperation among Developing Countries (within UNDP)
TDRI	-	Tropical Development and Research Institute, London
TPRI	-	Tropical Pesticides Research Institute, Arusha, Tanzania
TROPAG	-	Abstracts on Tropical Agriculture
TRT	-	Triennial Review Team (for ICIPE)
UNDP	-	United Nations Development Programme
UNECA	-	United Nations Economic Commission for Africa
UNEP	-	United Nations Environment Programme
UNESCO	-	United Nations Educational, Scientific and Cultural Organization

ABBREVIATIONS (cont'd)

USAID - United States Agency for International Development

UTRO - Uganda Trypanosomiasis Research Organization, Tororo, Uganda

EXECUTIVE SUMMARY

(i) The International Centre of Insect Physiology and Ecology (ICIPE) is financed by donations from United Nations agencies, governmental aid agencies, and private foundations. Since November 1980, these donors have established the Sponsoring Group for the ICIPE (SGI) with a Secretariat hosted by the World Bank.

(ii) On 27th November 1986, ICIPE received an international Charter which conferred upon it an international legal status commensurate with its international mandate. The Signatories to the Charter have delegated all responsibilities for the Centre to the Governing Council. As the principal policy-making organ, the Council approves policies for the scientific programme and resource allocation.

(iii) Strategic policies which have been approved by the Council will provide the framework of programme policies, priorities and general direction during the Plan period. The three-year plan serves as a benchmark for annual internal review of progress and for external triennial review. These triennial reviews, which have become a regular feature since 1983, assess progress against the Plan and advise on areas which hold promise for new scientific knowledge and for the design of integrated technologies pest management thereby guiding resource allocation.

(iv) ICIPE's vision for the next decade is to facilitate the generation of low-cost and viable pest management technologies for selected target pests, relevant to locale-specific socio-economic situations which will help farmers increase their food production and improve the health of rural communities in the tropics. In order to sustain these technologies, ICIPE is committed to seeing a growing community of indigenous scientists with expertise in insect science; and therefore training is an important integral part of the scientific programme, and interactive linkages with national programmes will be strengthened during the Plan period.

(v) The question of whether ICIPE should concentrate on basic or applied research is often asked. The Centre undertakes fundamental but mission-oriented research, always aimed in the long-term at a practical pest problem in the tropical developing countries. It has adopted an ecosystems approach in its crop and livestock pest management research while an approach of multi-parasite-disease situation providing a basis for community based vector control will characterize its future research on medical vectors. It is for these reasons, that during the Plan period, the ICIPE (a) is strengthening its capacity in pest population modelling and simulation, and (b) has incorporated social science into its programme activities.

(vi) Within this approach, the research addresses (a) crop pests of economic importance in the tropics; (b) livestock pests which reduce animal productivity (tsetse and ticks); and (c) major vectors of human diseases (leishmaniasis and malaria).

Crop Pests

(vii) The major target insect pests being investigated are those of sorghum, maize, cowpea, banana, rice (in the Philippines in collaboration with IRRI), and cassava (biological control in collaboration with IITA). The research strategy is based on effective utilization of plant resistance to insect pests; utility of mixed cropping; population modelling for monitoring pests; biological control utilizing natural enemies of target pests; and socio-economic studies of farmer perception and economic impact.

(viii) Pilot field trials of these components are being undertaken as they mature.

Livestock Pests (Tsetse and Ticks)

(ix) ICIPE's Super Tsetse Trap (STT) which incorporates buffalo urine engages the efforts of ICIPE ecologists and chemists. It has potential as a low-cost community-based tsetse management strategy; and its efficacy will be improved by a predictive tsetse population model being developed by the group. For livestock ticks, the principal thrust of research is directed towards developing effective methods for stimulating the host immune system which will be used in conjunction with immunization and curative drugs (being developed by other institutions) for integrated management of ticks and tick-borne diseases. Field studies aim to develop a tick population model for evaluating control regimen based on strategic and threshold dipping.

(x) When tsetse and ticks are efficiently managed, the livestock industry will be able to exploit animals of improved performance in areas currently unavailable to them, bringing a significant increase in milk and beef production.

Medical Vectors

(xi) Malaria, trypanosomiasis and leishmaniasis occur as multi-parasite-disease complex among rural communities. Subject to availability of funds, the foundation laid by ecological research will be extended to focus on the use of biological control agents in community-based vector control strategies.

Training

(xii) Efforts to strengthen scientific leadership in developing countries, and particularly in Africa, continue parallel with the research in pest management. Priority is placed in postgraduate training. Every year, eight students graduate with Ph.D degrees in insect science.

Resources

(xiii) The Governing Council has approved a maximum of 45 international professional staff; whether all are filled depends on the funding level. For 1987 the funding is US$.8.5 million which is still a minimum budget supporting programmes at only a functional level. An increase of 10% would move towards the desirable level and towards utilising ICIPE's full potential.

(xiv) Physical facilities continue to improve with the completion of Mbita Point Field Station and the new Headquarters laboratories, insectaries and maintenance workshops due to be completed in Nairobi by the end of 1987, leaving offices for administrative services, library, training and conference facilities as the critical remaining need at the Duduville campus. However, there is a continuing requirement for major research equipment such as electron microscopes, FT-NMR system, computers, and field vehicles. Adequate plans are being made, within funding constraints, for the maintenance of all facilities in good operating condition.

I. ICIPE's MANDATE

1. The prime concerns of the International Centre of Insect Physiology and Ecology (ICIPE) are research in integrated control methodologies for crop and livestock insect pests and other related arthropods, as well as insect vectors of tropical diseases crucial to rural health in the tropics (especially in Africa); and the strengthening of scientific and technological capacities of the developing countries in insect science and its application through training and collaborative work.

2. Within this mandate, the ICIPE's five principal objectives are to:

(a) Undertake fundamental research on selected pests in order to study their identity, abundance, distribution, ecology, behaviour, physiology, pathology, genetics, and the application of this knowledge to the problems of integrated pest and vector management systems, as well as on the beneficial use of insects;

(b) Establish research cooperation with key international research centres and advanced laboratories throughout the world, and with national programmes in Africa, to facilitate research on and the testing and demonstration of pest control strategies;

(c) Provide advanced training in research methods and techniques for pre-doctoral and postdoctoral fellows, as well as young practitioners, in insect science and technology;

(d) Provide an international forum for the discussion and exchange of knowledge among scientists through seminars, symposia, conferences, and training workshops, on new advances in insect science and management strategies for tropical pests and disease vectors;

(e) Promote the growth of the scientific community in the tropics, especially in Africa, by its activities and by its special relationships with universities and research institutions.

II. GOVERNANCE

3. The ICIPE was established in April 1970 as an international research centre. From 27th November 1986, its legal status has been established by an international Charter. The principal policy-making organ is the Governing Council. The Governing Council has responsibility for approving ICIPE's scientific programmes and resource allocation, and monitors the execution of these programmes. Council members are selected

for their experience with due regard to geographical distribution, and include expertise in science policy, various disciplines in insect science and related sciences, and Research and Development (R & D) institutional and resource management. The Director of the Centre is the Chief Executive. He is charged with the responsibility of carrying out the Mandate of the Centre, within the policies and regulations promulgated by the Council.

4. Historically, the ICIPE Foundation (an organization of national academies of science and other learned societies) has provided the ICIPE with a strong intellectual base. The Foundation has been considering for some time the possibility of extending similar support to other institutions in the world.

5. The ICIPE is financed by donations from United Nations agencies, governmental aid agencies and private foundations. Since November 1980, these donors have established the Sponsoring Group for the ICIPE (SGI), with a Secretariat hosted by the World Bank in Washington, D.C. The SGI provides an opportunity for members collectively:

(a) to review, advise, and concur in the ICIPE policies, programmes, and goals;

(b) to review proposed biennial budgets, and ensure that the approved programmes and budgets are in line with anticipated SGI support; and

(c) to monitor the quality of the ICIPE's performance.

The SGI meets twice a year to receive progress reports, and review scientific programmes and consider requisite funding; and to nominate eight members of the Governing Council.

6. The relationships between governance and management are elaborated in Section XI.

III. LONG-TERM PERSPECTIVES

7. In 1970, when the ICIPE was established, it was an innovative experiment in institution-building in the tropics (especially in Africa) - an experiment that would develop national capabilities so that the potential contribution of science and technology to national development could be effectively realized, and one that would organize its programmes to address the practical problems of developing countries. Over the last fifteen years, the experiment has proved successful, and the ICIPE has amply demonstrated its ability to generate scientific information relevant to pest management in the tropics. The results of this research have become all the more important with the continuing realization that high technology, high cost methods of pest control relying solely on pesticides, are not accessible to resource-poor rural communities.

Furthermore, such approaches give no long-term answer to pest control since insect resistance to pesticides is developing rapidly and the pesticides themselves are often deleterious to the environment.

8. The fundamental research of the ICIPE is opening new avenues and increasing the efficacy of existing low-cost methods of pest and vector control. An era of low cost, effective integrated pest management useful to the resource-poor farmer, is at hand. But basic research is not enough to achieve the mission. The results of basic research by such international centres as the ICIPE must be tested in the field both for their scientific content and for their social acceptability by the rural communities, and then they must effectively be passed on to national programmes for implementation.

9. The ICIPE's vision for the next decade is to see greater reliance in tropical developing countries on scientific research, leading directly to the generation of low-cost and viable pest management technologies relevant to locale-specific socio-economic situations, which will help increase food production and improve the health of rural communities. Social scientists, working in cooperation with biological scientists at the ICIPE will assist in the development of coordinated pest management strategies. This approach assures that the adoption of technological innovations is facilitated by taking into account the needs and constraints of the end users at the technology design stage. Secondly, to see a growing community of indigenous scientists with expertise in insect science, who can join in this pan-tropical effort to generate new knowledge and to help develop new technologies. This calls for intensified research and training, as well as institutional development more conducive for research and development. The ICIPE as an international institution based in the developing world has a significant role to play in these processess.

10. For the period of the Strategic Plan, 1987-1989, this vision of the future results in three challenges:

(a) The application of fundamental research to the development of innovative pest control technologies: The ICIPE will, during the Plan period, develop integrated pest management systems for cereal and grain legumes; develop a component of biological control for livestock ticks; develop low-cost tsetse control methodology incorporating bio-control agents and improved odour-baited traps which can be used directly by rural communities; and improve trapping methods, microbiological and epidemiological studies in support of national health services in the control of leishmaniases and malaria which are a drawback to rural development.

(b) The continuing participation of the ICIPE in training for scientific leadership in pest management to strengthen the national capabilities of developing countries, especially in Africa.

(c) The establishment of networks within which the ICIPE can work intimately with national programmes on research, development and demonstration of new pest management technologies.

11. In order to meet these challenges, the ICIPE will strengthen its world-wide collaboration with laboratories of advanced research to share its new technology and to benefit from new advances in science developed by other researchers. The recently concluded collaborarative research agreement with the Biological Control laboratories of the Chinese Academy of Agricultural Sciences and the long-standing collaboration with IRRI attest to this range of intercontinental collaboration. In addition, the ICIPE is developing research capabilities for social sciences to interface with its biologically-oriented research programmes in relation to the eventual application of any new pest management technology.

12. The ICIPE has taken cognizance of the fact that modern biological research cannot afford to ignore the powers of recombinant DNA techniques, which can make immediate impact on a number of ICIPE's research projects and which, in the longer-term, will be crucial to the success of other research goals (e.g. the development of tick antigens suitable for the artificial induction of host resistance). A consultant from the Tata Institute of Fundamental Research, based in Bombay (India), visited the ICIPE in July 1985 to advise on possible infusion of these techniques into ICIPE research activities. Plans are now underway to introduce the relevant molecular biology techniques, through training workshops or visits to other institutes. Similarly, advances in areas such as insect neurobiology, peptide chemistry and biochemistry and quantitative and population ecology have also been taken into account in giving a better foundation for ICIPE's next phase of R & D.

13. Great importance is attached to methods of effecting mutual partnerships in Collaborative Research and Development with national programmes, international and regional agencies and specialized institutions. Through these partnerships, the ICIPE expects to develop appropriate networking arrangements.

14. The African Regional Pest Management R & D Network (PESTNET) is an example of the collaborative research and development partnerships within which the ICIPE wishes to participate. PESTNET seeks to develop, through mutually beneficial long-term partnership with national programmes and institutions, interactive research, development and the testing of components of innovative technologies for integrated pest management appropriate for resource-poor farmers and rural communities. PESTNET will have three main objectives:

- To provide facilities for the multi-locational testing of ICIPE's pest management ideas in a wide-range of ecological zones;

- To identify the pest problems considered economically important by participating national programmes, and to learn from their respective technology and experience, and to exchange information; and

- To provide training for strengthening scientific leadership in pest management R & D in Africa.

In the Plan period, PESTNET will deal with the crop borers of cereals and legumes, and with tsetse and livestock ticks in relation to the control of trypanosomiasis and East Coast Fever, respectively.

15. The African Regional Postgraduate Programme in Insect Science (ARPPIS) is a collaborative postgraduate training network between the ICIPE and African universities. ARPPIS has three objectives:

- To train African students, in Africa, on the insect pests and vector problems of Africa, at the Ph.D. degree level;
- To provide continuing intellectual reinforcement and an initial financial support to ARPPIS alumni through an ARPPIS Scientific Network; and
- To create a critical mass of scientific leadership in insect science and its application in participating countries of tropical Africa.

16. The Postdoctoral Research Fellowship Programme offers young scientists from around the world the opportunity to work at the ICIPE. During the Plan period, the number of postdoctoral research fellows in residence at any time will be increased from 14 to 20. A series of Group Training Courses give insect science practitioners the opportunity to learn the most recent advances in ecologically sound pest and vector management systems. A continuing Staff Development Scheme upgrades the skills and knowledge of the ICIPE staff in order to maintain a high level of performance within the Centre.

17. The solutions prescribed for Africa's food crisis have highlighted the need for improved institutional framework and management. ICIPE's own success in working with national programmes depends on the existence of productive R & D institutes on the continent. It is therefore important that ICIPE's training programme includes FAMESA, a special project designed to improve the skills of research management. FAMESA's impact is already substantial; and it is planned to strengthen it and to extend its coverage from a sub-regional concentration in Eastern and Southern Africa to the wider field of Sub-Saharan Africa.

18. The Centre believes strongly in concentrating on a few selected areas of research where it has comparative advantage, so that by the next decade it can make a lasting impact in pest management in those areas. However, well argued requests have been made recently which would result in the inclusion of new areas of research activity. For example, it is argued that banana is important to subsistence farming in Africa, and yet little progress has been made in the development of acceptable techniques for the control of the banana weevil, the single most important insect pest of the crop. Further, banana would enrich ICIPE's combination of crops for intercropping systems, adding a tree crop to the cereals (maize and sorghum) and legumes (cowpea) already being tested in the scheme. Also, there seems to be good prospects for applying ICIPE's biological control approaches to the banana weevil. In view of these advantages, and subject to availability of funds, the banana weevil will be added as a target pest in crop pests research.

19. Malaria remains the number one killer of mankind in the Tropics. Despite tremendous effort and money expended, its final control through vaccination and other means is only envisaged in the next decade. The tremendous interest in mosquito research, generated by the grave concern about the recent dramatic increase in malaria incidence and drug resistance in the tropical world, has necessitated a refocussing of research on some aspects of the vectors of the disease. The development of new irrigation schemes and the expansion of the existing ones, particularly in Africa, is a major contributing factor in this new trend in malaria transmission. These schemes lead to the aggregation of people near potential mosquito breeding sites, and therefore, enhance man-vector contact. Reliable baseline information on the epidemiology of the disease is vital. This great concern was central in the ICIPE decision to revitalize mosquito research within the Medical Vectors Research Programme, subject to availability of funds. Already the Centre has some manpower with expertise to handle the problem. Integrated vector management strategies based on ecological and epidemiological investigations demand urgent attention. Consequently, subject to availability of funds, investigations on malaria mosquitoes will be initiated, on a modest scale, in the semi-arid irrigated area of Baringo District where malaria is endemic. Because possible breeding sites of the vectors in these areas are restricted, it lends itself very well to vector control using biological agents, as opposed to insecticides.

20. Many potential collaborators are seeking new initiatives in this problem-area. Furthermore, the possibility of a malaria vaccine becoming available in the short-term, means that greater effort needs to be put into complementary control of the vector. An eminent mosquito scientist has recently undertaken a review for the ICIPE in this area, and has identified several comparative advantages the ICIPE has in mosquito research. The Council has approved, subject to availability of funding, the inclusion of anopheline mosquito in the Medical Vectors Research Programme. The ICIPE will concentrate its research mainly on the ecological investigations, to define breeding sites and identify natural enemies of the vectors, and investigate the efficacy of biological control agents in isolated ecological niches in irrigated semi-arid areas, where malaria occurs alongside sandflies, and where the ICIPE's current research on the latter is being undertaken. Such areas are particularly suitable for studies of vector control utilizing available microbial agents, with the eventual possibility of their improvement by molecular biological techniques.

21. Along the same lines, it has been suggested that cotton should be included among the target crops because it is grown by small-scale farmers, and is usually intercropped with ICIPE's other target food crops. As a cash crop, cotton provides cash income to the resource-poor rural community for purchasing inputs needed to improve the production of the food crops. Through the funding of UNDP-TCDC, a consultant report has provided background information and analysis for reviewing this proposal. In reviewing cotton, the governing body and the Management concluded that under subsistence farming, socio-economic factors are more important constraints than pest problems and, therefore, planning a productive research effort

for its pest management requires basic understanding of these other factors. As several agencies are reviewing these factors, it has been decided to postpone the consideration to a later time within the Plan period.

22. Within these long-term perspectives, described in paras 7-21 above, the research and training work plans have been programmed at two levels. The main emphasis is on the activities proposed for this Plan cycle (1987-1989). However, each Programme has projected its visions for the next 6-10 years into potential areas of productive output, under their own specific long-term perspectives.

IV. STRATEGIC PRINCIPLES, RESEARCH PRIORITIES AND OUTPUT

Introduction

23. In March 1983, the First Triennial Review (FTR) of the ICIPE, under an international team commissioned by the SGI, reviewed thoroughly ICIPE's research and training programme and the Centre's management. The Triennial Review "identified planning as a key factor for the continued success of the ICIPE". At its 44th Meeting held in April 1983, the Governing Board accepted the recommendations of the Triennial Review Team (TRT) to formulate an ICIPE Strategic Plan. The first Strategic Plan, 1984-1986, was based on the recommendations of the FTR. This second Strategic Plan, 1987-1989, is based on the achievements and the lessons learnt over the period since then as well as taking into consideration the recommendations arising from the Second Triennial Review (STR) which was carried out during October 1986.

Planning Process

24. Based on the policy decisions of the governing body, the Management invited Programme Leaders and Divisional Managers to participate in the Strategic Planning for the second three-year cycle, 1987-1989 ("bottom-up" planning process). The Programme Leaders and Divisional Managers were required to review with their staff, the primary goals of their programmes, to state their achievements during the first cycle (1984-1986) and to state activities planned for the second cycle (1987-1989), including scientific collaboration; to indicate human and financial resources needed to achieve these goals; and to consider the effects of any financial constraints on these activities. These proposals were received by the Deputy Director, who subsequently discussed the goals and programme activities with the respective programmes in order to bring them in line with the resources that might be available in the context of Governing Board decisions. Subsequently, the in-house Research Committee reviewed the plans. The Management has finally reviewed with Programme Leaders (in the process of "top-down" planning) the draft plans in terms of feasible capacity, and in the context of competitive allocation of resources to the various programmes. This planning process has been designed to provide better decision-making, as well as affirm the decentralization of the management systems.

25. The criteria for assigning priorities, as an evaluation process, was to weight (i) the potential of the particular programme activity for a scientific break-through which is likely to remove a serious constraint on food production or rural health in the tropics (50%); (ii) the research competence of programme staff (20%); (iii) the ability to fund the relevant activity on a productive level for a required period of time (20%); and (iv) the scientific uniqueness of the particular activity in the tropics (10%).

26. The proposed Strategic Plan is presented to the Governing Council which reviews it through the Executive Board and its Programme Committee for scientific advice and for overall strategies and resource utilization. Once approved by the Council, these plans govern the scientific programme of the ICIPE during the Plan period. Within these plans, the Director, as the Chief Scientific Officer, has the responsibility to introduce appropriate and productive scientific methodologies and new advances in science to achieve programme objectives. However, where new major pests arise and if the ICIPE has the opportunity to contribute in their management strategies, the Council will review Management proposals in accordance with the set priorities and effective utilization of resources.

Resource Management

27. The ICIPE Governing body policy statement to the FTR, designated international professional staff (IPS) to be one of the indicators of the size of the Centre; and approved a maximum of 45 IPS for the medium-term. Subsequent to the FTR, for the first Strategic Plan (1984-1986), a budgetary strategy was adopted which held IPS constant at 42 in order to provide for progressive improvement of equipment, supplies, transportation, and staff remuneration. Considerable success has been achieved in improving this research infrastructure; and, although this Plan is based on the same strategy, the potential level of 45 IPS has been reiterated within which to review selective increases during the Plan period. This level would utilize, more effectively, the scientific potentials of the ICIPE, but would require an increase of 10% in the current level of resources. It would, for example, facilitate further improvement in equipment and research supplies; fuller utilization of new advances in science such as those referred to in para 12; and the implementation of the potential areas of research suggested in para 18-21. For the moment, one additional IPS has been approved for 1987, to exploit the research results on livestock ticks by appointing a specialist in integrated pest management with expertise in population modelling; a further two are approved (but not yet funded) for an ecologist in Medical Vectors and for a resident entomologist at IITA for collaboration within Crop Pests Research Programme.

28. Based on the strategy of progressive improvement within the resources available, the Council has developed three scenarios for the budget as follows:

Scenario I — The minimum budget is based on the current level of resources, and supports the present programmes only at a functional level. It should be noted that ICIPE has operated at this level for several years without any increases in real terms.

Scenario II — A budget at a level 10% above the minimum (Scenario I) would facilitate effective accomplishment of the crucial goals of the second-cycle Strategic Plan. It is only when additional funding moves towards this level that the scientific programme will embrace the potential areas of research and training; and IPS numbers will move along with it within the approved range.

Scenario III — This scenario envisages a "worst case" position, in which the minimum budgets could not be attained due to a drop in grant income of 10% or more. In these circumstances, the Council would review the parts of programme and support services (including administration) which could be reduced.

29. In all the programme plans, inadequacy of space is noted as one of the major constraints. Phase I of Mbita Point Field Station (MPFS) capital development programme has been completed. This facility meets, to a large extent, the requirements of the Crop Pests Research Programme, and portions of the programmes on Tsetse and Livestock Ticks based at MPFS. Facilities for insectaries, additional staff housing, and recreation facilities will be considered during the next Plan period, unless specific funds become available earlier.

30. The most critical space problem exists at the headquarters in Chiromo, Nairobi. It is planned to relocate all activities currently at Chiromo, to Duduville in the surburbs of Nairobi. The construction of the facilities for relocation of activities from Chiromo should be completed during this Plan period. A major effort is underway to raise the balance of the funding (60%) required to complete the Project already started in July 1986.

31. Along with physical construction, it is important to develop an orderly programme of acquisition and replacement of equipment and vehicles. It is for this purpose that the capital budget includes equipment.

32. Within these guidelines, the Council has adopted the policy on priorities as follows:

- Joint improvement of research infrastructure and staff remuneration

- Completion of Duduville Capital Development Programme (Phase II), as outlined in para 30 above

- Increasing international professional staff years to 45.

Reseach Output

33. Traditionally, research outputs are in the form of publications. The ICIPE has strengthened its information services to ensure adequate dissemination of its research results to the users, particularly to other researchers, extension personnel and policy-makers.

34. As indicated in para. 25, the measure of ICIPE's research output is based on the potential of the research activity for a scientific break-through which is likely to remove a serious constraint on food production or rural health in the tropics. The realization of this potential will be an indicator of the maturity and points of growth of the programme activity. This point will have been reached when the results of the laboratory and field experimentation are ready for pilot scheme trials. The outputs of such trials will become quantifiable in terms of increased crop yields through reduction of damage caused by pests and of livestock productivity and control of human disease.

V. ICIPE'S CORE PROGRAMME: RESEARCH

Introduction

35. ICIPE's Research Programme is primarily concerned with tropical insect pests of crops and vectors of livestock and human diseases. The crop pests under investigation include the crop borers of maize, sorghum, and cowpeas. The livestock pests being studied are tsetse, the vector of trypanosomiasis, and ticks, vectors of several debilitating cattle diseases including East Coast Fever (ECF). Since the early years of the ICIPE, there has been substantial emphasis on research on disease vectors and reservoirs of medical and veterinary importance. On-going work has been focussed on leishmaniasis, a fatal disease of man with wild and domestic animal reservoirs. Currently, strategic considerations envisage the reinstatement of investigations on malaria vector mosquitoes, including aspects of their biological control. The ultimate impact of ICIPE's research will be the development of integrated pest and vector management systems for these economically important pests and disease vectors.

36. ICIPE's research programmes are supported by four Research Units specialized in chemistry and biochemistry, fine structure, sensory physiology and biostatistics. Research in these units is focussed on the above target pests, and much is performed in direct collaboration with the major programmes. These Units are central in the Centre's development of fundamental knowledge required by the major programmes.

37. During the 1987-1989 period, it is planned that the tools of molecular biology should begin to infuse the relevant areas of ICIPE's programme research. Techniques of molecular biology have been developing rapidly since the first cloning experiments in the mid 1970s. They have now permeated most disciplines of biological sciences and are likely to play an increasingly important role in the development of insect science. ICIPE's approach in introducing these techniques will be through training workshops, visits by scientists to other institutes, collaborative research, and modest investment in equipment and biochemicals necessary to launch molecular biology research into a few selected programme activities. Initial selected projects include (a) the use of recombinant DNA techniques for the characterization of leishmanial parasites; (b) development of molecular karyotype analysis to differentiate between human and non-human infecting T. brucei in epidemiological studies of trypanosomiasis; and (c) either CDNAs or genomic clones coding for target tick antigens will be used in expression vectors for screening antiserum from tick-resistant host animals in order to identify tick DNA sequences of interest. Training workshops have been planned for the 1987-1989 period covering both theory and practical work in molecular biology and related techniques.

38. Productive R & D efforts resulting in generation of technologies or knowledge requires the establishment of a mechanism for the transfer of the products to the intended user groups; and that the effective mechanism in this process be imperatively linked with the forces of change in society and human behaviour. As the ICIPE enters its new phase and plans its strategy for the generation and application of its pest management technologies for increased food production, it will need to continually incorporate into its programmes, appropriate methodologies for the transfer of these technologies. The programmes will need to sharpen their understanding of the socio-economic milieu in which that technology adoption will occur; the processes affecting technology application at the community level; and the reorientation of the processes of technology development, taking full cognizance of the social and economic factors, and farmers' circumstances that are likely to militate against adoption of the technology.

39. The rationale for social science interface with the research and training activities at the ICIPE cannot be over-stated. As the Centre enters this era, there is a need for institutional capability to increase responsiveness of its research and training activities in a practical and sensitive way, to the user's needs and constraints. During the current Plan period, the ICIPE expects to intensify the involvement of social science expertise (e.g. social anthropology and agricultural economics) to undertake careful study of the environment of technology generation and application, and to input the resulting knowledge into ICIPE's IPM strategies. Linkages with the Social Science Interface Programme within the ICIPE and elsewhere are of two types:

(a) between scientists and the populations they are trying to assist, the farmers and

(b) between scientists at ICIPE and other development professionals at other institutions in Kenya and in the Africa region.

Linkage with farmers and their communities has been initiated through the use of on-farm trials, and exploratory use of farmer-managed experimental field trials in collaboration with the Crop Pests Research Programme. An analysis of constraints in animal production has also been initiated in collaboration with the Livestock Ticks, Tsetse, and Medical Vectors Research Programmes. Studies have been initiated to disseminate existing information and to obtain inputs and suggestions from the community on research efforts.

40. Training at the ICIPE is conducted in three major areas: (a) Professional scientific training is accomplished at both postdoctoral and postgraduate levels. The latter is done in close collaboration with several African Universities. (b) Short-term training courses in pest and vector management are offered to practising insect scientists and technologists from the developing world. (c) There is a staff development programme for the upgrading of special skills and techniques of the staff of the ICIPE itself.

41. The Research Support Services supply essential elements of support to the research and training programmes. They include Mbita Point Field Station (MPFS), and Workshops and Laboratory Service Unit. The International Guest Centre System (IGCS), the International School and the ICIPE Clinic at Mbita Point Field Station, provide Amenities and Social Services to the Centre as a whole. Finally, the Information Services (which include services on Library, Documentation and Publication, and Communication) provide critical support to the Scientific programmes of the ICIPE as a whole.

(a) CROP PESTS RESEARCH PROGRAMME

PRIMARY GOAL

42. The major goal of this programme is to undertake the research necessary for developing strategies for the integrated management of insect pests of crops by methods which are environmentally safe, economically and technically feasible as well as socially acceptable for resource-poor farmers in the developing tropics.

43. Since 1984, the programme has been restructured into four sections: Bionomics and Applied Ecology (BAE), Plant Resistance to Insect Pests (PRIP), Biological Control (BC) and Insect Mass-Rearing Technology (IMRT). These four sections contribute components for the control of the target crop pests; and the inter-sectional collaboration is aimed at combining these components to develop an effective Integrated Pest Management (IPM) system.

TARGET INSECT PESTS AND CROPS

44. The major target insect pests under investigation are those of sorghum, maize, cowpea and banana (the latter is a new target crop) in tropical countries, and of rice in the Philippines by the ICIPE resident team. Studies on the biological control of cassava green spider mite have recently been included under a special IFAD-supported project. These crops have been taken up for study for the present because they constitute the main staple diet of a growing majority of the people in the tropics. The principal target pests and their host crops can therefore be summarized as follows:

A. Maize and sorghum stem-borer: especially Chilo partellus, Busseola fusca and Eldana saccharina (in this order of priority)

B. Cowpea pod-borer, Maruca testulalis

C. Sorghum shootfly, Atherigona soccata

D. Cassava green spider mite (biological control only)

E. Rice brown planthopper, Nilaparvata lugens (under study off-campus in collaboration with IRRI in the Philippines), but will be concluded in the early part of the Plan period

F. Banana weevil (at MPFS)

G. Rice leaf-folder (at IRRI).

45. When certain other insect pest species have an impact on the attack by the target pests consistently in the areas of interest to the ICIPE, those species would also be included in the Programme (e.g. thrips and aphids on cowpea).

FIELD SITES

46. The field experiments and trials during the plan period 1987-89 will be carried out at:

(a) Mbita Point Field Station
(b) Ungoye Field Research Site (particularly large scale experiments/trials);
(c) Farmer's fields in selected ecological zones;
(d) Various national agricultural research stations in Kenya, particularly at Kitale, Alupe, Katumani and Mtwapa.

(i) BIONOMICS AND APPLIED ECOLOGY (BAE) SECTION

OBJECTIVES

47. A. Develop and standardise methodologies for:

(a) Assessment of crop losses
(b) Monitoring and surveillance of pest populations

(c) Assessment of efficiency of different cultural control practices (including intercropping) and behavioural manipulation in suppressing the pest populations.

B. Generate information on population dynamics, crop losses, reproductive biology, behaviour and ecology of the target pests.

C. Develop population models and forecasting systems for an integrated pest management system.

ACHIEVEMENTS

48. During the 1984-86 Plan period, the research under this Section had provided information on the following main aspects:

A. Methodology for assessing grain yield reduction caused by the crop borers has been standardised. Losses caused by C. partellus are higher when the plants are younger (i.e. 20 days after crop emergence) than when they are old (i.e. 40 days after crop emergence). This fact suggests that early planting of sorghum could reduce losses, since the plants would be old at the time when maximum borer infestation occurs.

B. The possibility of rearing B. fusca continuously, without an intervening diapause, on natural host has been demonstrated. Information was gathered on the reproductive capacity of diapausing and non-diapausing generations of B. fusca and the effects of delayed mating on the reproductive potential of B. fusca and C. partellus. These results revealed the potential of communication disruption as a strategy for pest management.

C. Information on the population patterns of stem-borers, in relation to crop phenology and carry-over mechanisms, have been gathered. This suggests that cultural practices, such as early planting, disposal of crop residues, and destruction of volunteer or alternative host plants, can suppress the stem-borer populations.

D. Borer attacks on the target crops have been demonstrated to differ according to the crop combinations used for intercropping. The crop combinations examined include host and non-host as well as inter-varietal combinations. Among these combinations, the host/non-host, sorghum-cowpea or maize-cowpea intercrop systems have a lower level of borer attack than the sorghum-maize intercrop. Differences in the varieties of sorghum and cowpea intercropped have also been found to affect the level of borer attack. Thus, intercropping can serve as an important component of the pest management system.

RESEARCH AREAS

49. Using the methodologies developed and information generated during the 1984-86 Plan period as the base, further research during the next Plan period (1987-89) is proposed to be undertaken in the following areas:

A. Populations of the target pests on the crops maize, sorghum and cowpea will continue to be monitored, particularly with a view to understanding how the populations are governed by ecological conditions, different hosts plant species and their cultivars, cropping systems and practices, and seasons. Study of these aspects will elucidate the conditions which boost or hamper the attack of the target pests to the target crops. This would serve to identify the elements which can be used directly or indirectly for the management of the pests.

For the above studies it would be necessary to develop and standardise population monitoring techniques. The methods that are already being developed include the use of the pheromones for trapping adult pests, as well as sampling their immature stages. Certain conditions necessary for the maximal performance of pheromonal trapping have already been identified and would be used for developing effective pheromonal trapping methods. The data collected will be used for modelling and forecasting of the pest populations.

B. The yield losses caused by the target pests on sorghum, maize and cowpea and certain important factors governing these will be studied in detail, using the methods developed and standardised during the previous plan period. Yield losses will be studied in relation to different crop cultivars, cropping systems, different ecological zones and seasons. Interactions of different pests infesting the same crop species and their effects on yield losses would be investigated. The data to be generated will be used for developing models of crop losses under different agro-ecological conditions. Efforts will also be made to assess yield losses on a regional basis, starting with Nyanza (Kenya) and later extending to other regions, depending on resources available.

C. Cultural practices for the management of the crop borers will continue to be developed or improved. The most important cultural practice that has been identified as promising and that is to be developed will be intercropping. Research on this component of pest management will concentrate on identification and utilisation of crop combinations which will reduce pest attack. For this, combinations of different cultivars of the target crops will be compared through on-farm research for their effects on pest populations and yield losses. Also, the mechanisms involved in the effects of intercropping on pest attack and on yield will be elucidated. The performance of selected intercropping systems will also be compared in different agro-ecological zones with a view to identifying combinations suitable for each of these zones.

D. Physiological factors, particularly nutritional, which govern development, fecundity and fertility of the pests will be investigated. The information generated will be used in two ways: (1) to improve the techniques of mass rearing of the pests, and (2) in the development of strategies for the control of the crop borers.

E. Factors controlling behaviour of the target pests, particularly mating, oviposition and feeding, that are involved in the establishment of the insects on their host plants will be elucidated. The information obtained will be used for manipulating the behavioural responses of the borers in pest management programmes.

(ii) PLANT RESISTANCE TO INSECT PESTS (PRIP) SECTION

OBJECTIVES

50. The research in this Section is being aimed at developing strategies for effective utilization of plant resistance to insect pests as a component of pest management system. These include:

A. Evaluation of target crop lines or cultivars obtained from various sources to identify the promising resistant ones;

B. Elucidation of the mechanisms and genetics of crop resistance or susceptibility to the target insect pests with a view to assisting plant breeders to develop pest-resistant cultivars.

ACHIEVEMENTS

51. The major achievements of this Section during the 1984-86 Plan period have been:

A. Standardization of methodology for evaluation of maize and sorghum germplasm for resistance to C. partellus.

B. Development of approach and methodology for investigating mechanisms of plant resistance to the target pests, particularly their colonising responses and the plant characters involved.

C. Identification of borer-resistant maize, sorghum and cowpea cultivars belonging to two categories:

(i) Those cultivars which combine borer resistance with good agronomic qualities, e.g., among maize, ICZ1-OM, ICZ2-OM; among sorghum, IS-1044, ICS1, ICS2; and cowpea, ICV1, ICV2, ICV5;

(ii) Those cultivars which are agronomically inferior but can serve as good sources of resistance, e.g. among maize, MP702, MP704; among sorghum, IS2205, IS-178; and cowpea, TVu 946 (for M. testulalis), ICV10, ICV11, ICV12 (for Aphis craccivora).

D. Mechanisms of borer-resistance in the target crops, as elucidated during the 1983-86 Plan period, involve one or more of the following categories of colonising responses of the borers to each of the target crops: Ovipositional nonpreference, larval orientation nonpreference, feeding nonpreference and antibiosis. Contribution of leaf surface trichomes in maize, and of leaf-volatiles in sorghum, to ovipositional nonpreference for their respective resistant cultivars has been demonstrated.

E. Genetic studies have suggested that inheritance of sorghum resistance to C. partellus is polygenic, and that both resistance and tolerance mechanisms are involved. However, the mechanisms of tolerance and resistance appear to be controlled by distinct and different sets of polygenes. The locally adopted cultivar 'Serena' was found to be most tolerant compared with others. Inheritance of cowpea resistance to M. testulalis is controlled by polygenes; while cowpea resistance to Aphis craccivora is controlled by a single dominant gene (monogenic).

RESEARCH AREAS

52. The work done thus far has revealed that certain cultivars of the target crops have a high pest resistance but low agronomic quality whereas others are highly susceptible but good agronomically. Also, a high degree of genotype - develop cultivars which will combine high pest resistance with other desirable characters and will be adaptable to diverse ecological conditions, additional cultivars from different international and national sources will be obtained and investigated. This would enable us to broaden our germplasm resources for borer resistance to cater for different agro-ecological systems. The areas to be investigated with reference to these cultivars are stated below:

A. Evaluation of the additional cultivars for resistance to target pests and for other characters will be carried out using the standardised methodology. The cultivars to be evaluated will include:

(a) those which have been reported to be resistant to the target pests in other parts of the world but not in Africa;

(b) those which have not been tested for resistance to the target pests anywhere.

Such an evaluation will be aimed at comparing among the cultivars:

(a) the components of pest-resistance, and
(b) overall Resistance-Susceptibility Indices (ORSI).

Information on these aspects will be helpful in understanding the mechanisms of resistance as well.

B. Mechanisms of resistance/susceptibility of these cultivars will continue to be elucidated to provide information which can be used by plant breeders for developing improved cultivars. Elucidation of the mechanisms will involve investigation of:-

(a) Pest-Plant communication systems determining resistance through disruption of insects' colonising behavioural responses (attraction/repulsion, feeding, oviposition) to plants. The systems to be investigated will be (i) morphological/physical characters of plants; and (ii) chemical characters (allelochemics).

(b) The pest-plant metabolic interactions contributing to the plant resistance through (i) disruption of metabolic processes of the pests, and (ii) reactions of plants, if any, to pest attack involving compensatory growth or synthesis of insect metabolic inhibitors.

C. Genetics of pest resistance in the target cultivars will continue to be investigated. The studies will be aimed at:

(a) elucidating the mode of inheritance of different resistant characters, and

(b) identifying genes for different resistant characters to enable plant breeders to combine these with other desirable characters.

D. Multi-locational trials with the cultivars showing resistance to the target pests will be undertaken in collaboration with the national programmes in different ecological zone to obtain information on:

(a) reaction of target pests to the cultivars, and

(b) adaptability of the cultivars to these zones.

(iii) BIOLOGICAL CONTROL (BC) SECTION

OBJECTIVES

53. To develop strategies for efficient utilization of locally occurring natural enemies (parasitoids, predators, pathogens) of the target pests in their management programmes.

ACHIEVIMENTS

54. The research under this Section during the 1984-86 Plan period has furnished important information in the following areas:

A. Identification of certain parasitoids and pathogens of the target pests, which can serve as suitable candidates for use in the biological control of the crop borers (parasitoids - Dentichasmias busseolae, Pediobius furvus and Trichogramma sp.; pathogens - Nosema sp., Panagrolaimus sp., Beauveria sp. and Bacillus sp.)

B. Basic biology and incidence of these natural enemies of the target pests at Mbita and the neighbouring localities

C. Effects of introduction of certain selected pathogens and parasitoids (Nosema sp., Panagrolaimus sp. and Pediobius furvus) against C. partellus under screenhouse conditions or in small field trials

D. Rearing of the parasitoids and successful culturing of the pathogens

E. Biotaxonomic investigations indicate that there may be intermediate forms of cassava green spider mites, between Mononychellus progresivus and M. tanajoa. An artificial diet is being tested in which preliminary observations indicate that the predatory phytoseiid mite, Amblyoseus teke, can complete its life cycle. Evidence for natural mortality agents (pathogens) against the cassava mite has been observed in field-collected mites.

RESEARCH AREAS

55. With all the above information as the base, it is proposed to undertake further studies on the above-named pathogens and parasitoids during the 1987-1989 Plan period with a view to using these promising natural enemies of the crop borers for their biological control (or introducing related species from exotic sources for experimental trials).

56. The research on pathogens and parasites will be taken up simultaneously. The areas studied will be undertaken in the sequence indicated below:

I. Pathogens

A. The factors governing the pathogenicity, virulence, and persistence of the selected pathogens of the crop borers will be elucidated. These factors will include solar radiation, temperature, humidity, and cropping systems. A knowledge of these factors will be helpful in maximizing the efficacy of the biocontrol agents.

B. The effects of the selected pathogens on non-target organisms will also be investigated in order to ensure their safety and compatibility with parasitoids and predators for practical field application.

C. Appropriate technology for large scale production and application of the pathogens, using already established techniques, will be developed in order to utilize these biocontrol agents in the integrated pest management programme.

D. The practical application for the strategies developed as above will be tested through on-farm trials with a few selected pathogens. These trials will be carried out on farmer's fields in different ecological zones.

II. Parasitoids

A. Populations of the selected parasitoids will be monitored in different ecological zones with a view to understanding the role of local parasitoids in regulating the pest populations. These studies will also aim at finding out differences, if any, on the incidence of parasitoids of crop borers in relation to different crop cultivars and cropping patterns.

B. The factors which determine the reproductive potential of the selected parasitoids, and which govern their efficiency of finding and establishing on their host pests will be investigated. These will provide the basis for manipulating the above factors to enhance the efficiency of the parasitoids for the control of the borers.

C. Technology for large scale production and release of the selected parasitoids for field application will be developed. Field trials will be conducted in different ecological zones.

57. It is proposed to strengthen the collaborative research project with IITA on the biological control of cassava mites. This project is funded specifically under the Africa-Wide Project on Biological Control of Cassava Pests. The areas of collaboration under this project are:

A. Biotaxonomy and distribution of the cassava green spider mite.

B. Alternative rearing methods for predators of the cassava green spider mite.

C. The potential of pathogens in the biological control of the cassava green spider mite.

(iv) INSECT MASS-REARING TECHNOLOGY (IMRT) SECTION

OBJECTIVES

58. A. Develop technology for mass production of high quality target insects. The stem-borer (*Busseola fusca*), a parasitoid (*Pediobius furvus*), a predator of cassava mite (the Phytoseiid mite, *Amblyoseus teke*), and vectors of livestock and human diseases (leishmaniasis and malaria).

B. Production and supply of target insects for use by various research programmes.

ACHIEVEMENTS

59. A. During the 1984-86 Plan period, this Section developed and improved the techniques, including the artificial diets, for rearing *Chilo partellus* and *Maruca testulalis*.

B. To ensure mating in *C. partellus*, adult emergence has been synchronized by delaying emergence in males, by keeping the pupae at low temperatures (10°C).

RESEARCH AREAS

60. During the 1987-89 Plan period, the work in the Section will concentrate on the following main aspects:

A. Development of diets for rearing the other target crop pests, particularly Busseola fusca; for a parasitoid, Pediobius furvus; and for predatory phytoseiid mites; as well as the development of techniques and procedures for their mass culture.

B. Development of procedures for monitoring the biological performance of the insectary-reared insects and mites and comparing their performance with the wild-type populations.

(v) INTER-SECTIONAL COLLABORATION

OBJECTIVES

61. A. Coordinate the integration of pest management innovations developed by different Sections of the Crop Pests Research Programme.

B. Undertake joint research in areas requiring participation of scientists from more than one Section or Units in the Centre with a view to developing an integrated pest management programme for the target crop pests.

ACHIEVEMENTS

62. During the 1984-86 Plan period, the following projects were involved in inter-sectional collaboration:

A. Identification of factors (such as trap height and inter-trap distances, number of females, their age and mating status and female population in the field) influencing the efficiency of pheromonal trapping of C. partellus males (BAE, PRIP).

B. Successful demonstration of the potential for diverting sorghum shootfly oviposition to a non-host crop (maize) using extracts of sorghum seedlings (BAE, PRIP, CBRU).

C. Elucidation of the factors (natural enemies, plant physiological factors, micro-climate) responsible for the advantages observed in the reduction of pest populations in an intercropping system (BAE, BC, PRIP).

RESEARCH AREAS

63. Further studies in the above stated areas, and other areas as listed below, will be undertaken during the current Plan period:

A. Development of improved techniques for monitoring the target pest populations using pheromones and other devices, including chemical attractants and visual stimuli, singly or in appropriate combinations (BAE, PRIP, CBRU, SPRU).

B. Chemical characterization and field testing of sorghum shootfly oviposition stimulant so as to divert its egg-laying to appropriate non-host plants (BAE, PRIP, CBRU).

C. Continuation of the study of the factors determining the effects of inter-cropping on pest incidence: plant physiological systems, biocontrol agents and pest behaviour (BAE, PRIP, BC).

D. Study of the host-seeking behaviour of insect predators and parasitoids and the controlling factors, including the role of kairomones and pheromones, with a view to an efficient utilization of these organisms for pest management programme (BC, PRIP).

E. Studies on the interaction between bio-control agents and host-plant resistance (BC, PRIP).

F. Assessment and maintenance of normal biological performance of the reared target insect pests: locomotor activity, reproductive potential (% and frequency of mating, fecundity, fertility), larval feeding, and susceptibility to diseases (IMRT, BC, BAE, PRIP).

G. Development of methodology for mass-culture of selected parasitoids and predators of the target pests (BC, IMRT).

H. Development of genetic methods of pest control, particularly through induction of F_1 sterility (BAE, PRIP, IMRT).

I. Plant characters (physical and chemical) influencing the expression of resistance to pest attack (PRIP, HFSRU, CBRU, SPRU).

J. Experimental designs, data analysis and pest population modelling (CPRP, BCS).

K. Development and evaluation of IPM strategies through on-farm trials (CPRP, Social Science Interface Research Unit).

L. Identification of the genetic bases and allelochemical factors of plant resistance; transfer of resistant genes to agronomically elite lines of target crops; and genetic manipulation of insect pests and their pathogens (bacteria, viruses, fungi, protozoa and nematodes) (CPRP, Molecular Biology Unit).

COLLABORATION

64. Collaboration with various national and international centres for research on the target insect pests and crops is particularly necessary for (a) extending and/or confirming the results of research done at the ICIPE, and for (b) conducting studies at the ICIPE utilising the materials and information furnished by the collaborating institutions. Such collaboration with IRRI (in the Philippines) on rice pests has already been going on during the past seven years, conducted by a resident ICIPE team. Similar collaboration with IITA, involving an ICIPE team resident at Ibadan, Nigeria, was initiated in early 1986. Both these components of collaboration would be continued and strengthened during this Plan period. Such collaboration is coordinated by the ICIPE's Outreach and Training Unit (OTU).

65. Collaboration with national programmes in Kenya, which is already going on, and with other African countries will be further strengthened, particularly with the objective of conducting trials and enhancing interactive cooperative R & D at different locations utilizing plant materials and the pest management components or packages developed at the ICIPE. Collaboration will be strengthened with Kenya Institutions working on farming systems and nutrition research maize and sorghum at Busia, Kitale, Kakamega, Katumani, Kibos, Kisii, Kitale, and Mtwapa. Such collaboration will also be undertaken with Somalia, The Sudan, Tanzania, Uganda, Zambia, Zimbabwe, and The Ivory Coast. Formal agreements to this effect have been concluded with Somalia and The Ivory Coast; and the establishment of PESTNET for crop borers will certainly put these arrangements on a firmer basis. Along the same lines, a pilot project on "Reduction of Food losses in Africa" is to be undertaken in collaboration with UNECA and FAO from early 1987. Formal collaborative agreements with the International Agricultural Research Centres - IRRI, ICRISAT, IITA, and IFPRI - have already been concluded for research on rice pests, sorghum pests, farming systems, and social science research, respectively. Informal collaboration with CIMMYT for research on maize pests, is already going on, and would be further strengthened during this Plan period. A collaborative project between the CPRP and Swedish groups on development of methods for application of pheromones in the management of stem-borers of maize and sorghum in Africa, with particular reference to Kenya, will be initiated during the current Plan period.

LONG-TERM PERSPECTIVES

66. The major thrust of research in the Crop Pests Research Programme in the longer term will be continued refinement of the various components of IPM technology developed in the Plan period. The objective would be to make this technology comprehensive, sustainable, adaptive to diverse agro-ecological systems and responsive to new developments in areas such as plant biochemistry, plant genetic engineering, and the biotechnology of biological control agents.

67. It is anticipated that as the studies on the present target pests mature for field application, a number of additional important insect pests will be included in the programme's research activities. However, the trend will be to study the pests as a complex; and this will be reflected in all areas of programme research, including population dynamics and modelling.

68. Studies in intercropping are likely to move from testing different combinations of crops and cultivars to elucidating the factors (physical, biological or chemical) which affect pest populations in intercrop systems. A better understanding of these factors could suggest further improvements in intercropping practices.

69. Identification of resistant cultivars, the study of resistance genetics, and the elucidation of the mechanisms of resistance will continue to be important activities of the programme. In the medium-term, it is expected that morphological and chemical studies currently underway and planned for the 1987-1989 period will provide further insights into the mechanisms of resistance. In the longer-term, research in this area is likely to move towards the determination of biosynthetic pathways for the synthesis of allelochemics, the identification of enzymes involved and in the genetic manipulation of resistance through genetic engineering techniques (in collaboration with CBRU).

70. It is anticipated that the key factors governing the establishment of natural enemies (pathogens and parasitoids) of target pests will have been identified in the next 3-6 years. This is expected to open several options in capitalising on the programme's findings: (i) manipulation of these factors to boost the natural populations of the bio-control agents; (ii) development of a basis for biotechnologies involving large-scale production of the agents; and (iii) in the case of pathogens, use molecular biological techniques for producing vectors with enhanced pathogenicity.

Pilot Projects

71. Finally, the maturity and fruitfulness of the Crop Pests Research Programme will be measured by undertaking collaborative pilot projects in different representative ecological and geographical zones in Kenya and neighbouring eastern and southern African countries. These pilot projects will involve biological and social scientists working on field trials on farmers' fields with the participation of small-scale resource-poor farmers, utilising the pest management components and practices developed by the Crop Pests Research Programme and will draw on socio-economic data base developed by the social science programme.

72. One such pilot project has already been initiated in 1987 and is being run in two divisions (Kendu Bay and Oyugis) in South Nyanza in Western Kenya. This project is being carried out in two phases: the pre-implementation phase and implementation phase.

73. During the pre-implementation phase, a survey of randomly selected 150 farmers (75 from each division) has been conducted in respect of their background, farming practices, pest problems and their solutions, and their socio-economic conditions. Such a survey has revealed that the farmers in these divisions certainly suffer heavy losses in the yields of various crops, particularly in staple food crops like maize, sorghum, cowpea and other legumes due to insect pests, especially crop borers. The farmers do not have adequate knowledge or means to control these pests and reduce food losses. In view of these findings, the resource-poor, small-scale farmers in these two divisions are most deserving for participating in the trials of the ICIPE's pest management components on their farmers during the implementation phase of the pilot project. For this, 50 farmers (25 in each division) have been selected, using appropriate parameters, out of the 150 surveyed farmers.

74. During the implementation phase, the pest management components developed by the Programme will be applied to the fields of these farmers. Their impact on the farmers' productivity recommended practices will be assessed.

75. On the basis of the experience in these two divisions, similar pilot projects will be undertaken in other regions of Kenya as well as in other parts of Africa.

76. BUDGET: CROP PESTS RESEARCH PROGRAMME

EXPENDITURE IN US $	ACTUAL EXPENDITURE 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL		961,000	929,000	966,000
INTL. PROFESSIONAL TRAVEL		181,000	112,000	120,000
MATERIALS, SERVICES AND EXPENDABLES		431,000	447,000	483,000
TOTAL	996,000	1,573,000	1,488,000	1,569,000
INTL. PROFESSIONAL STAFF	12	12	12	12
POSTDOCTORAL RESEARCH FELLOWS	5	5	5	5

RESOURCE COMMENTRARY

77. The Crop Pests Research Programme comprises four Sections, each with a Section Head. The projects to be undertaken in each of these Sections, together, not only constitute a large volume of work but also demand diverse expertise for their implementation. This programme has research teams resident at IRRI and IITA which are supported from its budget. It is

essential to have at least one Postdoctoral Research Fellow in each of these Sections, as well as one for each ICIPE off-campus team, so as to provide further support and new blood, hence the need for six PDFs. A specialist in integrated pest management will be needed during the Plan period, and will be provided through redeployment of positions. However, one position is needed for the scientist based at IITA.

(b) LIVESTOCK TICKS RESEARCH POGRAMME

PRIMARY GOAL

78. The principal thrust of the programme is directed towards developing effective methods for stimulating the host immune system for the control of livestock ticks, in particular *Rhipicephalus appendiculatus*. This method, used in conjunction with immunization and curative drugs against tick-borne diseases, should lead to integrated management systems for the control not only of ticks, but ultimately tick-borne diseases such as East Coast Fever (ECF). Some of the current field studies are therefore aimed at providing improved, more cost-effective tick control regimens which will include the minimum use of acaricides.

ACHIEVEMENTS

79. During the 1984-86 Plan period, the following results have been obtained:

Laboratory Studies on Host Resistance to Ticks

(a) Several antigens and protein sub-units derived from tick midgut tissue have been fractionated. This is the essential first stage in producing an anti-tick vaccine. The isolation, purification and characterization of these antigenic materials is proceeding.

(b) Tick embryonic cell cultures of *R. appendiculatus* and *Rhipicephalus evertsi* have been established. They have been shown to have common antigens with tick salivary glands. When tested for antigenicity in rabbits, the *R. appendiculatus* cultures di' not induce protection against the tick.

(c) Soluble protein extracts derived from embryonic *R. appendiculatus* cells have been used in an intradermal test in cattle to detect previous exposure to ticks. The antigen produces a local intradermal immediate hypersensitive response of the host. This test shows promise for screening large numbers of cattle to select tick-naive animals for experimental use.

(d) Tick vitellin has been isolated and purified. It too is antigenic, though not protective, in rabbits. Since this protein is almost pure in tick eggs, it was the first one to be tested.

(e) The results of attempts to stimulate natural resistance in cattle, in the laboratory and the field, using artificially applied R. appendiculatus adults, suggest that natural resistance is more difficult to induce in Bos indicus (Zebu type) than in Bos taurus (European type). With concentration of effort on the induction of resistance by defined antigens, work on the reinforcement of natural resistance has been temporarily stopped.

(f) A comparison of three strains of R. appendiculatus from field sites, where they always feed on livestock, with the long-established laboratory strain reared on rabbits, showed that the field strains withstand the effects of tick-feeding induced resistance better than the laboratory strain. This finding will be valuable in selecting the tick strains to be used in assessing resistance.

(g) Collaborative work with the Veterinary Research Department, KARI, has shown that transmission of ECF in cattle is influenced by their level of naturally induced resistance, and this in turn greatly reduces the level of Theileria parva infection acquired by ticks feeding on infected, resistant hosts.

Field Studies on Cattle

80. Four studies have been completed on the effects of different tick burdens on liveweight gains, blood parameters and on tick resistance itself. The following are the most important findings.

(a) It has been established what burdens of ticks Boran cattle (B. indicus) can tolerate before the value of production exceeds the cost of control measures. This threshold level is influenced by the tick species present, nutritional status of the animals and inter-current disease.

(b) Collaboration with KARI, who have shown that solid immunity to ECF can be achieved in the field, has enabled us to study, for the first time in Africa, the effects of varying levels of R. appendiculatus field challenge. This research has shown that adequate cover against other tick-borne diseases (e.g. anaplasmosis and cowdriosis) must be included in any scheme of integrated control involving the minimal use of acaricides.

(c) Naturally-acquired resistance can be overwhelmed by a sufficiently heavy tick challenge; and the animals then clearly show such deleterious effects as severe weight loss, anaemia, secondary infections, and there is also a progressive build-up of ticks on the pasture.

(d) Bos indicus cattle readily control infestations of the one-host tick Boophilus decoloratus.

(e) In collaboration with KARI, 13 different acaricidal ear-tags were evaluated in the laboratory, and then tested in two field trials. Several of these tags (particularly a mixture of amitraz and permethrin which gave protection against R. appendiculatus for up to 160 days) could have a role in integrated tick control, where they would provide a limited, but effective, input of acaricide.

(f) Two studies have been completed under the ARPPIS on host resistance to Amblyomma variegatum and Rhipicephalus evertsi.

(g) An intensive 3-week training course in tick management, funded by the EEC, was held in 1986 and further courses are planned.

(h) Immunisation studies in goats and sheep with antigen preparations derived from tick organs have given impressive results in goats and especially sheep. Major effects on all tick stages and fertility have been demonstrated of such a magnitude that effective control of the pasture populations by immunisation can be predicted.

RESEARCH AREAS

81. The main laboratory effort will continue to be directed to the artificial induction of resistance in rabbits, sheep, goats and cattle. The immunization experiments in sheep will be repeated. The work will concentrate on the isolation, characterization and demonstration of biological activity induced by individual antigens derived from tick midgut and other organs, and also from cell culture, in close collaboration with the CBRU (3 sub-projects).

82. The assessment of resistance and the determination of antibody levels in inoculated animals are essential for the evaluation of candidate antigens. Studies to improve the nymphal feeding test, including the effects of host resistance on adults and larvae, will complement studies on in vitro feeding as well as serological techniques being carried out in conjunction with the University of Neuchatel (Switzerland). Efforts will be made to identify the antigen responsible for the allergic response in the intradermal test; and its use as a purified protein will be evaluated.

83. The field studies will concentrate initially on the accumulation of data on climate, tick activity and host factors affecting seasonal tick numbers, augumented by studies on the survival of the unfed stages of R. appendiculatus and Amblyomma variegatum. These studies will be conducted in four ecological biotypes, Intona Ranch, Rusinga Island, Muguga and Mariakani. This information is needed for tick population/management modelling, which will lead subsequently to the development of regimens of "strategic" dipping (in which dipping is restricted to those times of the year when it is most cost-effective) and "threshold" dipping (where it is used only when tick burdens start to cause economic losses).

84. An intensive collaborative study of the ecology of A. variegatum is being made with the University of Neuchatel, with observations on activity, survival and host-seeking behaviour as well as detailed measurements of the micro-climate experienced by ticks on the ground and in the vegetation.

85. Different breeds of cattle commonly found in East Africa will be compared for their ability to respond to tick infestation and for the effect of tick challenge on cattle productivity. The influence of nutrition, age, disease, etc. on tick feeding induced resistance will also be studied.

86. Current studies on the mixed tick population and tick-borne diseases on resource-poor farms on Rusinga Island will be expanded to include tick survival. The tick model that is developed will be used to evaluate a tick control regimen based on the combined use of acaricidal ear-tags, strategic dipping and threshold dipping. Later, the effects of ticks, and the benefits of tick control, on productivity and tick-borne diseases will be monitored on the improved livestock that it is planned to introduce. It is envisaged that the project will first have to establish a data base on present productivity on ten selected farms. All control strategies will be integrated with a social science input to ensure that they are likely to be successful when added to traditional farming practice. Furthermore, there will be close collaboration with the Kenya Veterinary Services and KARI.

87. In parallel with the Kenya Government/International Fund for Agricultural Development (IFAD) Animal Health Services Rehabilitation Programme, the programme will carry out a similar project on small dairy herds. This will be based at Mariakani (Coast Province). Life cycle and survival data will be collected for R. appendiculatus, A. variegatum, Boophilus microplus and B. decoloratus populations. These data will be used in population modelling to study the effectiveness of strategic and threshold dipping. The economic returns will be assessed in terms of milk production. There will again be close collaboration with the Kenya Veterinary Department and KARI.

COLLABORATION

88. Integrated Pest Management will require tick population and disease epidemiology models to be integrated. New collaboration with the modellers at ILRAD and CRSP will be established to develop suitable IPM models. If progress is adequate a modelling workshop will be convened.

89. The current collaborative arrangements already described with KARI, Kenya Veterinary Services, Kenyatta University and the University of Neuchatel will be continued and expanded as appropriate (see para 81-85 below).

90. In collaboration with ILRAD, KARI and the Kenya Veterinary Services, the programme will continue to expand its knowledge of the effect of host resistance on the incidence of tick-borne diseases, in the various projects already described. On Rusinga a detailed study of the changes in ECF antigenicity and the effect of maternal immunity on disease occurrence in newborn tick exposed animals will be examined. Finally, it should be noted that an intensive 3-week training course in tick management funded by the EEC was held in 1986 and further courses are planned.

91. The University of Nairobi M.Sc students will be advised and assisted with tick related subjects for M.Sc degree.

LONG-TERM PERSPECTIVES

92. Peptide synthesis and genetic manipulation techniques are likely to play a major role in the large-scale production that will be needed when the antigens being sought by the ICIPE are finally ready for incorporation in an anti-tick vaccine for widespread use.

93. Host resistance mechanisms are probably similar for all hard ticks; and it should therefore be possible to develop further vaccines, or multi-valent vaccines, as required once the technique has been perfected for one species.

94. It should be possible, through PESTNET, to pool together the various modelling projects for R. appendiculatus that are at present under consideration, to present a comprehensive model of the population dynamics throughout its range. This will benefit all concerned in controlling the species, and could pinpoint key areas where foci of tick might persist. Total elimination of R. appendiculatus (or any other African tick species) is not a feasible objective, except in physically or ecologically isolated sites, unless its success can be virtually guaranteed over very large areas.

95. If planned work on the in vitro feeding of R. appendiculatus is successful, the benefits to ICIPE's tick research will be enormous: the mass rearing of ticks for experimental work will be greatly simplified, and studies on physiologically active substances of all kinds that can be presented during feeding will be facilitated. In particular, in vitro feeding should enhance our knowledge of the crucial mechanism of host rejection of ticks.

96. When ticks and tick-borne diseases are efficiently controlled, the livestock industry will be able to exploit animals of improved performance in areas currently unavailable to them, bringing a significant increase in national milk and beef production, particularly in the developing rural areas. The pilot studies on Rusinga Island will form a starting point in this process.

97. BUDGET:

LIVESTOCK TICKS RESEARCH PROGRAMME

EXPENDITURE IN US $	ACTUAL EXPENDITURE 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL		364,000	403,000	419,000
INTL. PROFESSIONAL TRAVEL		26,000	27,000	30,000
MATERIALS, SERVICES AND EXPENDABLES		165,000	193,000	208,000
TOTAL	357,000	555,000	623,000	657,000
INTL. PROFESSIONAL STAFF	5	6	6	6
POSTDOCTORAL RESEARCH FELLOWS	2.75	3	3	3

RESOURCE COMMENTARY

98. The Programme is reasonably well funded in terms of personnel and equipment. However one position has been added for IPM expert in population modelling and a scientist has been recruited. The man-power resources have also been strengthened by the collaborative agreement with the University of Neuchatel, which has provided a PDF for 1986-88, as well as mutually beneficial working visits by senior staff over the same period. The other 3 PDF positions are currently under recruitment. Current personnel resources are fully committed but the proposed studies at Mariakani are separately funded and these funds include extra personnel and equipment (see para).

99. The critical need is space, and the Programme has been given priority in the Capital Development Programme for the Centre's Headquarters at Duduville for laboratories, insectaries, and animal facilities. The latter have been re-designed to facilitate the rearing of calves, sheep and goats from birth to one year of age in tick-free conditions, when they will be used in studies on immunity to ticks. When completed in 1987-88, the programme should then have excellent facilities.

100. Problems still remain with paddock facilities for grazing and field experiments. The Centre depends at present on the courtesy of KARI, and it is hoped to locate suitable paddock facilities near to Duduville). An agreement has been reached with owners of Intona Ranch (Narok District) for ICIPE to continue with field experiments, and experimental studies have been agreed on the Agricultural Development Corporation stud at Mutara near Rumuruti. The development of the Rusinga Island and Mariakani projects should also give access to small farms, initially enough for observation rather than experiments.

(c) TSETSE RESEARCH PROGRAMME

PRIMARY GOAL

101. Tsetse transmit human sleeping sickness and animal trypanosomiasis, and is a very large problem in tropical Africa. It has defied concerted control efforts mounted over the last several decades. It is for this reason that ICIPE's research is seeking to understand tsetse physiology, ecology and pathology, as well as infection pattern, to provide a better understanding of tsetse biology and trypanosomiasis epidemiology, so as to begin to develop a much better strategy for a long-lasting solution to the tsetse menace. The main thrust of the programme is to develop new strategies so as to reduce trypanosomiasis challenge to animal and human life through vector control.

ACHIEVEMENTS

102. Some of the significant results of the programme activities at the ICIPE are:

(a) Studies, including the screening of a variety of chemical natural products as a factor in attracting tsetse to traps, has revealed that buffalo urine contains a potent attractant. This is likely to prove a major factor both in tsetse sampling and tsetse control. A blend of 7 simple phenolic compounds has been shown to be largely responsible for this activity. The attractants have been shown to be breakdown products of polar precursors which provide a reservoir for controlled release of the attractant compounds. Cow urine dispensed with acetone has also produced substantial increases in trap catches.

(b) A more effective trap (the Ngu trap, a new tsetse trap developed at ICIPE's Nguruman Field Research Site) can be used as part of a community participation strategy for tsetse control. The new trap costs less than the biconical trap, yet catches on an average three times the number of female Glossina pallidipes as the conventional biconical trap. Moreover, it can easily be made on site by the local people.

(c) A dynamic tsetse population model has now been developed using data gathered from three years of research at Nguruman on a Maasai group ranch. The model can already predict seasonal population change; and improvement in its predictive power is anticipated. Extensive mark-release-recapture studies are being used to relate biconical trap catches to absolute population size. Density dependent pupal mortality has been demonstrated in the field.

(d) Studies on the epidemiology of human trypanosomiasis in Western Kenya (Lambwe Valley) have shown that there is exchange of human infective trypanosomes between this focus and the Ugandan (Busoga) focus on the other side of Lake Victoria. This exchange could explain the frequent outbreaks of sleeping sickness in these two areas.

(e) The intervention of tsetse control measures in the Lambwe Valley, aerial spraying operations in particular, and the ICIPE's entomological evaluation of the short and long-term effects, provided much useful information on certain tsetse population demographics which would not otherwise have been obtainable. Furthermore, data obtained were used to develop a model for determining the effectiveness of aerial spraying - the first of its kind.

(f) Insofar as insecticidal pressure and population isolation promote insect resistance to insecticides, the influence of these factors has been expressed on tsetse, probably more intensely than elsewhere, on the G. pallidipes population in the Lambwe Valley, which was thus a prime candidate for an investigation of possible development of tsetse resistance. Susceptibility studies subsequently showed that while the Lambwe Valley strain was significantly more tolerant of dieldrin and endosulfan than a previously unexposed strain (from Nguruman), the differences were not sufficiently great to be incontestable evidence for the development of resistance.

(g) ICIPE's tsetse research over the last three years has revealed the presence of a virus which causes enlarged salivary glands in the main trypanosomiasis vector in Kenya, G. pallidipes, which makes them rather ineffective in feeding. Further research has now shown that the virus also causes a high level of sterility in the male tsetse. This finding paves the way for an alternative possibility for biological control of tsetse using a novel sterile-insect technique.

(h) The ICIPE scientists have succeeded in rearing G. pallidipes in an insectary at MPFS with rudimentary facilities, whereas many research groups with more sophisticated facilities have failed in the past to establish G. pallidipes colonies. This simple structure may offer ideas to other groups attempting to mass-rear G. pallidipes, if this becomes essential for tsetse control through the sterile-insect technique.

(i) Trypanosoma brucei-infected tsetse have been shown to be under stress: such flies have been shown to be far more susceptible to sublethal doses of pesticides than normal healthy flies. This implies that control measures, e.g. insecticide-impregnated screens, could reduce trypanosome infection by inducing selective mortality of infected flies.

(j) The presence of 3 families of antibacterial proteins, namely: lysozyme, attacins and cecropins has been demonstrated in the tsetse haemolymph. Two proteins of 17 and 70 kD have also been demonstrated to be specifically associated with the disappearance of bacteria in the tsetse haemolymph.

(k) Training of personnel from other institutes: Firstly, training on long-term tsetse management was provided to Ethiopian tsetse and trypanosomiasis control personnel. Secondly, a course has been developed through EEC funding on field and laboratory techniques in tsetse management and trypanosomiasis control; this course is intended for personnel already engaged in these activities in various East and Central African countries. Thirdly, M.Sc. and Ph.D. students from the University of Nairobi regularly conduct their thesis research under the guidance of Tsetse Programme scientists.

RESEARCH AREAS

103. The research areas outlined below are aimed at gaining a deeper understanding of tsetse biology, and thereby developing a more cost-effective control strategy using improved low-cost traps, biological control and the involvement of the community in the control operations. Some of these studies will be done in collaboration with the various ICIPE research programmes and research units where relevant.

104. At Nguruman, the tsetse population model will be tested and refined by manipulating the population size of G. pallidipes. Concurrently, studies will be intensified on pupal mortality factors. Density-dependent mortality or emigration of young flies will also be examined using mark-release-recapture methods. With increased collaboration from KETRI and Veterinary Research Laboratories of Kenya's Ministry of Agriculture and Livestock Development, it should be possible to incorporate the population model into a trypanosomiasis epidemiological model.

105. The proposed population manipulation will be used to test, in a pilot project on tsetse control, the new tsetse trap as part of a community participation control strategy. Trap manufacture, odour baiting and maintenance will be carried out by the neighbourhood Maasai under ICIPE supervision. The objective is to increase the trapping mortality progressively over the next two years, both to maximise our understanding of tsetse population dynamics and to test the viability of the community participation approach.

106. Intensive studies will continue on the identification and mode of action of active chemicals in buffalo urine, as well as on the use of additives to urine from domestic animals. In this respect research and development work will be directed at optimizing trap design, with the overall objective of developing more cost-effective trap/odour bait systems.

107. Work to isolate and characterize the other active ingredients in buffalo urine will be intensified; and the importance of various chemicals, either alone or in various blends, will be evaluated by behavioural, electrophysiological and field investigations. Studies will be carried out to determine the nature of the polar-precursors, and prepare them in the laboratory in quantity for field evaluation and to look for and identify non-phenolic attractant compounds which may be present in buffalo urine.

108. Studies will be initiated to investigate the behaviour of tsetse, with particular emphasis on communication around host animals and traps. Eventually, such studies will be extended to investigate behaviour of the flies at larviposition sites. Such studies will not only be useful in understanding the actual behaviour of tsetse populations in the field and contribute towards the development of an effective population model, but will also help in efforts to increase the efficacy of odour-baited traps and targets.

109. Studies will be continued to attempt to explain the apparent scarcity of T. brucei in certain G. pallidipes populations; the role of game and domestic animals in the endemicity of the disease; physiological factors in the tsetse which form barriers to trypanosome infection; studies on the genetics of G. pallidipes in relation to their trypanosome vectorial capacity; and the related eco-physiology of contrasting tsetse populations, especially in relation to the prevalence of trypanosome infection in the preferred animal hosts of these tsetse.

110. Molecular biology techniques will be used as a taxonomic tool in the epidemiological studies to separate T. brucei from human infecting T. rhodesiense, and to study immunity and genetics of the target tsetse species, G. pallidipes.

111. Anti-trypanosome factors in tsetse will be identified using immunological and molecular biology techniques, especially factors associated with trypanosome infectivity to the fly.

112. The successful rearing of G. pallidipes from Lambwe Valley has encouraged us to look further into the physiology of this fly. For instance, mating and insemination success of female G. pallidipes is still quite low under laboratory conditions. Experiments to investigate problems associated with these two events will therefore be carried out in order to identify and correct these impediments to mating success.

113. In the field of biological control of tsetse fly populations the role of virus-like particles among other pathogens of tsetse and also tsetse immune mechanisms are being investigated in collaboration with Histology and Fine Structure Research Unit and Chemistry and Biochemistry Research Unit. The work on culturing G. pallidipes virus has been initiated using pupal cells. The intention is to work on the mode of transmission of this organism from the insect to the mammalian hosts. Detection of virus-infected flies is being examined using immunological methods, and the male sterility factor is being examined.

COLLABORATION

114. A collaborative research project with ILRAD is going on on testing the effects of various insecticides on trypanosome-infected tsetse; with KEMRI on the transmission of tsetse virus particles to mammalian hosts and to tsetse G. pallidipes; with University of Alberta (Canada) on the genetics of tsetse (G. pallidipes); with KETRI on the standardization of blood infectivity incubation tests for human-infecting T. brucei (derived from tsetse), and testing tsetse-isolated trypanosomes against trypanocides; and with Kenya's Ministry of Agriculture and Livestock Development on attempts to suppress tsetse populations using traps. The work will start in late 1986, and continue into the 1987-1989 Plan period.

115. The constant ground spraying of Lambwe Valley to suppress the tsetse population has created a very low density population in this area. This has a unique opportunity to test the effectiveness of the various tsetse sampling methods on low densitites which will be undertaken in collaboration with the Kenya Government institutions.

116. Further collaboration is planned, as follows:

(a) Discussions with Uganda Trypanosomiasis Research Organization (UTRO) are in progress on a collaborative research project on the ecology of Glossina fuscipes (main human trypanosomiasis transmitter in Busoga District, Uganda), as well as the training of UTRO staff in biostatistics. The ICIPE intends to look into G. fuscipes situation in Businga Island, Kenya, in the very near future.

(b) Preliminary discussions have been held with the Ethiopian Government and ILCA officials on carrying out a collaborative project on tsetse challenge to trypanotolerant cattle. An ARPPIS student has already started to work along these lines. The ILCA/ILRAD/ICIPE training manual on tryptolerance compiled in 1982 will need to be revised during this Plan period.

LONG-TERM PERSPECTIVES

117. The World Food Conference Resolution XI (1974) calls for the control of trypanosomiasis so that food production in Africa can be increased. The obstacle to utilizing vast areas of land in Africa for livestock and crop production caused by tsetse and trypanosomiasis does not give much hope to realising the potential for increasing food production. In fact, there is concern that there exists already an increasing food gap. The need to double efforts in tsetse and trypanosomiasis research and control to meet the call for self-sufficiency in food production by the year 2000, requires the integration of available technologies in tsetse management and the development of the reclaimed areas.

118. The relative lack of success in tsetse control in the past suggests that new strategies are required in order to have a lasting impact. A strategy combining a deeper understanding of the various elements in the tsetse population dynamics (for example, pupal mortality factors), an understanding of the disease situation, effective and low-cost trapping technology, and full community participation in control schemes, offers the best prospects for the future. Such a strategy will necessitate studies on other important tsetse and possible non-tsetse vectors of trypanosomiasis, as well as assessment of cost-benefit ratios in pilot control schemes. Community involvement in such schemes offers both exciting possibilities and great challenges for the future, and will require the ICIPE to work closely with relevant national government institutions.

119. Although other biting flies may be important in the mechanical transmission of Trypanosoma vivax, at this stage the programme would rather include other important tsetse vectors of animal and human trypanosomiasis e.g. G. fuscipes fuscipes along Lake Victoria shores and nearby Islands e.g. Rusinga and Mfangano islands.

120. A pilot scheme to test the efficacy of the trap as a control strategy has been instituted at Nguruman in Kenya.

121. BUDGET: TSETSE RESEARCH PROGRAMME

EXPENDITURE IN US $	ACTUAL EXPENDITURE 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL		389,000	406,000	422,000
INTL. PROFESSIONAL TRAVEL		27,000	28,000	30,000
MATERIALS, SERVICES AND EXPENDABLES		140,000	147,000	159,000
TOTAL	442,000	556,000	581,000	611,000
INTL. PROFESSIONAL STAFF	6	6	6	6
POSTDOCTORAL RESEARCH FELLOWS	2.25	3	3	3

RESOURCE COMMENTARY

122. The expansion in field-oriented ecological research, as well as the mounting of a tsetse control pilot project, will necessitate the purchase of additional equipment and vehicles.

123. Funds are urgently needed to enlarge the existing insectary building at Mbita Point Field Station to provide laboratory support facilities.

(d) MEDICAL VECTORS RESEARCH PROGRAMME

124. The Medical Vectors Research Programme (MVRP) is one of the oldest ICIPE research programmes, having been established in 1972. In the early years, emphasis was placed on mosquito vectors of yellow fever, malaria and filariasis; but in 1979 research was extended to vector and animal reservoirs of leishmaniases. Due to lack of adequate funding, the mosquito research was suspended at the end of 1982, although a nucleus of postgraduate students continued with investigations with the support from mini-grants.

125. The tremendous interest in mosquito research, generated by the grave concern arising from the recent dramatic increase in malaria incidence and drug resistance in the tropical world, has necessitated the Programme refocussing on some aspects of vectors of malaria. An important factor leading to the trend of increased malaria transmission is the development of new irrigation schemes and the expansion of the existing ones; an example can be provided of such a scheme in Kenya. These schemes lead to the aggregation of people near potential mosquito breeding sites, thus leading to enhanced man-vector contact. This great concern has led the ICIPE to decide to revitilize mosquito research within the Medical Vectors Research Programme subject to availability of funds. Already, the Centre has some of the needed manpower with expertise to handle the problem within the MVRP Programme.

126. Malaria remains number one killer of mankind in the Tropics. Despite tremendous effort and money expended, its final control through vaccination and other means can only be envisaged in the next decade. Integrated vector management strategies based on ecological and epidemiological investigations demand immediate attention. Consequently, subject to availability of funds, investigations on malaria mosquitoes will be initiated on a modest scale in the semi-arid irrigated malaria-endemic areas of Baringo District. Because the breeding sites of the vectors are restricted in these areas, they lend themselves very well to the use of vector control using biological agents rather than insecticides.

127. Leishmaniases Epidemiological investigations on leishmaniases have been carried out throughout endemic areas of Kenya since 1979. The disease affects a large number of people in potentially productive agricultural areas; and it is estimated that approximately 400,000 new cases are reported yearly throughout the world. The disease is often fatal; affects mainly young people, or causes severe and permanent disfigurement of affected areas. The ICIPE has made significant advances in the understanding of the disease, its vectors and animal reservoirs.

PRIMARY GOALS

128. Identify and characterize the vectors, parasites and reservoirs responsible for leishmaniases in tropical Africa, and undertake relevant ecological and physiological research which might lead to the development of control methods for reducing leishmaniases in humans through vector and reservoir control.

129. Undertake epidemiological investigation on target vectors, i.e. vector ecology, vector-host interaction, vector identification, and vectorial capacity, with the intention of introducing the integrated management of the disease through vector control, which would greatly assist in attaining improved rural health.

ACHIEVEMENTS

130. Investigations on the feeding habits of sandflies using mammals, reptiles and birds have led to the identification of preferred hosts. These findings have been employed to intensify studies on candidate vectors of leishmania of man and animals in Baringo District.

131. The breeding sites of most of the species of sandflies in Baringo District have been elucidated through introduction of new techniques and modification of the standard methods of studying sandfly breeding sites. This has been a major achievement in view of the fact that the question of breeding sites of phlebotomine sandflies has puzzled researchers in East Africa for over two decades.

132. Leishmanial parasites were isolated in Kitui and Baringo Districts from three species of sandflies which were suspected to be vectors of leishmaniases of man and animals. Through animal infectivity studies, the clinical picture that emerged resembled that of *Leishmania major* for parasites isolated from two *Sergentomyia* species, which have so far not been incriminated in transmitting this disease. An isolate from a phlebotomine sandfly from Baringo behaved in an animal experimental model as *L. donovani*.

133. During the 1984-1986 Plan period, a new facility for typing leishmanial isolates was established. Using this facility, it was possible to establish that leishmanial isolates from a lizard, a genet cat and two sandflies (Sergentomyia garnhami and S. ingrami) were biochemically similar to human-infective Leishmania major.

134. Laboratory experiments on vectorial capacity: A laboratory bred-colony of various species of sandflies, was used in investigating the vectorial capacity of Sergentomyia species of sandflies; some species were shown to be capable to picking up human leishmania (L. donovani). This goes a long way to show that this group of phlebotomine sandflies can naturally become infected with human-type leishmania.

135. Taxonomic studies of complex species of vectors of both visceral and cutaneous leishmaniases were undertaken. Previous to these studies, it was not possible to tell apart the female forms responsible for the transmission of L. aethiopica and the Synphlebotomus complex. Questions were raised as to whether these were actu lly distinct species. The studies have shown that they really are distinct biochemically, even though they look alike morphologically.

136. The programme has assisted WHO/TDR in training staff from two institutions in epidemiology techniques for leishmaniases.

RESEARCH AREAS

137. The major research areas are:

A. Study of the vectors and reservoirs of leishmaniases: parasite isolation and experimental infections; observation of infectivity and infection rates in vertebrate and invertebrate hosts; and the characterization of the disease parasites biochemically and otherwise, e.g., through the use of immunological techniques (monoclonal antibodies) and recombinant DNA techniques (nuclei acid hybridization) in order to identify and characterize the species of leishmanial parasites and their vectors. Genotype analyses using molecular biology methods will be carried out to study the phylogenetic relationships among the parasite strains and species.

B. Detailed studies of the ecology of sandfly vector species will be initiated by: (a) monitoring sandfly populations in the field using the sticky sandfly trap; (b) carrying out behavioural studies, including the use of fluorescent dust and blood-meal analysis to ascertain the behavioural pattern of the vectors; and (c) analysing host-finding mechanisms (e.g. odour) - this will be a stepping-stone to collaboration with the Chemistry and Biochemistry Research Unit.

C. Development of laboratory-bred colonies of target sandfly species for experimental studies (including behaviour and ecology).

D. In collaboration with National Programmes in Kenya, Sudan, Somalia and Ethiopia, epidemiological investigations will be undertaken on humans, vectors and reservoirs of leishmaniases.

E. Subject to the availability of funds, research on mosquitoes will be revived on the following lines:

(i) Investigation of the ecology of malaria vectors in Baringo District i.e. their resting and breeding sites, parasite infection rates and biting behaviour;

(ii) Search for potential natural parasites, predators and pathogens of mosquitoes, and determine their ecology;

(iii) Carry out a limited pilot control trial using any of the above biological control agents found to have potential efficacy.

COLLABORATION

138. The Programme collaborates in research with the following institutions in Africa, South America, Middle East and Europe, in the following areas:

(a) Kenyan Ministry of Health
Division of Disease Control and Research - epidemiological investigations of leishmaniases in West Pokot

(b) Kenya Medical Research Institute
(Clinical Research Centre) - collaboration in rearing of phlebotomine sandflies

(c) UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases - on epidemiological investigations of leishmaniasis

(d) British Museum (Natural History) - on taxonomy of sandflies

(e) Imperial College, London - on blood-meal analysis for determination of sandfly vector species

(f) Universidade Federal de Minas Gerais
Instituto de Ciencias Biologicas, Brazil - on identification, through immunological studies, of leishmaniasis animal reservoirs

(g) Addis Ababa University, Ethiopia
Institute of Pathobiology - on epidemiology of kala-azar

(h) Ahmadu Bello University
Zaria, Nigeria - on epidemiology of leishmaniases

(i) Institute for Development Studies
University of Nairobi - on sociological aspects in the epidemiology of kala-azar in Kitui District, Kenya.

LONG-TERM PERSPECTIVES

139. The use of a plastic-sheet smeared with castor oil as a device for sampling sandflies and studying their diurnal directional movements in Kitui District has demonstrated the effectiveness of this simple device to greatly reduce sandfly populations in human dwellings. In such traps, considerable Anopheles mosquitoes were also caught. It may prove instructive to demarcate an area which is active for leishmaniases and malaria and apply some of the methods already developed in Kitui and Machakos Districts, and conduct a pilot control trial to demonstrate the efficacy of this trap in the control of malaria and leishmaniases.

140. In collaboration with the Chemistry and Biochemistry Research Unit, the identification of kairomones of sandflies will be initiated, in order to determine whether these could be used as a tool for the mass-trapping of sandflies both for control and population monitoring.

141. In collaboration with the Livestock Ticks Research Programme and the Chemistry and Biochemistry Research Unit, preliminary investigations will be undertaken on the sandfly antigens as a tool for the control of sandflies and leishmaniases. Recombinant DNA techniques will be used for mass production of sandfly antigens of interest.

142. The search for other biological control agents, i.e. parasites, pathogens and predators, will be an important activity of the Programme during the Plan period. The discovery of such agents may provide the basis for small-scale biotechnology involving industrial production of the agents which can then be used for the field control programmes of leishmaniasis and malaria.

143. BUDGET: MEDICAL VECTORS RESEARCH PROGRAMME

EXPENDITURE IN US $	ACTUAL EXPENDITURE 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL		264,000	254,000	274,000
INTL. PROFESSIONAL TRAVEL		20,000	20,000	22,000
MATERIALS, SERVICES AND EXPENDABLES		122,000	84,000	91,000
TOTAL	275,000	406,000	358,000	387,000
INTL. PROFESSIONAL STAFF	3	3	3	3
POSTDOCTORAL RESEARCH FELLOWS	1	2	2	2

RESOURCE COMMENTARY

144. Because of the very strong component of field work, transport is essential for the success of this Programme; hence the provision of a vehicle each year, including a replacement one. Laboratory facilities are inadequate; and therefore there is urgency in raising additional funds for the completion of the Duduville Capital Development Programme (Phase II).

145. With the establishment of a parasite characterization service at the ICIPE, the relevant expenditure is reflected on the added costs for equipment, reagents, materials and expendables. Seasonal field staff levels have been increased due to greater demand for field data collection, and this is also reflected in increased field expenses.

VI. ICIPE'S CORE PROGRAMME: RESEARCH SUPPORT UNITS

(a) CHEMISTRY AND BIOCHEMISTRY RESEARCH UNIT (CBRU)

PRIMARY GOALS

146. The primary role of the Research Unit is to carry out collaborative research with the ICIPE Core Programmes in areas of chemistry and biochemistry which are pertinent to their goals. Specifically, the Research Unit provides support to isolate and characterize antigenic proteins which may be useful in preparing anti-arthropod vaccines; and to isolate, identify and synthesise insect-active compounds (pheromones, kairomones and allomones) which may be useful in the management and control of insect pests and vectors. More than 75% of the Unit's time is devoted to such collaborative research activities.

147. About 25% of the Research Unit's time is spent in exploratory research in areas of arthropod chemistry and biochemistry which falls within the mandate of the ICIPE. The aim is to encourage new ideas, and allow some exposure to challenging problems.

ACHIEVEMENTS

148. Tick biochemistry: The major egg-yolk protein from *Rhipicephalus appendiculatus* has been purified, characterized and tested as an immunogen in rabbits. Antibodies to vitellin ingested by the adult ticks fed on immunized rabbits were ineffective in disrupting egg development in these ticks. This ineffectiveness appears to be partly due to high relative abundance of the protein in the tick; and partly due to relatively small proportion of the antibodies crossing the midgut.

149. A carboxyl proteinase in the midgut of *R. appendiculatus* adult female has been identified, partially purified and characterized. Anti-serum preparation to this enzyme raised in rabbits completely blocked the enzyme activity in an *in vitro* assay.

150. Pheromones and kairomones: The active compound in the sex-pheromone mixture from Glossina pallidipes has been shown to be the meso-diastereoisomer of 13,23-pentatriacontane. A new dihalo phenolic component was identified in the pheromone mixture of R. appendiculatus. These studies have now been concluded.

151. A blend of 7 simple phenols present in buffalo urine has been shown to give a 7-fold increase in tsetse catches in the field. These compounds appear to be derived from a reservoir of water-soluble precursors, the breakdown of which provides a built-in mechanism for controlled-release of the phenols. The Research Unit is now collaborating with the Tsetse Research Programme and the Sensory Physiology Research Unit in evaluating various compositions of synthetically derived phenolic components.

152. Crop plant allelochemical studies: An ethyl acetate extract of the stems of a resistant variety of cowpea was shown to have a feeding deterrent effect on Maruca testulalis larvae. Activity has now been narrowed down to a fraction containing a small group of compounds, which includes a mildly active mixture of phytosterols.

153. Stimulation of oviposition on sorghum shoots by the sorghum shootfly, Atherigona soccata, has been shown to be due to a mixture of polar and non-polar components, two of which have been identified. Identification of the other components now underway may make it possible to use the stimulant mixture to divert oviposition to non-host crops in intercropping systems.

154. Exploratory studies: A number of chemicals with anti-insect activities were isolated from tropical plants including several new compounds (a potent limonoid anti-feedant from Harrisonia abyssinica; a pterocarpan antifeedant from Tephrosia hildebrandtii; and a potent isobutyl amide mosquito larvicide from Spilanthes mauritiana). Some of these plants and related species have been selected for further evaluation through the PESTNET system. These include S. mauritiana and Plumbago zeylanica for their mosquito larvicidal activities, and Ocimium suave as a stored grain protectant.

RESEARCH AREAS

155. The proposed research programme embraces the following areas:

A. Tick Biochemistry: Emphasis will be placed on the collaborative project with Livestock Ticks Research Programme on the identification, purification and characterisation of potential antigens from the midgut and salivary gland secretions of the tick, R. appendiculatus. The carboxyl proteinase will be further purified and characterized; and the effectiveness of the corresponding antibodies in disrupting digestion in ticks will be evaluated.

It is envisaged that the tick antigen work will be the Research Unit's first entry point into the application of molecular biological techniques. The use of expression vector libraries will be made to isolate cDNA to tick-tissue mRNA or DNA fragments coding for tick antigens. A library of DNA fragments will then be created, which can then be used to study the stuctures of the relevant genes, and to carry out large-scale in vitro synthesis of the target antigens.

B. Crop Plant Allelochemical Studies: The broad aim of this area is to collaborate with the Crop Pests Research Programme and Sensory Physiology Research Unit in the identification of the allelochemics implicated in the colonization or rejection of different cultivars of crop plants by the target pests. Identification of these allelochemics will allow the development of rapid chemical analytical methods (GC, HPLC, etc) for quantitating resistance which may prove useful in resistance screening/breeding programmes. The forthcoming studies will focus on the completion of the work on Maruca feeding deterrents in a resistant variety of cowpea, and on the sorghum shootfly oviposition stimulants. New problems to be undertaken will include the Chilo feeding and oviposition factors in sorghum and maize plants.

C. Pheromones and Kairomones: Identification of Chilo partellus sex pheromone system will be carried out in collaboration with the University of Lund (Sweden) Insect Pheromone Group. Priority will thereafter be given to the sex pheromones of Maruca testulalis. Several convergent research activities will be undertaken on tsetse kairomones in collaboration with the Tsetse Research Programme: (a) identification and synthesis of polar precursors of active phenols; (b) identification of any non-phenolic attractant components which may be present in buffalo urine; and (c) structure-activity studies on selected analogues to see if more attractive compounds can be identified.

D. Exploratory Studies: No more than 25% of the scientists' time in the Research Unit will be devoted to exploratory work, and this will be done largely during the off-peak periods in the scientists' activities. Projects to be undertaken may include:

(a) Screening of selected elements of the African flora used in cultural practices as crop and grain protectants or known to be effective in deterring insects, and structure determination of compounds isolated.

(b) Exploratory synthetic work and structure-activity studies on interesting anti-insect compounds (e.g. potent sesquiterpenoid insecticides isolated from a traditional medicant).

(c) Investigation of the tissue source of the vitellins from R. appendiculatus eggs, and studies on the kinetics of vitellogenin gene expression through in vitro translation of vitellogenin mRNA during the tick adult stage.

COLLABORATION

156. Moth pheromone studies will be carried out in cooperation with the University of Lund, and funds for this collaborative arrangement are now assured. The University of Maine, U.S.A, has been providing some of the NMR spectra needed for the identification of crop plant allelochemicals and other natural products. Long-term basic structure-activity work on limonoid anti-feedants and growth disruptors arising from exploratory studies initially undertaken in the Research Unit is now being largely carried out at Maine on a collaborative basis. Evaluation of analogues of the sesquiterpenoid insecticide will be undertaken in collaboration with the ICIPE team based at IRRI.

157. Collaborative link with the University of Neuchatel, in Switzerland, on tick research has now been formalized. The Research Unit will also be able to count on a wide-range of assistance from the Biochemistry Departments of the Universities of Arizona (at Tucson) and Chicago, U.S.A.

158. The Research Unit provides assistance in mass spectrometry to TPRI, Arusha, Tanzania, the University of Nairobi and Kenyatta University, both in Kenya. The VG-12250 (GC-MS-DS) Gas Chromatograph-Mass Spectrometry-Data System installed in 1984 is the only one of its kind in the whole of Eastern Africa. With the acquisition of an (FT-NMR) Fourier Transform Nuclear Magnetic Resonance Spectrophotometer System, the Centre could play the role of a regional centre for NMR and MS, and provide the much needed stimuli for research in relevant chemical problems in the region.

LONG-TERM PERSPECTIVES

159. It is envisaged that the Research Unit will continue to be engaged primarily in semiochemical and biochemical research relevant to the goals of the Core Research Programmes. The following represents a summary of the expected lines of research in different areas:

Tick Antigens in Collaboration with Livestock Ticks Research Programme

(a) It is anticipated that some of the key tick antigens responsible for the protection of cattle against R. appendiculatus will have been identified in the next 3 - 4 years. This will pave the way for structural and analytical work at epitope level. It is anticipated that recombinant DNA and immunochemical techniques will be used in combination with state-of-the art solid-phase peptide synthesis, LC peptide mapping, and mass-spectral techniques to identify the structures of immunodominant regions of important antigens. This would then lay down the groundwork for

large-scale production of immunogenic peptides synthetically and/or by DNA cloning techniques. In the longer-term, it is expected that research in this area will probably move toward the identification of antigens of other economically important tick species, such as Amblyomma variegatum, Boophilus decoloratus, R. pulchellus and R. evertsi.

Crop Plant Allelochemics in Collaboration with CPRP, and SPRU

(b) The identification of allelochemics involved in insect-plant interactions between ICIPE's target pests and sorghum, maize and cowpea cultivars is expected to become an important part of the Unit's research activities. It is anticipated that in the longer-term, allelochemical research will progress along two different routes: (i) the study of the chemical environment pertaining to inter-cropping systems, in order to provide an insight into the role of chemical blends in such systems which influence the behaviour of insects and their parasitoids; and (ii) the study of the biogenesis and enzymology of selected allelochemics, in order to provide a greater understanding of the mechanisms and pathways involved in the accumulation or emission of crop plant-defensive compounds. This is expected to open up a number of possibilities in activating the natural resistance mechanisms of plants, e.g. by the manipulation of appropriate enzymes; by the use of inducers or inhibitors; or by the use of genetic engineering techniques.

Pheromones and Animal Odours in Collaboration with CPRP, MVRP and SPRU

(c) It is anticipated that the Unit will continue to work on the chemical ecology of different species of tsetse, including the identification of kairomones involved in host location and any chemical ques that may be implicated in the larviposition process.

(d) It is expected that a sufficient base of behavioural knowledge will have been generated on important parasitoids and predators of crop pests to allow chemical work to be undertaken on their pheromone systems and on kairomonal compounds responsible for host location. The availability of these compounds in quantity could have tremendous implication on the monitoring and manipulation of parasitoid and predator populations.

(e) A major current limitation in field trapping of sandflies, the vectors of leishmania, is a lack of readily available attractants. Identification of kairomones from sandfly host odours is therefore expected to be an important undertaking of the Research Unit.

Anti-Insect Natural Products in Collaboration with Core Programmes

(e) Screening for novel anti-insect compounds from tropical plants may continue at the present subdued level of priority. If special funds become available for this type of work, it is intended that additional postdoctoral research fellows and graduate scholars will be recruited to undertake the extra load of work.

(f) It is anticipated that natural products research will branch into the study of compounds (peptides and non-peptides) responsible for the pathogenicity of bacteria and fungi identified as promising biological control agents for ICIPE's target pests and vectors. This would then allow the use of cloning techniques to produce genetically engineered vectors with improved pathogenicity.

160. BUDGET: CHEMISTRY AND BIOCHEMISTRY RESEARCH UNIT

EXPENDITURE IN U.S.$	ACTUAL EXPENDITURE 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL		236,000	279,000	301,000
INTL. PROFESSIONAL TRAVEL		25,000	41,000	44,000
MATERIALS, SERVICES AND EXPENDABLES		108,000	130,000	140,000
TOTAL	244,000	369,000	450,000	485,000
INTL. PROFESSIONAL STAFF COMPLEMENT	3	4	4	4
POSTDOCTORAL RESEARCH FELLOWS	3	2	2	2

RESOURCE COMMENTARY

Chemistry and Biochemistry Equipment

161. The new GC-MS-DS installed in 1984 has been a tremendous boon to the Unit's studies on volatile semiochemicals. Likewise, the acquisition of a high-speed centrifuge, an FPLC equipment and a new UV spectrophotometer, has improved the facilities for biochemical research. On the other hand, lack of an FT-NMR system with H-1 and C-13 facilities remains a major constraint in the identification of semiochemicals. Moreover, a number of medium-priced items of equipment are needed to strengthen both chemical and biochemical research, and to enable scientists in the Research Unit to catch up with the state-of-the-art techniques in their respective areas of research. The following summarises the needs of the Research Unit, arranged under three levels of priority:

Priority 1

(a) FT-NMR (essential for structure determination of small amounts of semiochemicals).

(b) Preparative High Performance Liquid Chromatograph (HPLC) and Counter Current Chromatograph (separation of mixtures of chemicals including peptides on preparative scale).

(c) Ultracentrifuge, with rotors; a microfuge; and specialised incubators (standard biochemical equipment for separation work and culturing).

Priority 2

(d) Multi-Instrument Data Station (for computerised handling of chromatographic data).

(e) HPLC-MS interphase, and Fast Atom Bombardment accessory for the MS (for increasing the versatility of the existing equipment; will allow direct analysis of polar compounds and molecular weight determination of large molecules).

(f) Spinning Band Column (for preparative separation of volatile compounds; necessary where components need to be isolated for bioassays and spectral identification).

Priority 3

(g) Gas Chromatographic-Fourier Transform Infra-Red Spectrophotometer (GC-FTIR) (of growing importance as a complement to GC-MS techniques for the identification of volatiles).

162. The much needed space will become available at Duduville in late 1987.

163. The proposed research programme relies on a continual flow of trainees at both postdoctoral and predoctoral levels. An optimum of 5 such personnel at any one time is planned during the next three years; they would reinforce the senior scientific team in the Research Unit in each of the main areas of research.

Radioisotope Laboratory

164. IAEA-sponsored Type C-Radioisotope Laboratory is now operational. It is equipped with a scintillation counter, beta-imager, speed vacuum concentrator and other monitoring equipment. Funds for a freeze-dryer, and other smaller items have become available. These will allow the Research Unit to provide an improved central radioisotope research and training facility in the Centre. In view of anticipated increase in the use of radioisotope techniques in the Centre, particularly in Molecular Biology, provision has been made for additional running costs of the laboratory in the Research Unit's budget.

Molecular Biology

165. A lot of equipment already being used by the biochemists and the microbiologists in the Research Unit can also be used for molecular biological work. However, in addition to instruments already available, the Research Unit will need additional rotors for the ultra- and high-speed centrifuges, vacuum oven, microfuge, water baths, specialized incubators and smaller laboratory instruments. It is intended that, with the acquisition of this additional equipment, CBRU will be able to provide central facilities for research and training in the application of molecular biological techniques to insect science. Provision has been made for these in the three years of the Plan period.

(b) HISTOLOGY AND FINE STRUCTURE RESEARCH UNIT (HFSRU)

PRIMARY GOALS

166. The Histology and Fine Structure Research Unit (HFSRU) supports the ICIPE core programmes by carrying out research on the morphology (histology, ultrastructure and cytochemistry)and function of cells and tissues of target insects as well as pathogens and pathological materials. Approximately, 60% of the scientists' time is assigned to programme support research; and the remaining 40% is spent on complementary basic and innovative research within ICIPE's mandate.

ACHIEVEMENTS

167. The achievements of HFSRU are usually incorporated in the major studies accomplished by the core programmes utilizing the results of the Research Unit's experiments. However, the following is a selection of some of the significant results recently obtained in the HFSRU in collaboration with the following research programmes: Crop Pests, Tsetse, and Livestock Ticks as well as Sensory Physiology Research Unit.

A. Crop Pests Research Programme

(i) Scanning electron microscopy (SEM) revealed that Chilo partellus larval antennae have two types of sensilla (namely, sensilla styloconicum and basiconicum), while the moth has on its forelegs trichoid sensilla (which were confirmed to be chemo-mechanoreceptors). Electrophysiological responses of these sensilla and their innervation were investigated in collaboration with the Sensory Physiology Research Unit.

(ii) Trichomes on maize leaf surfaces reported to influence the selection of oviposition sites on resistant and susceptible maize genotypes were investigated using SEM. The lower leaf surface preferred for oviposition had no trichomes, whereas the upper surface had a mixture of trichomes and spines.

B. Tsetse Research Programme

Structural studies focussing on tsetse reproductive biology and salivary gland physiology revealed the following:

(i) The protein mucopolysaccharide which is secreted by the choriothete of the uterus acts as cement to bind to the egg membranes and exuvium from the newly moulted second-instar larva.

(ii) The cell ultrastructure of the ejaculatory duct of male Glossina morsitans, which is involved in the reception and transfer of sperm and accessory gland secretions at the time of mating, is indicative of absorptive and transport functions. The epithelial structure, musculature, tracheole and nerve supply all point to an active tissue that would be essential for the movement of sperm and accessory gland secretions during mating.

(iii) Evidence gained in ligaturing tsetse larvae suggest that, apart from delaying pupariation, ligation causes changes in the structure and contents of the testicular cells which retard normal testes development.

(iv) Ultrastructural observations of the aortic wall and corpus cardiacum have revealed that the aortic wall acts as the neurohaemal organ for the neurosecretory material originating both from the brain and the corpus cardiacum.

(v) Trypanosome-infected tsetse salivary glands show depletion of secretory granules, destruction of cell organelles, and widespread prevalence of whorl-like rings indicating tissue degeneration.

C. Livestock Ticks Research Programme

(i) In collaboration with the Livestock Ticks Research Programme, embryonic cells of the tick Rhipicephalus appendiculatus cultured for production of antigens, were shown to be made up of epithelial- and fibroblast-like cell types.

(ii) The peripheral fat body in the engorged female R. appendiculatus has been shown to actively synthesize a proteinaceous substance which is condensed into protein granules that later occur in the central fat body in the vicinity of vitellogenic oocytes and resemble the yolk granules within the oocytes.

RESEARCH AREAS

168. The primary goal of HFSRU is to carry out morphological and functional studies at organ and cellular levels of the target pests and vectors in collaboration with the core programmes. An understanding of the morphology at both cell and tissue level is designed to provide basic information on which to relate functional knowledge. Thus, the principal objective is to contribute towards the understanding of the relationship between structure and function, be they part of normal physiological processes or a result of effects caused by chemicals, gene defects or microbial organisms such as viruses, bacteria and fungi. A meaningful, comprehensive ultrastructural study should, therefore, consider not only structural changes in cellular components, but also pertinent functional implications and the chain of regulatory events or mechanisms responsible for such modifications. In so doing, both normal and injured cells are examined. All aspects of research activities undertaken within HFSRU take into consideration structural, immunochemical, cytochemical and endocrinological aspects as well as cellular-tissue facets and host-parasite interactions. This critical in-put is illustrated by two major themes which characterize the basic research strategy of the Research Unit:

A. The first theme deals with issues of biotaxonomy in relation to evolving species complex and biotypes. Studies are based on micro-anatomical features which remain largely stable within the species complex. In the characterization of difficult populations, biochemical methods will be employed as an adjunct to fine structural studies.

B. The second theme looks at the changing functions of cellular and subcellular units as well as the mechanisms of their regulatory physiology under normal and injury conditions. It is envisaged that injury-related work will continue to embrace effects of parasites, pathogens and chemical stimuli on the tissues of target pests.

169. The scope of work handled by HFSRU calls for close bridging with Sensory Physiology Research Unit (SPRU), Chemistry and Biochemistry Research Unit (CBRU) and the core Programmes. 60% of the Unit's time is spent on direct collaborative research activities; and during the Plan-period the following projects are emerging as a continuing research activities:

(a) Structural identification of sensory receptors of target crop pests and tsetse

(b) Taxonomic investigations of the cassava green spider mite, and its potential biological control agents *Nosema* and *Vairimorpha* sp.

(c) Study of anatomical features of various sorghum and maize cultivars to determine the extent of damage caused on the plants by *Chilo partellus* and *Eldana saccharina*, in close liaison with the Crop Pests Research Programme.

170. 40% of the research time is spent on Unit-initiated research projects. In the current plan period it is intended to focus on problems relating to tsetse, such as immune mechanisms, development of secretory tissues, functional competence of different tissues of the insect and associated derangements. A few examples of the projects to be investigated include:

(a) Cell-parasite interactions in trypanosome/virus infected tsetse (Glossina spp.)

(b) Functional changes in tsetse fed on animals immunized with tsetse tissue components (or other immunogenic preparations)

(c) Synthesis and secretion of different components of male accessory reproductive glands in tsetse, and their transfer into the spermatophore.

COLLABORATION

171. Collaborative work (other than with ICIPE programmes and research units) will continue with the following institutions:

(a) International Institute of Tropical Agriculture (IITA): Collaborative Research on the characteristics of male genitalia of Cicadulina leaf-hoppers collected from maize in various zones of West Africa.

(b) Tokyo University of Agriculture and Technology: Studies involving ligation of tsetse larvae, which have suggested that a factor from the brain is necessary for testes development and spermiogenesis.

(c) A small percentage of time is devoted to assisting outsiders in electron microscopy work.

172. It is anticipated that collaboration with the National University of The Ivory Coast will be initiated in the near future in the context of crop borers and tsetse.

LONG-TERM PERSPECTIVES

173. The future trend of research activities within HFSRU largely reflects the activities of the Core Programmes at that particular time - at least in terms of its collaborative research time (60%).

174. It is envisaged that basic experimental Unit-initiated studies will be strengthened. In this connection, various techniques (such as biochemistry, immunology and eventually molecular biology) will feature strongly in the Research Unit's research work during the Plan period.

175. It is envisaged that some of the research areas in the Research Unit may include the following in the longer-term:

(a) In vitro and in vivo screening of the tsetse sterility and spermiogenesis factors following their purification and characterization.

(b) Investigations on mechanisms of host/parasite interactions.

(c) Functional changes in tsetse fed on animals immunized with antigens from tsetse tissue components (and other immunogenic preparations).

176. BUDGET: HISTOLOGY AND FINE STRUCTURE RESEARCH UNIT

EXPENDITURE IN US $	ACTUAL EXPENDITURE 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL		139,000	146,000	152,000
INTL. PROFESSIONAL TRAVEL		8,000	8,000	10,000
MATERIALS, SERVICES AND EXPENDABLES		51,000	54,000	58,000
TOTAL	140,000	198,000	208,000	220,000
INTL. PROFESSIONAL STAFF	2	2	2	2
POSTDOCTORAL RESEARCH FELLOWS	1	2	2	2

RESOURCE COMMENTARY

177. The two electron microscopes, Philips Transmission Electron Microscope (EM 201S) and Jeol Scanning Electron microscope (JSM-15), which were acquired in 1973 and 1974, respectively, have now become obsolete and are currently under continual repair work. Pertinent spare parts are out of production. Both instruments have limited optical magnification and limited resolution, hence inadequate for on-going and expanding research needs. Therefore, replacement of these items of equipment with up-to-date, more technologically advanced instruments suitable for high-resolution work (e.g. fully computerized EM with audiovisual facilities, X-ray microanalysis and cryo-specimen holder with cryo-transfer system) has now become crucial for the successful implementation of the Research Unit's strategic objectives.

(c) SENSORY PHYSIOLOGY RESEARCH UNIT (SPRU)

PRIMARY GOALS

178. The research theme of the Unit is "Sensory biology and chemical basis of insect behaviour". The Unit will continue to support ICIPE core programmes by investigating the role sensory and chemical systems play in various aspects of insect life such as inter and intra species communication and insect host relationships. Methods of investigation are based on electrophyiological and behavioural techniques. Knowledge of sensory basis of behaviour is useful when developing insect pest control methods based on the manipulation of insect behaviour.

ACHIEVEMENTS

Tsetse Sounds Produced in Conjunction with Mating and Larviposition

179. Investigations in this area showed that the male produces sound and drums the female with the tarsi of the meso- and meta-thoracic legs within the first 4 minutes after mounting. During the long copulatory phase, the male produces sound when the female becomes restless or the pair is disturbed. The male's singing and drumming possibly facilitates the initiation and maintenance of copulation. Soon after larviposition, female tsetse produce a characteristic sound, which distinctly differs from sounds associated with feeding and mating behaviour. The post-partum song may have a signalling function. If perceived by other pregnant females, it may help account for the aggregations of pupae frequently encountered in the field.

Electrophysiology on Tsetse Sensilla and Detection of Olfactory Stimuli

180. Observations in the laboratory recently showed that a pair of dome-shaped sensilla occurring on the outer and inner surfaces of G. m. morsitans tibiae have no olfactory function. Electrophysiological tests and ultrastractural methods clearly showed that those sensilla are campaniform sensilla sensitive to mechanical stimuli.

181. Electroantennograms (EAG) could be recorded from the tsetse antenna when it was stimulated with tsetse sex pheromone. EAG responses could also be evoked by compounds such as methylethylketone, 1-octen-3-ol and buffalo urine and its components. The sensitivity of the antennae to those stimuli was further supported by a behavioural bioassay.

182. A behavioural bioassay involving antennal movements was recently developed; this offers a rapid method for screening various synthetic and natural products for possible attractancy and use in tsetse control. Among the natural products so far tested are fractions of buffalo urine, a potent natural tsetse attractant. In collaboration with CBRU, structure activity relationships of various synthetic analogues of host-derived kairomones were investigated.

Stimuli Associated with Host-Plant Selection among Crop Borers

183. Electrophysiological recordings from taste sensilla of larvae of Chilo partellus, Eldana saccharina and Maruca testulalis showed that the medial and lateral maxillary sensilla styloconica of each of the three species had cells sensitive to NaCl, water and sucrose. The medial styloconica sensilla of Chilo was found to contain a cell sensitive to chlorogenic acid. Chilo and Eldana appeared to be more sensitive to sucrose than Maruca. In all three species, the lateral sensilla styloconica were found to be more responsive to sucrose, but less responsive to NaCl than the medial ones.

184. Observations on Chilo larvae showed that the lateral styloconica sensilla are very sensitive to sucrose, and the aqueous extracts from susceptible and resistant maize cultivars. The medial styloconica sensilla were found to be mainly sensitive to NaCl; and among the stimuli tested, maize leaf exudates had the least effect on the two sensilla. These observations confirm that the lateral and medial styloconica sensilla differ in their modalities, in spite of the fact that they are externally similar.

185. Electrophysiological tests on Chilo and Eldana moths provided new information on the responses of certain tarsal and ovipositor sensilla. It was shown that those sensilla are innervated by mechano- and contact-chemoreceptor cells. The tarsal receptors are sensitive to sucrose, whereas the ovipositor sensilla are more sensitive to NaCl. Futhermore, the ovipositor sensilla are very sensitive to the maize-leaf exudate. The behavioural significance of such responses to the maize-leaf exudate remains to be elucidated.

RESEARCH AREAS

186. Research topics will be approached using the following methods of investigation:

(a) Investigate components of reproductive (mating, oviposition) host finding and feeding behaviour. The objective is to get data on certain behavioural patterns with the view of manipulating insect bahaviour for the benefit of pest management.

(b) Electrophysiological work will continue to investigate the sensing and encoding characteristics of the peripheral sensory system to determine what information is made available to the central nervous system. This entails characterization of the adequate stimuli and dose/response relationships of various types of sensory neurones and determination of their specificity.

(c) Investigation on the decoding of information by the central nervous system should be started. This work will require recording from the central nervous system and tracing of sensory axons to determine their central connection. This approach is an essential step in elucidating on the processing of sensory inputs and other related factors.

187. These approaches will make it possible to carry out work on pheromones, kairomones and allomones which play important roles in the bahaviour of insect pests and their predators (parasitoids).

Major Areas of Research

A. Crop Pests:

The stimuli which induce mating, host-plant selection, oviposition and feeding in crop-borers (Chilo partellus, Maruca testulalis, Eldana saccharina, Busseola fusca, and Sesamia calamistis) will be investigated in collaboration with the Crop Pests Research Programme and Chemistry and Biochemistry Research Unit. So far, most of the work has been done on Chilo partellus and Eldana saccharina, major pests of sorghum and maize. Effort is devoted on the following areas:

(i) Electrophysiological tests on the maxillary styloconica sensilla are intended to establish whether those sensilla can be used as indicators of potential differences among host-plants and non host-plants materials. Furthermore this work is likely to facilitate identification of chemical factors acting at the sensory level to bring about susceptibility or resistance of different host-plant varieties. A feeding bioassay technique specially developed for the borers is now established and yielding reproducible data. Electrophysiological studies on the oviposition stimuli of the sorghum shootfly, Atherigona soccata, will be done using material obtained from sorghum seedlings. Here emphasis will be placed on the ovipsitor taste sensilla.

(ii) Behavioural techniques involving flight tunnels and alterations of insect diurnal rythms will be used to investigate sexual and host-plant selection behaviour. There is no detailed information on the mating behaviour of some of the cropborers. Here there are a number of pest to be investigated individually or on a comparative basis. Pre and post-mating behavioural patterns will be examined. Interactions between sexually aroused males and females will be investigated to determine whether any inhibitory pheromones exist.

(iii) The use of a Gas Chromatograph (GLC) connected to the electrophysiological set-up will enhance studies on insect odour stimuli. Work is already in progress on the pheromone system of Chilo. As there is no information on Maruca and Busseola pheromones similar work will be done on these two pests. Electrophysiological work will investigate sensory responses of males to components of the pheromone blends to be isolated. Synthetic pheromone analogs will be examined. In addition to this, work on host-plant odours has been started.

(iv) The functional morphology of the relevant receptors in the target insect is being investigated in collaboration with the Histology and Fine Structure Research Unit.

B. Tsetse flies (chemocommunication and behaviour)

In collaboration with the Tsetse Research Programme and Chemistry and Biochemistry Research Unit the two major East African tsetse species Glossina morsitans and Glossina pallidipes are investigated. Studies are designed to identify chemical factors involved in host and mate selection. Research is focussed on the following:

(i) Screening of various synthetic and natural compounds for attractancy or repellency in order to identify potential compounds for possible use in tsetse control. This include the identification of active buffalo urine components which can be used to improve the efficacy of odour baits for tsetse flies.

(ii) Structure-activity work on analogues of host derived kairomones like 1-octen-3-ol and phenols to optimise their activities and identify more potent attractants.

(iii) Field studies have been initiated to investigate behaviour and intraspecific communication of tsetse with particular emphasis on communication at larviposition sites, and around host animals.

C. Artificial Feeding of Ixodid Ticks

The chemical factors involved in host resistance to ticks are to be examined using artificial feeding techniques. The objective is to establish a viable artificial feeding method for the brown ear tick Rhipicephalus appendiculatus in order to investigate the chemical factors involved in cattle resistance to tick infestation. This work is done in cooperation with the Livestock Ticks Research Programme as well as with counterparts at the University of Neuchatel, Switzerland (under the ICIPE/Swiss Government Cooperation Project on Tick Resistance)..

D. Sensory Biology and Behaviour of Sand flies

In collaboration with the Medical Vectors Research Programme, chemical factors involved in mate and host selection in sand flies are to be investigated. This calls for work on sand flies pheromones and Kairomones in particular.

COLLABORATION

188. The Veterinary Research Laboratory at Kabete, Kenya, is providing the buffalo urine and other animal natural products used in on-going experiments. Collaboration with the University of Neuchatel, Switzerland, is continuing. A firm collaborative arrangement has been concluded with the University of Lund, Sweden; this collaboration will hopefully be sponsored by the Swedish Agency for Research Cooperation with Developing Countries (SAREC); and the work will focus on moth pheromones, especially Chilo partellus. The Research Unit is actively participating in the Ivory Coast/ICIPE Scientific Collaboration on training in insect sensory physiology techniques and research on olfaction of crop-borer larvae. A visiting scientist from the National University of the Ivory Coast worked in the Unit for three months in 1986 and these visits will continue.

189. Comparative studies on thermoreception by certain insect pests, such as the tsetse, and small vertebrates will be conducted in collaboration with the Electrophysiology Laboratory, Department of Animal Physiology, University of Nairobi. Arrangements have been finalized to collaborate with Professor D.E. Sonenshine at the School of Science and Health Professions, Old Dominion University, Norfolk, Virginia, U.S.A., which will involve investigating olfactory detection of certain phenols by African Hyalomma tick species, as well as the three-host ticks such as Rhipicephalus appendiculatus.

LONG-TERM PERSPECTIVES

190. Research direction in the Research Unit will reflect the main concerns of the Core Research Programmes at the time. Currently, research activities emphasize electrophysiological studies on olfaction and taste, as well as investigating the related behavioural responses. This approach will be expanded to include other sensory modalities, such as vision and thermoreception. At the moment, electrophysiological studies are based on data obtained using extracellular recording methods. It is envisaged that, in future, intracellular recording methods will be employed. This approach will include tracing sensory pathways from the receptors to the central nervous system, and then recording electrical impulses from the corresponding central neurons and/or interneurons. Insect behaviour experiments will play a more prominent role. This is so because it is essential to interpret the electrophysiological data in terms of the behaviour of a given insect. In this connection various techniques and equipments such as wind tunnel are to be employed.

191. BUDGET:

SENSORY PHYSIOLOGY RESEARCH UNIT

EXPENDITURE IN US $	ACTUAL EXPENDITURE 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL		99,000	105,000	109,000
INTL. PROFESSIONAL TRAVEL		8,000	8,000	10,000
MATERIALS, SERVICES AND EXPENDABLES		22,000	27,000	29,000
TOTAL	87,000	129,000	140,000	148,000
INTL. PROFESSIONAL STAFF	2	2	2	2
POSTDOCTORAL RESEARCH FELLOWS	1	2	2	2

RESOURCE COMMENTARY

192. The scientists in this Research Unit should provide the necessary expertise in electrophysiology and insect behaviour; the latter aspect has been strengthened by advanced training recently undertaken by one of the two scientists in the Research Unit. At the moment, the Research Unit has two research scientists, one Postdoctoral Fellow, and four qualified technicians. There is need for extra postdoctoral fellows to work on insect behaviour or sensory physiology.

193. The equipment situation will need constant attention. Behavioural studies require the following equipment: wind-tunnel, video camera and recorder, as well as climatic chambers. Computer hardware and software for data acquisition, control and analysis has been acquired.

(d) BIOSTATISTICS AND COMPUTER SERVICE UNIT (BCSU)

PRIMARY GOALS

194. Collaborate with ICIPE scientists on quantitative aspects of research, particularly experimental design, data analysis and system modelling.

195. Provide training in data management, biostatistics, computer operations, analytical methodology for the interpretation of data and automatic acquisition of data.

196. Develop a research capacity to work in on-line data processing and expert decision support system that relate to on-going ICIPE programme. Develop new method for quantitative analysis of population data and the interface of population data with environmental monitoring.

197. Develop the capacity for ICIPE to utilize remote sensed data and process geocoded information in both spatial and temperal dimensions. Develop the capacity to utilize Geographic information system and large scale data management system.

ACHIEVEMENTS

198. The Biostatistics and Computer Service Unit (BCSU) was established in 1983 on the installation of a Wang Computer generously donated by UNDP. The Service Unit had two and one-half staff members from 1983 until late in 1984, when two more staff members were hired. The operation of the Service Unit was decentralised with the installation of eight microcomputers at three different locations: Chiromo, Mbita Point and Duduville; furthermore, two minicomputers, 2200 LVPs, were installed, one at Chiromo and one at Mbita Point Field Station. This number will rise to 28 by the end of 1987.

A. The MSTAT (a statistical package) is now fully operational in the microcomputers and is being used by many scientists for entering, editing and analysing data. The Senior Computer Programmer has been assisting the scientists at Chiromo on data analysis since 1st April 1986.

B. The BCSU has provided a computerized data storage system for the research scientists such that raw data are stored in an appropriate format prior to analysis. The Tsetse Research Programme now has massive data in the mainframe computer disks and the Medical Vectors Research Programme has finished inputting research data gathered over several years.

C. The development of simulation models for tsetse and certain crop borer population was initiated. The simulation model being developed for tsetse population has used field research data, while that for crop borer population has yet to use research data.

D. Courses in computer programming and biostatistics were offered to ARPPIS students and other training groups at the ICIPE. Training in computer operations and applications were given to staff of the ICIPE and selected institutions in Kenya. Training in computer programming of two staff members from the Ministry of Agriculture and Livestock Development, Government of Kenya, was undertaken for one month (August 1985).

E. Computer support was extended to the organisers of international conferences, including: the 7th International Congress of Protozoology (Nairobi, June 1985), IDRC- sponsored Symposium on Scholarly Publishing Nairobi (August 1985), and the International Conference on Tropical Entomology (which is to be held in Nairobi, September 1986).

F. A personnel information system was implemented for the Administration and Information Division using a Wang microcomputer (PC). A payroll system is now running in the mainframe system, the Wang VS-80: it produces over twenty monthly reports for the Finance Division. The gratuity and provident fund scheme was implemented in April 1986, using a PC which was installed in the Finance Division.

G. Collaborative arrangements were made with ILRAD and ICRAF to study hardware and software requirements for bibliographies. The working group consisting of representatives from the three institutions of the ICIPE, ICRAF and ILRAD recommended using a microcomputer with a 30 MB of hard disk and In-Magic as the standard software package for bibliographies.

H. The Linotype CRTronic Phototypesetter was interfaced with a Wang PC using asynchronous communication and word processing early in 1986.

Problem Areas

199. Software must be acquired for computerization of financial information and transactions, personnel information and records. These must start immediately.

200. The limited man-power of BCSU will have to be substantively increased to provide for adequate service to research, training and administration of ICIPE. This can be accomplished primarily by reassignment within ICIPE, by filling vacant position and the establishment of a few new positions.

PRIMARY ACTIVITIES

201. The Service Unit will continue to liaise with scientists in the various research programmes and research units in the planning and designing of projects, in order to ensure that appropriate and efficient designs are adopted. The following services will be extended to the relevant research scientists:

A. Data analysis with advice on interpretation and presentation of results.

B. Introduction of a comprehensive computer data storage system for research scientists so that raw data can be stored in an appropriate format prior to analysis.

C. The Service Unit is collaborating with Tsetse, Tick and Crop Pests Research Programmes on simulation modelling. Simulation models are currently being developed for the Tsetse and Crop Pests Research Programmes, and later on for the Livestock Tick Research Programme.

202. Using the recommendations of the working group from ICIPE, ILRAD and ICRAF (referred to in para 183, I. above), cataloguing for the library services is being computerized; and storage with rapid retrieval facilities for bibliographies is provided using In-Magic, a data base recently acquired.

203. BCSU will provide laboratory and training to ICIPE to assist the institute to convert from its current computer environment to an IBM compatible environment.

204. The Service Unit will enhance its training on computer applications to staff of the ICIPE and selected institutions in Kenya .

205. The BCSU will supervise the operations and maintenance of all ICIPE computers located at all campuses and field sites of the ICIPE in Kenya.

COLLABORATION

206. Training at the BCSU is being provided on a selective basis. Collaboration has been started with the Kenya Polytechnic, Nairobi. Three students have undergone training for five months (April to August 1985) on computer operations and applications.

207. Collaboration with research institutions has been started, as exemplified below:

A. Collaborative arrangements will continue with international research institutions, such as ILRAD and ICRAF, to exchange information on computer hardware and software (see para. 183, I. above).

B. Collaborative arrangements will be made on population modelling with international institutions that have more experience in this area. Michigan State University of East Lansing, USA, has been identified as one of such international institutions.

LONG-TERM PERSPECTIVES

208. The activity of the Biostatistics and Computer Service Unit will permeate all research, training and administrative activities of ICIPE. The Unit will develop and offer direct support to all programmes in areas of mathematical modelling, simulation, optimization, data analysis and acquisition. To do this, the Unit will have to develop its own research capacity in the areas of theoretical ecology, decision theory, environmental monitoring, geographic information analysis, image processing and develop cybernetic and simulation methodology. The Unit will provide training in advanced biometrics, simulation and computer application.

209. BUDGET: BIOSTATISTICS AND COMPUTER SERVICE UNIT

EXPENDITURE IN US $	ACTUAL EXPENDITURE 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL		93,000	101,000	105,000
INTL. PROFESSIONAL TRAVEL		4,000	4,000	5,000
MATERIALS, SERVICES AND EXPENDABLES		54,000	56,000	60,000
TOTAL	140,000	151,000	161,000	170,000
INTL. PROFESSIONAL STAFF	1	1	1	1
POSTDOCTORAL RESEARCH FELLOWS	-	1	1	1

RESOURCE COMMENTARY

210. The research programmes of ICIPE have gathered large data files on: tsetse, ticks, stem borers and sociological information. These programmes need assistance to capitalize on these data banks and need the support of this Unit. The Unit must expand its professional and support staff to carry out the long-term perspectives presented in para. 208. This can be accomplished by reassignments, correctly filling vacant position and four new positions in the areas of applications specialists, computer operators and climatic data technician in 1988 and 1989

211. The development of a local area network at Duduville and Mbita Point Field Station will require the acquisition of new hardware and software and the reconfiguration of the Unit as presented in para. 210.

VII. ICIPE'S CORE PROGRAMME OUTREACH AND TRAINING UNIT (OTU)

INTRODUCTION

212. The primary goal of the Outreach and Training Unit (OTU) is to strengthen the scientific leadership and technological capability of tropical developing countries in applied insect science through collaborative research and training programmes. In using the term Outreach it is meant to encompass research collaboration in its widest sense; and in the OTU includes five major sections:

- PESTNET - The African Regional Pest Management Research and Development (R & D) Network
- Collaborative Research and Development
- ARPPIS - The African Regional Postgraduate Programme in Insect Science
- FAMESA - Financial and Administrative Management of Research Projects in Eastern and Southern Africa: a special project of the ICIPE dealing with research management, discussed in Section VIII below.
- The Training programmes which interact, support and link the research and development efforts of the ICIPE. The programmes are:
  - Postdoctoral Research Fellowship Programme
  - Research Associate Scheme
  - Staff Development Scheme.

[A Table summarizing present collaborative activities of OTU is to be found at the end of this section (pages 108 and 109)].

(a) AFRICAN REGIONAL PEST MANAGEMENT R & D NETWORK (PESTNET)

OBJECTIVES

213. PESTNET is an interactive research, development and applied technology network, designed to meet the demands of rural communities and their resource-poor farmers for integrated pest management.

ACHIEVEMENTS

214. In its formative stage during 1985-1986, PESTNET has been the focal point for the following activities:

A. Two PESTNET planning missions were conducted: in July 1985 with the assistance of USAID, and in October 1985 with the assistance of UNDP-TCDC.

B. A PESTNET Planning Workshop was held at Duduville International Guest Centre, Nairobi in October 1985 sponsored by USAID and UNDP-TCDC, bringing together participants from Burundi, Kenya, Somalia, Tanzania, and Uganda.

C. A four-man PESTNET Mission, composed of participants from the Kenya Government and the ICIPE visited the Sudan, Burundi, Tanzania, Zambia, Zimbabwe, Malawi and Rwanda during May 1986 to introduce the PESTNET concept and to define areas of mutual cooperation.

D. An International Working Group Meeting on the Implementation of PESTNET was organised from 22-26 June 1986 to include most of the countries in the Eastern and Southern African region.

ACTIVITIES

215. In the Plan period (1987-1989), the PESTNET scheme will make a beginning with two components: that dealing with crop borers of cereals and grain legumes; and that dealing with tsetse control. The PESTNET has four objectives:

A. To identify the major pest problems which are considered crucially important by the national programmes.

B. To provide facilities for multi-locational testing of the network pest management ideas in varying ecological zones.

C. To enhance scientific leadership and provide a critical mass in pest management in collaborating countries by advanced training.

D. To provide a multi-way flow of information and technology through the exchange of scientists between the network institutions, and through the establishment of a PESTNET Newsletter.

COLLABORATION

216. Areas of collaboration were identified during the June 1986 Meeting (referred to in para 214, D. above), and are being formalized in subsequent negotiations among the Participating Countries include:

A. Ministries of Agriculture and Animal Resources in collaborating countries.

B. National research institutes in all the collaborating countries in the Eastern and Southern African region currently working on crop and livestock pests.

C. Projects run within countries through funding by international bodies and bilateral aid agencies directly concerned with crop and livestock pests.

D. National Councils of Science and Technology, or similar national science policy bodies.

(b) COLLABORATIVE RESEARCH AND DEVELOPMENT

OBJECTIVES

217. Collaborative Research and Development's goal is to facilitate the testing and development of integrated pest and vector management strategies (those not included in the PESTNET programme) in the field at the national level and in varying ecological zones; and to develop regional or international projects for this purpose.

ACHIEVEMENTS

218. Cooperation with national research and extension institutions, and with CGIAR centres, was given priority at the time the OTU was established in 1985.

A. Collaborative activities with national institutions has continued in Kenya and Cote d'Ivoire; and were recently initiated in Somalia and Uganda.

B. Formal agreement of cooperation in research and training was completed with the Somalia Democratic Republic early in 1986.

C. At the initiative of national agencies, exploratory missions visited Uganda and the Cameroons to assess what role the ICIPE might play in the strengthening of national research and extension systems in pest management research and training.

D. Collaboration between the ICIPE and the CGIAR centres was strengthened by consolidating the ICIPE research team at IRRI; the exchange of resident scientists between the ICIPE and IITA which begun in late 1985; and by collaboration with IITA, IFAD and OAU/STRC in research on the biological control of the cassava green spider mite, and in related training activities.

E. Collaboration between the ICIPE and ILCA was initiated by a visit to ILCA by the ICIPE Director in January 1985, and a subsequent visit to the ICIPE by ILCA's Director General and Training Officer. An early result of this cooperation was the in-service training of two ILCA scientists at the ICIPE in tsetse research, and initiated an ARPPIS-type postgraduate training scheme at ILCA.

F. The Centre continues to give substantial weight to existing as well as potential linkages with international and regional agencies, and with centres of excellence. The Centre initiated collaborative linkages in research and training with FAO, EEC, UNEP, USAID, UNDP, IAEA, ABN and IUBS. Contacts have also been made with ARCT for collaboration in training and technology information exchanges.

G. Linkages were maintained at a mutually beneficial level with CSIRO, Australia, and with various research institutions such as the Centre for the Study of Infectious and Tropical Diseases at the University of Neuchatel (Switzerland) and the Universities of Sussex (U.K.) and Maine (U.S.A.).

219. Current activities include collaboration with the following institutions:

A. Kenya Ministry of Agriculture and Livestock Development. Project on maize and sorghum tolerance to Chilo.

B. Kenya Ministry of Health: Research on leishmaniases, with the Ministry taking responsibility for clinical aspects.

C. GERME, Cote d'Ivoire. Research and training in insect sensory physiology and fine structure of crop borers.

D. Somalia: Research and training on stem-borers of sorghum and maize in rainfed and irrigated agriculture.

E. Zambia: Research and training on the management of tsetse and livestock ticks.

F. The Sudan: Research and training on the management of tsetse and livestock ticks.

G. IITA: Testing of cowpea and rice germplasm against major African pests; cowpea breeding at MPFS incoporating resistance to Maruca; IPM research of cowpea-based cropping systems in Nigeria.

H. CIMMYT: Testing of maize germplasm against two major crop borers.

I. ICRISAT: Testing of Sorghum germplasm against the sorghum shootfly and major African stem-borers.

J. ILRAD: Research on livestock ticks; on the sensitivity of trypanosome-infected tsetse to pesticides; and the analysis of tsetse blood-meals.

K. ILCA: Training of ILCA-sponsored persons in tsetse and livestock tick ecology, and consultations on postgraduate training.

L. University of Alberta (Canada): Research on tsetse genetics

M. University of Neuchatel (Switzerland): Research on immunological and ecological aspects of livestock ticks.

N. Royal Society, London: Exchange of scientific staff.

O. U.N. Economic Commission for Africa: Pest management R & D pilot projects in Eastern Africa.

P. CREPHY, The Cameroons: Research and training on pest management.

Q. Istituto Guido Donegani, Italy: Screening for anti-pest agents from African tropical plants.

R. Zambia Government: on research and training on stem borers of maize

S. University of Lund (Sweden): on pheromones of Chilo.

T. Tanzania Government: on tsetse research

U. Moi University (Kenya): on research and training in pest management

220. Negotiations are presently underway to establish collaborative activities with:

- Cote d'Ivoire: on tsetse ecology
- Uganda Government: on tsetse and crop borer research
- OAU/Scientific, Technical and Research Commission (Inter-African Phytosanitary Council): on research and training on plant protection
- KETRI: on research on tsetse challenge to cattle in trypanosomiasis enzootic areas
- Egerton College (Kenya): for research and training in pest management

- Tropical Pesticides Research Institute, Arusha (Tanzania): on research on natural pesticides

(c) AFRICAN REGIONAL POSTGRADUATE PROGRAMME IN INSECT SCIENCE (ARPPIS)

PRIMARY OBJECTIVES

221. ARPPIS is a collaborative postgraduate training programme between the ICIPE and Participating African Universities, whose objectives are:

A. To provide training at the Ph.D. level for African students in Africa on the insect pest and vector problems of Africa.

B. To provide continuing intellectual and financial support to ARPPIS alumni through an ARPPIS Alumni Scientific Network, thus enabling them to make a continuing and substantial contribution to the reduction of the pest and vector management problems of the continent.

C. To strengthen scientific leadership in the countries of tropical Africa in insect science and its application to practical problems.

ACHIEVEMENTS

222. ARPPIS is a revolving 3-year programme leading to the award of the Ph.D. degree of the Participating Universities. ARPPIS admitted its first class of 8 students in April 1983. Further classes were admitted in March 1984, March 1985 and March 1986. ARPPIS became a core programme of the ICIPE in January 1985.

223. The present 31 students from the 4 classes have come from 9 African countries:

Ethiopia	1	The Sudan	3
Ghana	3	Tanzania	3
Kenya	12	Uganda	5
Malawi	1	Zaire	1
Nigeria	2		

224. The members of the 1983, 1984 and 1985 Classes are attached to the following ICIPE research programmes and units for their project work:

Crop Pests	8
Livestock Ticks	4
Tsetse	6
Medical Vectors	3
Chemistry and Biochemistry	1
Termites (in collaboration with the National Museums of Kenya)	1

225. Members of the 1986 Class will be placed in research programmes or units after their proposals have been approved by the ARPPIS Board of Studies and the ARPPIS Academic Board.

226. The research projects of ARPPIS students are developed by the students, in close consultation with ICIPE research Programme Leaders. They are critically reviewed by ICIPE Scientists, sitting as the ARPPIS Board of studies, and by the participating and registering universities, both in the ARPPIS Academic Board and in the appropriate University Committee. The research projects must fulfil three criteria; be relevant to the strategic research objectives of the ICIPE, be relevant to the needs of the students home institute, and command the interest of the student.

227. The 1983 Class completed their studies in February 1986. Of the 8 students in the class, 3 have already submitted their theses and the remaining 5 will do so by the middle of 1986. The first ARPPIS student was awarded his Ph.D degree during March 1986, just 3 years after joining the Programme.

228. ARPPIS has demonstrated its effectiveness as a programme for training and motivating the next generation of insect scientists for the national programmes of African countries.

PRIMARY ACTIVITIES

229 ARPPIS is aware of the need to ensure that its students are evenly distributed among the Programmes and Units of the ICIPE so that the responsibilities of supervision are spread equitably amongst the scientists of the Centre. This requirement will be a consideration during the selection of students by the ARPPIS Academic Board. The selection process will also ensure that the quality of students is not sacrificed to quantity in order to meet student target numbers.

230. ARPPIS will expand its activities into francophone Africa; and it is hoped that francophone African Universities will formally join ARPPIS during the Plan period. Negotiations have begun with the following Universities:

- National University of Cote d'Ivoire
- University of Yaounde, The Cameroon.

231. Discussions have begun with two Kenyan Universities, and it is hoped they will join ARPPIS during the 1987-89 period. The Universities are:

- Moi University, Eldoret
- Kenyatta University, Nairobi.

232. In collaboration with IITA, training will be offered specifically on the principles and practice of biological control. Training will be at both the M.Sc. and Ph.D. levels. The Ph.D students will be attached to ARPPIS, and registered at ARPPIS Participating Universities. A collaborative agreement has been reached with Rivers State University of Science and Technology, Nigeria for training at the Masters level. Both M.Sc. and Ph.D students will carry out research projects within the Biological Control Section of the Crop Pests Research Programme. Training will be restricted to applicants from African cassava-growing countries, and the selection of candidates will be in accordance with the manpower requirements of the countries.

233. Throughout the Strategic Plan period, 24 students will graduate from ARPPIS with the Ph.D degree. These will be in addition to the 8 members of the 1983 Class. ARPPIS alumni will return to their countries and national programmes.

234. The ARPPIS Alumni Scientific Network will provide ARPPIS students with continuing intellectual and financial support after they have left the ICIPE. The Network will be a deliberate attempt to help alumni establish productive and creative careers, and so prevent the drift of young African scientists away from active research within the continent.

COLLABORATION

235. ARPPIS is a collaborative network and therefore involves close cooperation between the ICIPE and the Participating Universities. ARPPIS itself, will also collaborate with the following networks and organizations:

A. National and international organizations concerned with pest and vector management, to train the manpower needed by the organizations for the implementation of their own strategic objectives

B. PESTNET

Many linkages will develop between PESTNET and ARPPIS. ARPPIS will offer training to scientists from national programmes participating in PESTNET. Members of the ARPPIS Alumni Scientific Network, back in their own countries, will be able to contribute to the work necessary to reach the PESTNET objectives.

C. FAMESA

In cooperation with FAMESA, ARPPIS will establish training on research management, strategic and project planning and budgeting for ARPPIS students and alumni.

(d) POSTDOCTORAL RESEARCH FELLOWSHIP PROGRAMME

OBJECTIVES

236. The Postdoctoral Research Fellowship Programme has the following objectives:

A. To provide young scientists from anywhere in the world with the opportunity to work with ICIPE scientists for periods of up to 2 years.

B. To offer scientists the opportunity to work in a tropical environment on some of the major insect pests of Africa.

C. To provide skilled help to ICIPE research programmes for the achievement of the Centre's own strategic plans.

D. To establish a world-wide network of future collaborators.

ACHIEVEMENTS

237. Since 1983, fourteen postdoctoral fellows from 8 countries have worked at the ICIPE:

Ghana	3	Sierra Leone	1
India	2	Tanzania	2
Kenya	3	U.S.A.	1
Poland	1	Vietnam	1

238. They have been attached to 6 research programmes and units at the ICIPE as follows:

Crop Pests	7
Livestock Ticks	1
Tsetse	1
Chemistry and Biochemistry	3
Histology and Fine Structure	1
Sensory Physiology	1

ACTIVITIES

239. During the Strategic Plan period (1987-89), the number of postdoctoral research fellows in residence each year will be increased from the present ceiling of 14 to 20.

240. OTU will continue to ensure that postdoctoral research fellows receive training at the highest level and that they contribute significantly to the achievement of the goals of the ICIPE's Strategic Plan.

241. Mechanisms will continue to be developed to ensure that the ICIPE maintains contact with postdoctoral research fellows after they have left the Centre.

COLLABORATION

242. Where appropriate, linkages will be developed between the Postdoctoral Research Fellowship Programme and PESTNET.

(e) RESEARCH ASSOCIATE SCHEME

243. The Research Associateship Scheme gives scientists from national programmes and universities, the opportunity to come to the ICIPE for short periods of time and work alongside ICIPE scientists. Research Associates may make several short visits (of several weeks or months) to the ICIPE during the tenure of their attachment (usually 3-4 years).

244. Four Research Associates are expected each year during the Plan period; and they will come from organizations already collaborating with the ICIPE in research and development activities.

245. The Scheme will be of particular value to PESTNET, by providing a mechanism through which collaborating scientists from national programmes working in PESTNET will be invited to work at the ICIPE on the research and development aspects of the methodologies being further implemented within PESTNET.

(f) INTERNATIONAL TRAINING PROGRAMME

PRIMARY OBJECTIVES

246. Group Training Courses are intended to assist in building the scientific leadership and technological capabilities of the tropical developing countries, particularly in Africa, with an emphasis on strengthening national R & D programmes so as to make them better prepared for the implementation of effective pest management technologies.

ACHIEVEMENTS

247. The following developments may be highlighted:

A. Two new Group Training Courses, one each on tsetse and on livestock ticks, were successfully presented during 1985 and early 1986, respectively. Participation was restricted to practitioners from The Sudan, Kenya and Zambia, by the course sponsor - the European Economic Community (EEC).

B. A Regional Pest and Vector Management Course in English was successfully presented in Yaounde, The Cameroon, for 25 participants from Ghana, Liberia, Sierra Leone and Cameroon.

C. A total of 56 participants successfully completed the Course in Pest and Vector Management in 1984 and 1985. This brings the total number of participants to 215 from 35 tropical developing countries since the course was started in 1977.

ACTIVITIES

248. The major scientific training activities during the Plan period will be as follows:

A. The International Group Training Courses on Pest and Vector Management Systems. This annual 3-week course emphasizes an ecologically sound approach to integrated pest management, including both crop pests and vectors of tropical diseases. Each course accepts a maximum of 32 participants from Africa, Asia, the Middle East and Latin America. As well as this course, it is hoped to continue the EEC-sponsored courses on Field Research and Management of Livestock Ticks and Tsetse.

B. Training for Self-Reliance in Ecological Pest Management in Africa. During the Plan period, additional pest management courses focussing specifically on the needs of West African countries will be given for both anglophone and francophone countries, and will be delivered in the appropriate language. They will be presented in Yaounde, The Cameroon.

C. International Training Course on Insect Growth, Development and Behaviour is a short course, of two weeks duration, for up to 20 participants, aimed at improving the skills of young scientists actively engaged in research or teaching. It complements the more applied courses on pest and vector management. The course is held every two years; the next course is planned for 1987.

D. African Regional Training Course for the Use and Safe Handling of Radioactivity in Insect Sciences. The annual course (sponsored by the IAEA) is intended for scientists and senior technicians wanting to establish, use and manage, radioisotope and radiation laboratories for research targeted on arthropods. Each course will last one to two weeks and will be open to ten participants.

E. International Group Training Course on Insect Molecular Biology. The first course in this series will be held in the 1987-1989 period. It will introduce insect scientists to the techniques of modern molecular biology for application to their own research projects.

(g) STAFF DEVELOPMENT SCHEME

249. The ICIPE has a comprehensive staff development programme, open to all members of the Centre, which seeks to maintain and improve the morale and efficiency of the staff, and to train staff in new techniques and the use of new equipment

(h) RESOURCES

250. The OTU has a coordinating role to play in ICIPE to ensure that the major challenges, set out in paragraph 10, of translating the research of the Centre into practical field pest management strategies, is achieved. ICIPE scientists are expected to commit part of their time to training activities. The time given will not exceed 10% in order not to constrain research. The OTU will ensure that ICIPE works in consonance with national R&D systems so that tropical developing countries are at the forefront of scientific knowledge and endeavour for the solving of pest and vector management problems.

251. In achieving the particular objective outlined in para 243 below, the OTU will continue to participate in and coordinate the establishment of collaborative arrangements and, where appropriate, formal networks to facilitate the free interchange of information between the ICIPE, the participating national programmes and other institutions.

252. The OTU will provide a further significant input to the infrastructure and mechanisms for the strengthening of manpower and scientific leadership in insect science in national programmes.

253. PESTNET activities will cover wider research areas of the ICIPE as new technologies for pest management are developed. ARPPIS and other training projects of the ICIPE will explore novel methods, such as interactive computer modules, for the instruction and support of young scientists so as to increase their productivity in research. In this connection, training programmes will be continously evaluated to ensure their relevance and impact in the national R&D systems.

254. BUDGET: OUTREACH AND TRAINING UNIT

EXPENDITURE IN US $	ACTUAL EXPENDITURE 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL		156,000	160,000	166,000
INTL. PROFESSIONAL TRAVEL		48,000	48,000	48,000
MATERIALS, SERVICES AND EXPENDABLES		141,000	145,000	160,000
TRAINEE COSTS		591,000	641,000	705,000
TOTAL OTU	828,000	936,000	994,000	1,079,000
IPS	2	2	2	2
PDF	16	20	20	20

RESOURCE COMMENTARY

255. When fully established, PESTNET will make considerable demands on the personnel of OTU. A PESTNET Coordinator will be required to ensure the proper development of the network.

256. The formal collaborative and training networks depend for their success on adequate personal contacts. For this reason, and to continually assess the relevance and focus of ICIPE training programmes, the staff of OTU will be required to travel to collaborating institutes and to ARPPIS and training alumni. Funds will be required for this important activity.

257. Additional facilities will be required, as OTU activities expand (office space, equipment and vehicles). The preparation of documents, and the efficient storage and retrieval of records, will necessitate additional data storage and word processing facilities.

258. The OTU has introduced a Newsletter and will add new series of publications, including training manuals and descriptive materials.

VIII. ICIPE'S SPECIAL PROJECT: FINANCIAL AND ADMINISTRATIVE MANAGEMENT OF RESEARCH PROJECTS IN EASTERN AND SOUTHERN AFRICA (FAMESA)

PRIMARY OBJECTIVES

259. FAMESA is a research and development (R&D) management training network through which national research programmes in agriculture and health, can acquire research management concepts and skills appropriate for the achievement of their goals for national development.

ACHIEVEMENTS

260. Within its goals of research, consultancy and training in R&D management, FAMESA has made the following gains:

A. Conducted workshops for scienstists and research administrators in Eastern and Southern Africa, to review the status of R&D management in the sub-region (January 1982).

B. Conducted a workshop for research policy-makers in Eastern and Southern Africa to appraise them of the role of R&D in national development (January 1983).

C. Conducted an international planning workshop to devise strategies for FAMESA activities and to formulate its Work Programme for a three-year period (November 1983).

D. Initiated and published institutional profiles for more than 40 R&D institutes (RDIs) in the sub-region; this exercise included the identification of training needs in the area of R&D management (1983).

E. Completed the development of a manual on RDI Strategic and Project Planning and Budgeting, now being utilized in training workshops in the sub-region (1985).

F. Completed field-work research on curriculum development needs of RDIs on facilities, materials and inventory management (August 1985).

G. FAMESA, in collaboration with the National Research Council of Malawi (NRC) and the Malawi Bureau of Standards (MBS), successfully conducted a training workshop on R&D Strategic and Project Planning and Budgeting for 18 senior R&D managers in Malawi (March/April 1986).

PRIMARY ACTIVITIES

261. During the Plan period, 1987-1989, FAMESA will continue its activities on research, consultancy services and training in R&D management in Africa; more specifically, the following activities are envisaged:

A. Research: Assessing training needs of RDIs; and establishing an appropriate information and documentation service for FAMESA.

B. Curriculum Development: FAMESA will undertake curriculum development in the critical areas of R&D management, namely:

- R & D Institute - Client Relationship;
- RDI Management Information Systems;
- RDI Project Planning, Monitoring and Control;
- RDI Personnel Management;
- RDI Financial Administration and Management.

C. Development of other Training Materials: FAMESA will, in addition to curriculum development, be involved in the development of other training materials to supplement its R & D management manuals. These materials will include case studies and texts.

D. National Training Workshops: FAMESA will assist national RDIs and other relevant organizations to implement training courses for R & D managers using the manuals already developed, or being developed.

COLLABORATION

262. In implementing its activities, FAMESA collaborates with various types of organizations dealing with science and technology policy or R&D management, e.g.:

- National RDIs, especially for profile surveys and the assessment of needs;
- National and regional management and development training institutes;
- Councils for Science and Technology on policy formulation;
- OAU/STRC (The Organization of African Unity's Scientific and Technical Research Council);
- International organizations concerned with R & D management training.

LONG-TERM PERSPECTIVES

263. In the long-term, Africa's hopes for rapid economic development, recovery and rehabilitation will hinge upon a well-conceived scientific and technological advancement. This will require, inter alia, a sharpening of research and development priorities along with a heavy investment in efforts to improve productivity in the R & D activities. This is a vision which requires drastic measures for the stringent management of the available resources for production and harnessing of technology for development.

264. It is FAMESA's fervent hope that, through its strategy and modality for ensuring national self help, African countries will establish their own on-going R & D management delivery systems to provide a core of competent R & D managers. In this grand strategy, FAMESA has already begun to build pre-eminence in the vital aspect of increased productivity for national development.

265. During the Plan period, FAMESA will have completed curriculum development in the areas of R & D institute financial administration and management; management information systems, project planning, monitoring and control; personnel management; institute-client relationship; and facilities, materials and inventory management. The training materials will be used for training R & D managers through national training workshops.

266. BUDGET: FAMESA: SECRETARIAT EXPENSES

EXPENDITURE IN US $	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL	47,000	49,000	51,000
INTL. PROFESSIONAL TRAVEL	5,000	6,000	7,000
MATERIALS, SERVICES AND EXPENDABLES	7,000	8,000	9,000
TOTAL	59,000	63,000	67,000
INTL. PROFESSIONAL STAFF	1	1	1

RESOURCE COMMENTARY

267. Funding for curriculum development is done separately for each of the seven areas, and 13 to 20% of the total project cost is charged by FAMESA for management of the Secretariat. National training workshops are funded through bilateral arrangements for each country.

IX. RESEARCH SUPPORT SERVICES

(a) MBITA POINT FIELD STATION (MPFS)

INTRODUCTION

268. Mbita Point Field Station (MPFS), located on the shores of Lake Victoria in Western Kenya, is ICIPE's main field facility. Started in 1978, and commissioned in August 1986, the MPFS accommodates the Crop Pests Research Programme; provides insect and animal rearing facilities for the Tsetse and Livestock Ticks Research Programmes; and provides the infrastructure for the operation of ICIPE's training and collaborative research programmes at the Field Station. The MPFS management supervises physical plant, and two welfare services (St. Jude's Clinic and the Mbita Point International School), based at MPFS.

PRIMARY OBJECTIVES

269. The principal objectives of the Field Station are to provide the ICIPE research, outreach and training activities with:

A. A management service for ensuring a coordinated plan for executing research and training activities.

B. An infrastructure for ecological studies, field and laboratory experimentation and a coordination focus for on-farm research studies and demonstrations.

C. Facilities for the development, testing and packaging of pest management technologies in collaboration with national programmes.

D. Training facilities in insect science and research methodologies, for postgraduate research scholars, pest management practitioners, visiting scientists and postdoctoral research fellows.

ACHIEVEMENTS

270. During the Plan period 1984 - 1986, MPFS recorded the following accomplishments:

A. Provision of a suitable environment for ecological studies, field experimentation, and coordination of on-farm research studies and demonstrations.

B. Provision of infrastructure for the training of pre-doctoral and postdoctoral fellows, pest management practitioners and visiting scientists.

C. Provision of facilities for the successful holding of institutional and international meetings.

D. Provision of the administrative and physical facilities for the mutual interraction with, and demonstration of, ICIPE research results to the resource-poor rural farmers, through visits by farmers to the Field Station, hosting of Open Days, and vigorous interaction between the ICIPE scientists and rural farmers in the latter's own fields.

E. Completion and the coming into operation of priority capital development work on the laboratories, senior staff housing, office complex, Guest Centre, and extensions to the Clinic and the International School.

ACTIVITIES

271. The main activities of the Field Station will be:

A. Participation in the planning and execution of research and training activities.

B. Provision of field and laboratory facilities for conducting research and training.

C. Provision of services for collaborative research with national and international institutions.

D. Development of infrastructure at Ungoye, in North Gwasi Location some 25-30 km away, as a field research site.

E. Assurance and sustainance of an effective and productive scientific environment.

F. Provision of elementary educational facilities to children of the ICIPE staff and to the community around Mbita Point.

G. Provision of medical and clinical service to the ICIPE employees and their families, and to the community in the environs of MPFS.

COLLABORATION

272. The Mbita Point Field Station collaborates closely with the District and Provincial Administrations to ensure the efficient functioning of the Field Station in general and contribution to community development.

273. BUDGET:

MBITA POINT FIELD STATION

EXPENDITURE IN US $	ACTUAL EXPEND. 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL		428,000	441,000	459,000
INTL. PROFESSIONAL TRAVEL		4,000	4,000	4,000
MATERIALS, SERVICES AND EXPENDABLES		317,000	412,000	453,000
TOTAL	739,000	749,000	857,000	916,000
INTL. PROFESSIONAL STAFF	1	1	1	1

RESOURCE COMMENTARY

274. Priority construction work on the laboratories, senior staff housing, office complex and extension to the Clinic, the International School and the Guest Centre System, completed during the 1984-86 Plan period, will accommodate the increased research and support activities at the Field Station. Specific funds will be sought, during the 1987-1989 Plan period, to facilitate the construction of insectaries and recreational facilities; the extension of the existing accommodation for ARPPIS students and trainees; and for developing camping infrastructure at Ungoye field research site. Increasing resources are being allocated to maintain the physical plant.

(b) WORKSHOPS AND LABORATORY SERVICE UNIT

INTRODUCTION

275. The Workshops and Laboratory Service Unit is organized in two parts. The Central Unit, based in Nairobi, and a Branch located at MPFS. It is hoped that both parts will be fully equipped to enable MPFS to provide its own services although in close cooperation with the Central Unit in Nairobi. The Central Unit, in Nairobi, is divided into five sections, namely: Electronics and Instruments, Fabrications, Refrigeration, Automobile, and Maintenance.

PRIMARY OBJECTIVES

276. The entire Service Unit is charged with the task of ensuring the smooth and continuous operation of all ICIPE's facilities, including equipment, instruments, machinery, vehicles, plants and buildings, site works, associated infrastructure, and utilities (electricity and water supply, drainage, sewage, and refuse disposal).

277. The Service Unit carries out electro-mechanical design work for scientific equipment. Furthermore, it undertakes the fabrication of minor items of research equipment.

ACHIEVEMENTS

278. With the rapid expansion of the ICIPE, the demand on the Workshops and Laboratory Service Unit has risen accordingly. The workshops have achieved the following:

A. Design and fabrication of scientific equipment, such as animal holding cages, traps, and specialized experimental apparatus.

B. The workshop has been actively involved in Capital Development activities both at MPFS and the projected Duduville Capital Development Programme (Phase II). At Mbita Point, the Unit has successfully completed the required construction work.

PRIMARY ACTIVITIES

279. The Unit will provide the following services:

A. The maintenance and modification of the buildings and permanent structures of the ICIPE facilities and associated infrastructure; and to provide technical advice and service for research conferences, study workshops and other meetings.

B. Technical and maintenance services and records for the ICIPE scientific equipment, instruments, other machinery and office equipment.

C. Technical and maintenance services for ICIPE vehicles.

D. Design function and fabrication of scientific equipment, their accessories, and plant and farm machinery.

E. Technical advice or and full participation in the purchase, supply, installation, modification and commissioning of all equipment, instruments, and machinery

F. Full participation in the planning, design, and in some instance the construction and commissioning, of all ICIPE Capital Development Programmes and Projects.

G. Contractual instrument maintenance service for institutions in Kenya in areas of ICIPE's competence.

COLLABORATION

280. The Service Unit is supported by engineers from suppliers of specialized equipment through maintenance agreements. Further, it shares maintenance facilities with other institutions in the Nairobi area.

LONG-TERM PERSPECTIVES

281. The Workshops and Laboratory Service Unit intends to be self-sufficient in its expertise of specialized engineering and maintenance skills. It is also hoped that the Service Unit will provide a technical service to other research institutions in Kenya for the support and maintenance of electronic and nuclear equipment.

282. The Service Unit will undertake the development and support of field research sites as need arises.

283. BUDGET:

WORKSHOPS AND LABORATORY SERVICE UNIT

EXPENDITURE IN US $	ACTUAL EXPEND. 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL		174,000	185,000	192,00
INTL. PROFESSIONAL TRAVEL		-	-	-
MATERIALS, SERVICES AND EXPENDABLES		29,000	21,000	23,000
TOTAL	184,000	203,000	206,000	215,000

RESOURCE COMMENTARY

284. Improved accommodation is urgently required by the Central Unit, located in Nairobi, both to improve safety and efficiency and to extend the storage space for expendable materials used for routine maintenance. This will become available at Duduville Headquarters in late 1987.

285. All the present equipment and tools need to be upgraded or replaced. There is at present no glass-blowing equipment at all; and the Service Unit is currently dependent on renting the University of Nairobi facility as and when required.

(c) AMENITIES AND SOCIAL SERVICES

286. The ICIPE provides amenities and social services in support of its core activities. These services are essential, and are regarded as a legitimate charge to the core budget. However, they are not expected to overburden the core programme and, in the long-term, it is planned that they will become self-supporting. These services are:

(i) The International Guest Centre System
(ii) Mbita Point International School
(iii) Medical and Clinical Service Scheme.

(i) INTERNATIONAL GUEST CENTRE SYSTEM (IGCS)

INTRODUCTION

287. The International Guest Centre System (IGCS), comprising Duduville International Guest Centre (DIGC) in Nairobi and the MPFS Guest Centre, has been established by the ICIPE as social and welfare amenities to support research and training, and to provide welfare services to staff.

PRIMARY ACTIVITIES

288. The primary activities are:

A. Provision of accommodation and meals to ICIPE training and conference activities, ICIPE staff and ICIPE visitors.

B. Establishing a collaborative network with other Guest Centres and similar institutions, both within and outside Kenya, with the primary aim of exchanging knowledge and skills.

COLLABORATION

289. The International Guest Centre Systems (IGCS) has on-going collaborative arrangements with similar institutions in Kenya, namely Utalii College, Nairobi Club and the ILRAD Guest Centre. Outside Kenya, it is planned that contact will be made with Guest Centres at IITA, IRRI and ICRISAT.

290. BUDGET: INTERNATIONAL GUEST CENTRE SYSTEM

INCOME IN US $	ACTUAL EXPENDITURE 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
ACCOMMODATION		104,900	171,300	185,000
FOOD		100,000	62,500	67,500
DRINKS		25,000	10,600	11,500
LAUNDRY		3,700	2,400	2,600
RENT		12,800	15,600	16,900
MISCELLANEOUS		4,000	1,900	2,000
GRANT-IN-AID		61,600	61,600	61,600
TOTAL INCOME	300,700	312,000	325,900	347,100

	ACTUAL EXPENDITURE 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
EXPENDITURE IN US.$				
PERSONNEL		179,600	190,800	198,000
MATERIALS, SERVICES AND EXPENDABLES		126,800	129,500	143,000
EQUIPMENT		5,600	5,600	6,100
NEW VEHICLES		-	-	-
TOTAL EXPENDITURE	360,200	312,000	325,900	347,100

RESOURCE COMMENTARY

291. Duduville International Guest Centre (DIGC) has been functioning with sub-optimal equipment. Equipment for laundry, kitchen and conferences are needed; and replacement of old vehicles will be essential. Provision of these will improve the services and help in the generation of income forecast in the Budget.

(ii) MBITA POINT INTERNATIONAL SCHOOL (MPFS)

INTRODUCTION

292. The primary objective of the Mbita Point International School (MPIS) is to provide elementary education for the children of ICIPE staff.

PRIMARY ACTIVITIES

293. The major activities are:

A. Provision of a broad-based curriculum aimed at equipping the child with the capacity to pursue an international system of education in Kenya or in other countries of the world; and, within the Plan period, to stabiiize this curriculum.

B. Providing the child with a co-educational, cross-cultural learning environment in a rural Kenyan setting.

C. Fostering social responsibility by admitting children from the environs of Mbita Point in addition to the children of ICIPE staff.

D. Consolidation of infrastructure during the Plan period, in terms of staffing and staff development, development of physical facilities and purchase of equipment.

COLLABORATION

294. Collaboration has been established with Kenya's Teachers Service Commission for the secondment of staff, if needed, to the International School. Regular consultation with the Kenya Institute of Education will be established to facilitate the assessment and review of the school curriculum. The ICIPE is in the process of identifying an institution outside Kenya, which will facilitate the exchange of information, staff and academic materials.

RESOURCE COMMENTARY

295. The ICIPE aims at developing MPIS to provide excellent educational facilities to meet the needs of a multi-cultural staff resident at the Field Station. Additional physical facilities have been provided since early 1986 to cater for the expansion of classes up to the eighth grade. However, additional school equipment is required for special subjects (science laboratory, language laboratory, music room and school workshop).

296. BUDGET: MBITA POINT INTERNATIONAL SCHOOL

INCOME IN US $	ACTUAL EXPEND. 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
SCHOOL FEES		18,800	25,300	30,000
GRANT-IN-AID		114,800	114,800	114,800
MISCELLANEOUS INCOME		1,900	3,100	3,700
TOTAL INCOME	111,800	135,500	143,200	148,500
EXPENDITURE IN US.$				
PERSONNEL		121,700	127,600	132,700
MATERIALS, SERVICES AND EXPENDABLES		9,300	9,500	10,400
FIELD EXPENSES		4,500	5,000	5,400
INTERNATIONAL TRAVEL		-	-	-
EQUIPMENT		-	1,100	-
TOTAL EXPENDITURE	111,800	135,500	143,200	148,500

(iii) MEDICAL AND CLINICAL SERVICE SCHEME (MCSS)

INTRODUCTION

297. The ICIPE has established the Medical and Clinical Service Scheme (of which St. Jude's Clinic at Mbita Point Field Station is the first clinic), with the objective of catering for the medical and clinical needs of the ICIPE staff and their families.

PRIMARY ACTIVITIES

298. The primary activities of the MCSS are:

A. The provision of a Group Medical Insurance Scheme for staff at the Headquarters in Nairobi, at MPFS, and staff resident at collaborating institutions, such as those at IRRI and IITA.

B. The provision to ICIPE staff and their families in Kenya of preventive medical services, health education, ante- and post-natal care, child welfare and family planning; the carrying out of clinical and laboratory diagnoses and treatment; and the referral of patients to other hospitals or medical consultants for specialized treatment and follow-up.

299. In addition to the activities set out in the paragraph 286 above, the St. Jude's Clinic will also fulfil the following services with respect to the ICIPE staff at MPFS:

A The provision, at a reasonable charge, of emergency medical and clinical care to the people living in environs of Mbita Point.

B. Determination of the seasonal pattern and prevalence of diseases around Mbita Point.

COLLABORATION

300. St. Jude's Clinic at MPFS has established an active consultancy arrangement with the Aga Khan Hospital in Kisumu, Kendu Bay Mission Hospital in South Nyanza, and with the neighbouring Health Centres. It is planned that negotiations will be initiated with an established research institute for tropical medicine so as to make possible an exchange of staff and the learning of new skills in tropical diseases. In this respect, short-term immunological training is envisaged for the Laboratory Technologist, with emphasis on tropical diseases; while training in Clinical Pharmacy is anticipated for the Pharmaceutical Technologist so as to augment his knowledge in comprehensive pharmacy and patient counselling.

301. The Clinic gives advisory and consultancy help to the Health Centres on Rusinga Island.

LONG-TERM PERSPECTIVES

302. A detailed review will be made to decide whether a Clinic should be established for staff at the Nairobi Headquarters of the Centre.

303. BUDGET: MEDICAL AND CLINICAL SERVICE SCHEME

EXPENDITURE IN US $	ACTUAL EXPEND. 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL		60,000	63,200	65,700
MATERIALS, SERVICES AND EXPENDABLES		197,400	202,400	205,400
COORDINATION TRAVEL		-	-	-
TRAVEL AND ACCOMMODATION		2,500	2,700	2,900
TOTAL EXPENDITURE	203,100	259,900	268,300	274,000

RESOURCE COMMENTARY

304. The ICIPE Medical and Clinical Service Scheme (MCSS) has been functional as a self-financing scheme since mid-1982, based on capitation fees computed for staff to cover operating costs of providing medical services. The capitation fees are budgeted with personnel costs in the Programmes.

305. St. Jude's Clinic at MPFS is a limited service intended to cater for staff at the Field Station. The ICIPE will upgrade the Service Scheme so that resident staff will continue to have confidence in the standard of medical facilities provided. A new extension for maternity and laboratory service has been completed, but additional equipment is required in order to fully utilize the facilities.

X. CAPITAL DEVELOPMENT PROGRAMME

PRIMARY OBJECTIVES

306. Major works of Mbita Point Field Station capital development programme were completed in the 1984-1986 Plan period. These facilities include laboratories, farm complex, maintenance unit, administration offices, guest centre, senior staff houses, international school, clinic, and infrastructural facilities. However, there are several important facilities still lacking, which would make the utilization of the Field Station more

efficient, such as insectaries for mass-rearing, middle and junior staff housing, and recreation facilities. The provision of basic infrastructure at Ungoye field research site, which is an extension of MPFS, is a priority consideration.

307. The main capital development programme during this Plan period will be Duduville Headquarters (Phase II). However, minor works will be undertaken to equip the field research sites with basic camp facilities, as outlined in paragraphs 313-316 below.

308. As indicated in paragraphs 349-351, provision for the improvement of equipment and transportation has been made. In the case of transportation, provision has been made for six vehicles each year, mainly as replacements.

PRIMARY ACTIVITIES

309. The major capital development activities to be undertaken are:

A. Construction of Duduville Headquarters (Phase II): a first priority project.

B. Construction of Mbita Point Field Station (Phase II), subject to availability of specific capital funds.

C. Minor physical works at other field research sites to ensure and safeguard their ownership, and to facilitate their on-going usage (such as the fencing of Muhaka and land preparation at Ungoye).

D. Assessment of needs for other physical facilities.

310. The above major activities will be undertaken as projects. Priority on these projects has been approved by the ICIPE Governing Council, and they will be undertaken subject to the availability of funds.

311. Duduville is a 26-acre site on the Nairobi-Thika Road (in a suburb of Nairobi) on a 99-year lease. The area includes 7 acres alloted for the development of staff housing; but the latter is not planned for during the Plan period, unless specific funding becomes available. Phase I of the capital development programme at Duduville comprises a training facility, which was completed in July 1980. This contains 30 study-bedrooms, and a catering and laundry facility. It is used by trainees, conference participants, and visiting scientists. Duduville will be developed as the new Headquarters of the ICIPE; and the facilities presently concentrated at Chiromo will progressively be transferred to Duduville, as segments of the Duduville Capital Development Programme (Phase II) become completed. Masterplanning for Phase II started in mid-1985; and construction of part of it (already funded) started in July 1986.

312. Phase II of the Duduville Capital Development Programme, as approved by the Governing Council, subsumes the relocation there of priority activities to be transferred from Chiromo. These include research laboratories, insectaries and animal breeding units, maintenance workshops and warehouse, training and conference facilities, library and documentation, and the administration complex. It is planned that the construction works will include the extension of the Guest Centre to provide additional 30 study-bedrooms. Phase II is estimated to cost US$9.9 million (at 1986 prices) (see paragraph 341, and Table 4). By the end of 1986, US$4.8 million was available for this Project. In the circumstances, the Project is being undertaken in segments; and the first contract is for the construction of the research laboratories, insectaries and animal breeding units, maintenance workshops and central stores, as well as the associated infrastructure.

MINOR WORKS AT FIELD RESEARCH SITES

313. There are existing small camping facilities at Nguruman Escarpment (in Masailand) and Lambwe Valley (in South Nyanza District) for tsetse ecological research; while leishmaniasis research uses field facilities provided by Kenya Government institutions at Machakos (Machakos District) and Marigat (in Baringo). These are intended to remain working camps, and no major capital expenditure is envisaged during the present planning cycle.

314. During the last Plan period, adequate camping facilities were provided at Nguruman Escarpment, which is a Tsetse Field Research Site in the Kenya Rift Valley; and the ICIPE also established its own camping facilities at Marigat.

315. Muhaka Field Research Site is important because it represents a different ecological zone from MPFS. It is in a humid equatorial zone with two rainy seasons; and it has a wide range of pests: crop borers, cassava mites, tsetse, livestock ticks, sandflies, mosquitoes, etc. A planning mission comprising ICIPE scientists visited the site and identified its potential research usage. These will form the basis for its further planning during this Plan period.

316. Ungoye Field Research Site is being developed as an extension of MPFS, in order to supplement the Field Station for:

- Verification trials before large-scale field trials are extended to other ecological zones;

- Testing and developing seeds produced from experiments into bulk foundation seeds for large-scale field trials in national programmes;

- Providing additional land for collaboration with national programmes and international agricultural research centres. For example, IITA has placed a scientist at MPFS; and it is anticipated that similar arrangements will be made with other CGIAR centres in the future;

- Developing demonstration fields for training, and plots for student project experiments;
- Preservation and multiplication of natural enemies of insects for biological control;
- Growing crops under protection from pests (as an experimental control measure).

317. Ungoye will be operated from MPFS until specific funds are obtained for developing camping infrastructure at the site.

XI. GOVERNANCE, MANAGEMENT AND INFORMATION

(a) GOVERNANCE

318. The ICIPE is constituted by an international Charter. The signatories to the Charter have established a Governing Council which exercises all the powers conferred by the Charter upon the ICIPE. In executing this role, the Council has responsibility for approving and monitoring strategic plans, as well as the financial and human resource policies necessary to support the programme. These decisions are embodied in Strategic Plan documents (implemented through the approved annual Programme and Budget); Financial Regulations and Rules; and Staff Regulations and Rules.

319. The Governing Council comprises 16 members, and is self-perpetuating. Its members are appointed in accordance with the stipulation of the ICIPE Charter. The Council regularly meets once a year. The Council has an Executive Board which advises it, and may act on its behalf, on programme policy, management and resources, and on nominations for council membership. The Executive Board has established a Programme Committee, which under its direction, is responsible for the formulation of policies regarding the scientific, educational and training programmes of the ICIPE.

320. Council policies are executed through the Director of the institute, who is the Chief Executive Officer and is a full member of the Council. The Directorate is a single entity; but the Director delegates responsibility to the Deputy Director (for general assistance and overseeing for the scientific programme); and to Managers in-charge of Administration and Information, and Finance. An organization chart is presented in Table 2.

321. Measures to ensure adequate Governing Council involvement in policy formulation and decisions, monitoring of implementation, budgetary controls, and reviews of key decisions were streamlined and reinforced during the 1984-86 Plan period. From November 1986, these have been reaffirmed by the international charter.

Strategic Policy and Planning

322. The Governing Council and Management have streamlined strategic policy and planning systems to keep in focus the long-range goals of the institute, the resources needed to accomplish the goals, and to meet the needs of the principal constituents of the institute's research and training mandate. In this respect, the donors, through the SGI which nominates eight members of the Council, are better informed of the ICIPE; while the general constituents are participating more actively through research and training collaboration (the latter within the recently established PESTNET).

323. Overall, these strategies are succeeding in yielding more stable funding for the Centre. Research and training collaboration is extending to other continents, as exemplified for instance by a collaborative research agreement concluded in 1986 with the Biological Control Laboratory of the Chinese Academy of Agriculture Sciences.

(b) MANAGEMENT AND INFORMATION

ACHIEVEMENTS

324. Much has been achieved over the last two years in streamlining and consolidating human resource management, simplifying staff recruitment and performance evaluation processes, and improving general administrative support services. Recruitment for senior positions which were previously vacant has been completed. Among these positions are those of Deputy Director, which fell vacant following a death, Divisional Managers; Programme Leaders for Tsetse, Livestock Ticks, Crop Pests, and Medical Vectors Research Programmes, Heads of the Research Support Units, including Chemistry and Biochemistry, Histology and Fine Structure, Sensory Physiology, and Biostatistics and Computer Service Unit; as well as Head of Outreach and Training Unit (OTU). With these appointments the Centre's senior management and scientific leadership are now at full strength. The Centre launched, during the 15th Annual Anniversary Celebrations, the ICIPE's first ever merit award scheme - THE ICIPE MEDAL FOR INNOVATIVE RESEARCH - which has set the pace for other research institutions in Africa.

325. Wide-ranging measures have been adopted to achieve a compact and efficient system of administrative support services to the research and training activities:

A. The complement of support staff is being reviewed so as to establish it at a level commensurate with the number of international professional staff adopted by the Council (at 45 man-years).

B. Selected administrative and research staff were placed on specialized training courses ranging from 3 months to 2 years for the upgrading of skills, as part of the Centre's staff development programme.

C. As a result of a Secretarial Audit, the Centre instituted improved filing systems; assigned secretaries to research programmes and units for the first time; and made arrangements to upgrade secretarial skills and practices.

D. Recruitment on a competitive basis, formal systems of evaluation, peer reviews and renewal or discontinuation of Service Agreement have been standardized. Personnel records have been computerised for easy retrieval.

E. Staff morale and overall productivity have been maintained at a satisfactory level. Among the contributory factors were upward revision of salary scales in January 1984, and further increases in emoluments from March 1985.

Transport

F. Appropriate vehicles have been allocated to each Research Programme and Unit, instead of the pool system which had proved unsatisfactory. The decentralisation has gone further, and now includes support units.

G. Budget limitations and rates of customs duty chargeable on the sale of unserviceable vehicles have restricted the operation of a standard schedule of vehicle recycling; but the Management has accepted the principal of regular replacement, and has adopted four years as the recycling period.

Land Leases and Acquisition

H. In accordance with the Centre's field research needs, 78.12 hectares of land has been acquired through the Kenya Government at Ungoye in South Nyanza, about 29 kilometres from Mbita Point Field Station.

I. As at May 1986, 4.6 hectares of land at Marigat in Baringo District has been applied for to provide field facilities for the Medical Vectors Research Programme. Similar arrangements for the acquisition of 2.02 hectares at Nguruman in Kajiado District was made for the Tsetse Research Programme for camping facilities, which were completed in the last Plan period.

Relations with the Host Government

326. The Centre maintained good relations with the Kenya Government during the Plan period, climaxed by visits to the Centre both in Nairobi and Mbita Point Field Station by top officials from the Ministry of Agriculture and Livestock Development; the official opening of the 1986 Annual Research Conference by the Chief Secretary and Head of the Civil Service; and the hosting on 27th November 1986 of a conference of Plenipotentiaries to adopt the ICIPE Charter.

Information and Publicity

327. In the 1984/85 period, the information component of the Administration and Information Division made significant advances in sharpening its support role within the ICIPE. The result is that the Centre's work is now better known and better appreciated than ever before, both within the host country, Kenya, and internationally. With this increased awareness of the ICIPE and its research and training programmes, there has been a tremendous upsurge of interest in the Centre, with more institutions as well as individual scientists seeking collaboration, more visitors, more requests for our publications, better attendance at our annual research conference and study workshops, greater exposure in the news media, etc. Among specific achievements, the following can be singled out:

A. The 1983 Annual Report marked a significant improvement in content and design on previous efforts. The 1984 and 1985 Reports have taken this process of gradual improvement a step further.

B. The Open Day, held at Mbita Point Field Station in May 1984, was a major success and paved the way for active collaboration with the national research programmes in Kenya.

C. The 1985 Annual Research Conference and 15th Anniversary Celebrations in April 1985 received unprecedented publicity and were very well attended. As part of the 15th Anniversary activities, the Centre published a special newspaper supplement in one of Kenya's daily newspapers, which proved to be most effective in increasing public awareness of the ICIPE and its research and training programmes. It is a measure of the success of our new information strategies that the 1986 Annual Research Conference improved on the high level reached by the 1985 one, in terms of both attendance figures and the quality of scientific presentations.

D. For the first time ever, a video-documentary was produced on the work of the ICIPE. This is now being used extensively for fund-raising, as well as for general information. The number of requests for copies of the documentary, especially from our donors has confirmed that the investment was worthwhile and that the experiment has been a great success. More programme-oriented documentaries are planned, subject to availability of funds.

E. An attractive information package is now available to selected ICIPE visitors.

F. An ICIPE Archives is now operational, and will be expanded when more space and funds become available. Library and documentation services have been streamlined and further improvement are underway.

G. The Centre's corporate image is being consolidated. A new logo is already in use.

H. A modern photo-typesetting machine has recently been installed, and will form the nucleus of a small in-house publications production unit.

Financial Management

328. Financial management has been streamlined; and the Governing Council approved revised Financial Regulations and Rules for implementation from 1st January 1985. The financial information is currently being computerized.

(i) THE DIRECTORATE

PRIMARY OBJECTIVES

329. The Director is the Chief Executive Officer of the institute (see para. 308), and links the Governing Council and the Management (see para.312); he implements Council decisions, and brings to the Council policy issues. The Director develops medium- and long-term plans, coordinates the mobilization of resources, and ensures the implementation of the ICIPE programme.

330. On scientific and technical matters, the Director is supported by a Deputy Director, who acts in his absence; on other management matters, he is supported by Managers for Administration and Information, and Finance, respectively. The objectives of these services are dealt with later in this Section. During the Plan period, emphasis will be placed on outreach R & D and training for scientific leadership; and mechanisms for its coordination will be established within the Directorate and OTU.

ACTIVITIES

331. To facilitate Strategic Planning, mobilization of resources, and implementation of the ICIPE programme, the Director is supported in undertaking the following tasks in the manner outlined below:

By the Deputy Director in:

A. Development of strategic research plans on medium-term and annual basis.

B. Coordination of research programmes and technical support services.

C. Taking the responsibility for the in-house Research Committee, Farm Committee at MPFS, and inter-programme Consultative Group for Insect Mass-Rearing.

D. Assurance of appropriate linkage with outreach R & D training programmes, through the Head of OTU, by way of

- Coordination of outreach activities within the ICIPE as well as with external institutions;
- Planning and coordination of training programmes in concert with programme staff.

E. Establishment and management of merit award schemes, namely the ICIPE MEDAL FOR INNOVATIVE RESEARCH and the ICIPE RESEARCH MANAGEMENT MEDAL, and others which may be instituted from time to time.

By the Planning and Development Unit (PDU) in:

F. Coordination of the Strategic Planning process (of which the strategic research planning exercise is a crucial component).

G. Budgeting.

H. Preparation essential for effective resource mobilization and monitoring.

I. Undertaking regular financial auditing (the latter is reported directly to the Director but, for logistical purposes, the work is organized within PDU).

J. Undertaking management auditing, in collaboration with the respective executive Managers.

By the Office Management Senior Staff in:

K. Providing logistics between the Directorate and the Governing Council, as well as with the staff of the ICIPE.

COLLABORATION

332. The Directorate endorses and formalizes all collaborative arrangements negotiated by ICIPE programmes.

333. The Staff of the Directorate often use other institutions (such as the World Bank, UNDP, IDRC, FAO, CGIAR Centres, and the Academies of Science), for exchange of information, consultancy, or for training to upgrade skills.

(ii) FINANCIAL MANAGEMENT

OBJECTIVES

334. The following are the primary objectives of the Finance Division:

A. Ensure that those elements of the Financial Regulations which are currently the responsibility of the Finance Division are administered in line with the policies as approved by the Governing Council.

B. Ensure that the Financial Rules, promulgated by the Director, as Chief Executive Officer of the ICIPE, are applied.

C. Ensure that the Director is provided with up-to-date monthly and other periodic management reports, to the highest professional standards, for planning and management purposes.

D. Ensure that the expenditure of the ICIPE remains within the appropriations as approved in the Programme and Budget, only for the purposes approved by the Governing Council.

E. Prepare the annual accounts in conformity with the best professional practice.

F. Ensure that the supplies function is operated to the best professional standards.

ACTIVITIES

335. The following are the primary activities of the Division:

A. Preparation of the Financial Statements for the financial year.

B. Provision of quarterly financial reports to the Executive Board and up-to-date financial reports to the Council at each of its regular meetings.

C. Cash management, including where applicable short-term and long-term investments of money.

E. Administration of Budget appropriations.

F. Determination of records to be maintained in respect of equipment and other property purchases.

G. The maintenance of adequate checks against irregularity.

H. Control of the purchasing function.

(iii) ADMINISTRATION AND INFORMATION DIVISION

336. The two Divisions of Administration and Communication and Information have been merged, since January 1986, to provide for more efficient and effective management of these important support functions, which overlap in several areas. The new Division of Administration and Information is divided into four Departments: Human Resources, Administrative Services, Publishing and Documentation, and Communication Services.

OBJECTIVES

337. The objectives of the new larger Division comprise:

A. Management and development of the Centre's human resources, in liaison with other Divisions and Units.

B. Initiating and processing modern management information through committee procedure to assist the Centre in personnel policy formulation and implementation.

C. Management of administrative support services in the areas of security, transport, estates, utilities and the International Guest Centre System (IGCS).

D. Coordination and management of the Centre's capital development programmes.

E. Dissemination of research information generated at the ICIPE through editorial, publication and photographic services.

F. Establishment, in the long-term, of an ICIPE Science Press for the production and marketing of high-quality scientific journals and books.

G. Collection, processing, storage and dissemination of information in support of the Centre's research, training and outreach programmes, through professional library and documentation services, including archives.

H. Development and maintenance of a dynamic communication network between the ICIPE and its constituencies, through the exchange of information and by coordinating seminars, study workshops and conferences on new advances in insect science and pest management strategies.

I. Coordination of public and constituency relations, including the visitor service.

J. Coordination and management of an efficient travel service for the Centre.

ACTIVITIES

Human Resources Department

338. The Human Resources Department, headed by a Principal Administrative Officer, has as its primary functions and activities the following:

- Staff recruitment and selection;
- Staff performance evaluation;
- Job analysis and descriptions;
- Staff development training, in liaison with the Outreach and Training Unit (OTU) which plays the lead role;
- Review of staff emoluments and benefits within guidelines approved by the Governing Council;
- Liaison with the Planning and Development Unit (PDU) in strategic planning and budgeting in relation to human resources.

Administrative Services Department

339. The Administrative Services Department, headed by a Principal Administrative Officer, has the following as its main functions:

- Estate management services;
- Security;
- Utilities;
- Transport;
- The International Guest Centre System (IGCS);
- Liaison with the ICIPE lawyers;
- Contracts and Tenders.

Publishing and Documentation Department

340. During the present Planning cycle, the Publishing and Documentation Department will fall directly under the Manager for Administration and Information, who is also the overall head of the Division. The Publishing and Documentation Department is charged with the following functions:

- Development of a comprehensive publications programme for the Centre, and the implementation of specific publishing projects in accordance with the Centre's dissemination policy;

- Provision of editorial, graphic, typesetting and photographic services to the Centre and, in this respect, the assurance of uniformity of style and outlook for all ICIPE publications (Annual Report, Insect Science and Its Application, Dudu, Research Highlights, the book series, Current Themes in Tropical Science and others being planned);

- Coordination and management of in-house design and production of newsletters, brochures, corporate stationery, etc.;

- Promotion, marketing and distribution of all ICIPE publications either directly or through arrangement with selected international publishers and distributors;

- Provision of an appropriate system of collection of journals, reprints, books, maps, films, slides and other information materials required by the ICIPE's research and training programmes.

- Provision of a current awareness service based on information on insect science and pest management available at the ICIPE and important data bases (CAB Abstracts, AGRICOLA, AGRIS, MEDLINE, etc);

- Establishment of a documentation service for pest management information systems, starting with crop borers during the present plan period;

- Establishment and development of an appropriate gift and exchange scheme between the ICIPE and other institutes' library and documentation services;

- Developing further the recently established ICIPE Archives;

COMMUNICATION SERVICES DEPARTMENT

341. The Communication Services Department is headed by a Principal Communication Officer, and has the following as its primary functions:

- Coordination of the planning, administration and evaluation of the Centre's scientific and other professional meetings (Annual Research Conferences, study workshops, seminars, open days, scientific exhibitions, etc.);

- Gathering and packaging of information on ICIPE's activities for public awareness;

- Coordination and management of induction programmes for new staff and employees;

- Coordination of the Centre's visitor service at its various campuses;

- Coordination and management of the Centre's domestic and international travel service.

342. There is on-going collaboration with other institutes in the following areas:

A. IDRC/ICIPE training project on scientific publishing in collaboration with the newly formed African Association of Scientific Editors (AASE).

B. A joint IDRC/ICIPE/ICRAF/KREMU project for the development of capabilities in scientific publishing for Eastern and Central Africa; in this respect, a workshop for scientific editors was held in August 1984, and an international symposium was held in August 1985, both in Nairobi.

C. Institutions in Kenya and elsewhere on inter-library loans, gifts and exchange of publications as well as international data bases and information systems such as AGRIS.

D. Practical attachment at the ICIPE of Library Assistants from other institutes is a continuing activity; similarly, study visits by ICIPE library and documentation staff to other research institutions (including universities) are periodically organized.

343. In the process of strengthening its information mechanisms, the ICIPE plans to extend collaboration as follows:

A. Co-publication of scientific information with CGIAR institutions. A staff member from the Division attended a Workshop on Co-Publication which was held at IRRI in 1983. The Senior Graphic Artist was attached to IRRI's Communication and Publication Department for six months, from July to December 1984.

B. Publishing during the Plan period of a Union List (of journals and periodicals available in principal libraries in East Africa) jointly with the University of Nairobi.

344. BUDGET: INFORMATION

EXPENDITURE IN US $	ACTUAL EXPENDITURE 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL		316,000	334,000	347,000
INTL. PROFESSIONAL TRAVEL		11,000	11,000	12,000
MATERIALS, SERVICES AND EXPENDABLES		201,000	226,000	249,000
TOTAL	356,000	528,000	571,000	608,000
INTL. PROFESSIONAL STAFF	1	1	1	1

345. BUDGET: GOVERNANCE AND MANAGEMENT

EXPENDITURE IN US$	ACTUAL EXPENDITURE 1986	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PERSONNEL		970,000	961,000	999,000
INTL. TRAVEL		176,000	201,000	221,000
MATERIALS, SERVICES AND EXPENDABLES		301,000	374,000	411,000
TOTAL	1,263,000	1,447,000	1,536,000	1,631,000
INTL. PROFESSIONAL STAFF	4	4	4	4

RESOURCE COMMENTARY

346. During the Plan period, the Centre will strengthen its information system to provide improved services in publications, library and documentation, and communication. In support of this improvement, resources will be required as follows:

A. Two additional staff will be required for (i) scientific editing and writing, and (ii) proof-reading. The Publishing and Documentation Department is at present benefiting from the presence of a UN volunteer science writer/editor, acquired through UNDP for a period of two years. The Library needs another library assistant with copy-typing qualifications; while the Communications Services Department needs a photographer. Another graphic artist is required to be based at Mbita Point Field Station.

B. The Publishing and Documentation Department has recently upgraded its typesetting facilities, and now has a modern phototypesetting machine. In addition, the Department has a Wang Professional Computer and Word Processor, but in the future, a further workstation with appropriate software will be needed for the Library. The Communication Services Department needs to upgrade its audio-visual presentations; and additional equipment will be required, including a SLR Camera, video recorder and monitor.

C. The intensification of collaboration through PESTNET and other arrangements will result in increased travel for staff of the Directorate. One vehicle for Supplies and Stores needs replacing, and one in the Directorate should also be replaced.

XII. HUMAN AND FINANCIAL RESOURCES

Human Resources

347. Of the three challenges being tackled by the ICIPE (see para.10), budgetary provision is made in these plans for fundamental research geared to technology development, and for central services in support of training and collaboration. However, these budget levels are inadequate to meet the full training needs, and the desirable collaborative projects with national programmes. Increased fellowships will continue to be sought for the former, while tripartite multilateral and bilateral funding will be necessary for the implementation of the latter.

348. The Council has approved 45 IPS from 1987, subject to funding being available and ability to meet other priorities set by the Council. Postdoctoral Research Fellowships will be used as research back-up for the core research, and to provide training opportunities for young scientists who will in turn strengthen national programmes institutions. The fellowships are for 2-3 years; and the number of such personnel will be increased from 16 to 20 during the Plan period, subject to funds being available. Qualified personnel is usually the most limiting factor in the implementation of a strategic plan. ICIPE's personnel policy is designed to ensure the recruitment of high-calibre scientists, and a reward system which maintains high scientific productivity and quality. The Council attaches high priority in the area. Furthermore, funds are budgeted for international travel to enable scientists to appraise themselves of new scientific advances and exchange ideas with their peers. In special circumstances, visiting scientists will be invited to advise and train staff in new techniques, while undertaking relevant research at the ICIPE.

Capital Costs

349. As indicated in para.338, equipment is budgeted as part of the Capital Development Programme, along with the construction programme for Duduville Headquarters (Phase II), which is one of the critical areas of capital costs. Efforts will continue during this Plan period to raise funds for the remaining

portions: computer rooms, communication and library facilities, conference and training facilities, administration offices, and the extension of DIGC. These are estimated to cost US.$5.1 million (at 1986 prices). The works will be undertaken when funded, and have therefore been excluded from the budgets of this Plan. A special appeal has been made to donors for funding for this Project.

350. In addition to construction, major equipment and the replacement cost of vehicles continues to be one of the priority capital cost. Provision is made under the capital budget to build funds for the purchase of some of the critical items of equipment which need a large capital outlay; such as electron microscopes (EMs) for HFSRU, NMR for CBRU, electrophysiological equipment for SPRU, and upgrading of VS-80 Wang Computer for BCSU. Provision has been made for equipment and vehicles at US.$695,000; $228,000; and in 1987 and 1988, respectively while that for 1989 will depend on increases in income levels. Some items of equipment (such as NMR) are very costly, and will require substantial increases in grants or specific funds and cannot be accommodated in the present budget.

351. Replacement of vehicles will require large outlays of funds if the replacement schedule is to be met at levels which will provide serviceable vehicles necessary to sustain the increasing field work. The current budget provides, on average, for six replacement vehicles annually instead of twelve vehicles required to maintain a reasonable fleet. A special appeal, similar to the one made for the construction of Duduville Phase II, has been made to donors for equipment and vehicles.

Budgetary Scenarios

352. The core operating costs and forecasts budgeted for these plans (excluding capital construction costs and special project costs) amount to US$ 8.476, 8.401 and 8.696 million in 1987, 1988 and 1989, respectively (see Table 4). These are based on the current forecast of income for core operations for 1987 which is the minimum budget (Scenario 1 in para.28). The ICIPE has operated at this minimum level for several years, with no increases in real terms. However, the Council has set priorities in the Programme to be undertaken if additional funding becomes available. In undertaking these priorities in research and training activities, the ICIPE would wish to move towards the desirable level of Scenario 2, and towards utilizing its full potential. For this level, one would need to budget for at least the following additional elements (which are not included in the plan budgets):

		Cost (in U.S.$)
(a)	2 IPS at a total annual cost of	360,000
(b)	4 PDF at a total annual cost of	80,000
(c)	6 additional replacement vehicles annually	110,000
(d)	Annual additional provision for equipment	250,000
	TOTAL	800,000

In effect, one would have to increase the current level of grants ($ 8.074 million for 1987) by about 10% to achieve this full potential, notwithstanding that this level would still exclude collaborative projects with national programmes.

353. A summary of the estimated costs is presented in the Plan Budget Table 3; while a summary of the Duduville Capital Development Programme costs is presented in Table 4.

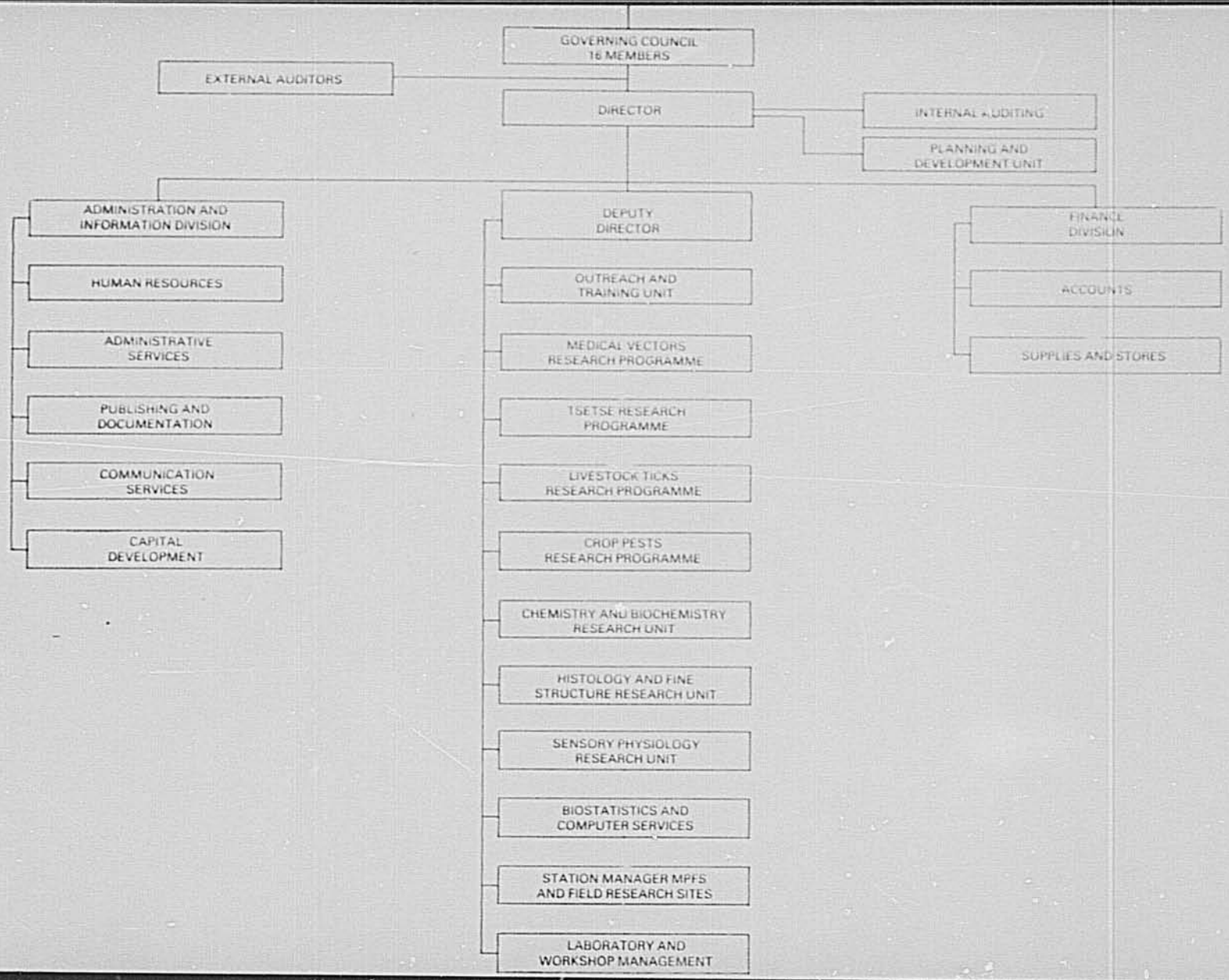
Table I

COLLABORATIVE PROGRAMME

OTU PROGRAMMES	NATIONAL BODIES	INTERNATIONAL COLLABORATING AGENCIES
PESTNET	Governments of The Sudan, Burundi, Rwanda, Zambia, Kenya, Tanzania, Uganda, Somalia, Ethiopia, Zimbabwe and Malawi	UNDP USAID
COLLABORATIVE RESEARCH AND DEVELOPMENT	Government institutions in Kenya, Zambia, Cote d'Ivoire Somalia, Tanzania, Uganda, The Sudan, China	IRRI CIMMYT, ILCA ICRISAT ILRAD
	Universities of: Moi and Neuchatel, KETRI, Egerton College	UNECA OAU/STRC
GROUP TRAINING COURSES		
International GTC on Pest and Vector Management Systems	Government institutions in Africa, S.E. Asia, S. America and Middle East	
GTC on Ecological Pest Management in Africa	Government institutions from the West African Region	CREFPHY UNEP
GTC on Insect Growth, Development, and Behaviour	Government institutions from the tropical developing countries, and a few from developed countries	

Table I
pg. 2

OTU PROGRAMMES	NATIONAL BODIES	INTERNATIONAL COLLABORATING AGENCIES
Tsetse and Tick Management Course	Government institutions in Kenya, The Sudan and Zambia	EEC
African Regional Training Course for the Use and Safe Handling of Radioactivity in Insect Science	Government institutions in Cote d'Ivoire, Kenya, Uganda and Zambia	IAEA
African Regional Postgraduate Programme in Insect Science	Universities of: Sierra Leone, Liberia, Ibadan, Khartoum, Zambia Khartoum, Addis Ababa, Makerere, Dar es Salaam, Malawi, Zimbabwe and Rivers State University of Science and Technology	Australian Development Assistance Bureau (ADAB); Arab Bank for Economic Development in Africa (BADEA); German Academic Exchange Service (DAAD) Netherlands; Studies in the Region (SIR); International Fund for Agricultural Development (IFAD); European Economic Community (EEC); US Agency for Interantional Development (USAID); Ford Foundation; UNDP, Scientific, Technical and Research Commission of the OAU (STRC/OAU)


GOVERNING COUNCIL
16 MEMBERS
EXTERNAL AUDITORS
DIRECTOR
INTERNAL AUDITING
PLANNING AND
DEVELOPMENT UNIT
ADMINISTRATION AND
INFORMATION DIVISION
HUMAN RESOURCES
ADMINISTRATIVE
SERVICES
PUBLISHING AND
DOCUMENTATION
COMMUNICATION
SERVICES
CAPITAL
DEVELOPMENT
DEPUTY
DIRECTOR
OUTREACH AND
TRAINING UNIT
MEDICAL VECTORS
RESEARCH PROGRAMME
TSETSE RESEARCH
PROGRAMME
LIVESTOCK TICKS
RESEARCH PROGRAMME
CROP PESTS
RESEARCH PROGRAMME
CHEMISTRY AND BIOCHEMISTRY
RESEARCH UNIT
HISTOLOGY AND FINE
STRUCTURE RESEARCH UNIT
SENSORY PHYSIOLOGY
RESEARCH UNIT
BIOSTATISTICS AND
COMPUTER SERVICES
STATION MANAGER MPFS
AND FIELD RESEARCH SITES
LABORATORY AND
WORKSHOP MANAGEMENT
FINANCE
DIVISION
ACCOUNTS
SUPPLIES AND STORES

Plan Budget, Table 3

FINANCIAL RESOURCES (IN US $)

EXPENDITURE	ACTUAL EXPENDITURE 1986	INTERNATIONAL PROFESSIONAL STAFF 1987	APPROVED BUDGET 1987	FORWARD BUDGET 1988	FORWARD BUDGET 1989
PROGRAMME					
CROP PESTS	996,000	12	1,573,000	1,488,000	1,569,000
LIVESTOCK TICKS	357,000	6	555,000	623,000	657,000
TSETSE	442,000	6	556,000	581,000	611,000
MEDICAL VECTORS	275,000	4	406,000	358,000	387,000
CHEMISTRY AND BIOCHEMISTRY	244,000	4	369,000	450,000	485,000
HISTOLOGY AND FINE STRUCTURE	140,000	2	198,000	208,000	220,000
SENSORY PHYSIOLOGY	87,000	2	129,000	140,000	148,000
BIOSTATISTICS AND COMPUTER SERVICE	140,000	1	151,000	161,000	170,000
OUTREACH AND TRAINING	828,000	2	936,000	994,000	1,079,000
MBITA POINT FIELD STATION	739,000	1	749,000	857,000	916,000
WORKSHOPS AND LABORATORY SERVICE UNIT	184,000	-	203,000	206,000	215,000
INFORMATION	356,000	1	528,000	571,000	608,000
SUB-TOTAL	4,788,000		6,353,000	6,637,000	7,065,000
GOVERNANCE AND MANAGEMENT	1,401,000	4	1,447,000	1,536,000	1,631,000
TOTAL OPERATING COSTS	6,189,000	45	7,800,000	8,173,000	8,696,000
CAPITAL DEVELOPMENT:					
MPFS	368,000	-	-	-	-
Construction (Duduville)	1,538,000		*	*	*
Scientific Equipment and Vehicles	475,000		676,000	228,000	**
SPECIAL PROJECTS:					
-Lignocellulose	50,000	-	-	-	-
-FAMENA	99,000	1	59,000	63,000	67,000
TOTAL EXPENDITURE	8,719,000	46	8,535,000	8,464,000	8,763,000

(See Notes next page)

* Balance of Capital Funds for the approved project held in Trust Account and excluded from these budgets.

** Provision will depend on level of increase in grant income

NOTES: (1) PERSONNEL COSTS HAVE BEEN INCREASED BY 4% TO CATER FOR ANNUAL INCREMENTS, BUT DO NOT INCLUDE A PROVISION FOR MAJOR REVIEWS OF STAFF.

(2) THESE COSTS ARE IN REAL U.S. DOLLARS, AND INCLUDE ANNUAL EFFECTS OF INFLATION AT 10% ON COSTS OTHER THAN PERSONNEL.

(3) THE BUDGETS APPEAR TO BE STATIC IN COMPARISON WITH THE BUDGETS OF THE FIRST PLAN PERIOD. IN REAL TERMS, THEY ARE 10% HIGHER. THE EXPLANATION IS THAT THE BUDGETS ARE COSTED IN KENYA SHILLINGS AND CONVERTED TO U.S. DOLLARS. THE CONVERSION RATE HAS VARIED BECAUSE OF FLUCTUATION IN KENYA THE SHILLING.

DUDUVILLE CAPITAL DEVELOPMENT PROGRAMME (PHASE II)

ESTIMATED PROJECT COST IN KSHS.

I. CONTRACT I: FUNDED SEGMENTS 1, 2, 3

(a)	Insectaries and Animal Breeding Units	18,571,740
(b)	Laboratories	38,537,870
(c)	Maintenance, Workshops, Estate Services and Central Stores	12,298,490
	Sub-Total	69,408,100
(d)	Professional Fees (10.5%)	7,287,900
	Total	76,696,000

Equivalent in US$4,793,500 (KSHS.16/US$ 1.00)

II. ESTIMATED COST OF SEGMENTS 4, 5, 6

(a)	Outreach, Training Library, Editorial and Computer Centre Conference Centre	36,416,000
(b)	Administration Complex	17,024,000
(c)	Extension of Duduville International Guest Centre	9,104,000
	Sub-Total	62,544,000
(d)	Additional Works/Costs required by Planning Authorities and for Equipping the Facilities	18,592,000
	Total	81,136,000

Equivalent US$.5,071,000 (KSHS.16/US$1.0)

Equivalent in US$.9,864,500