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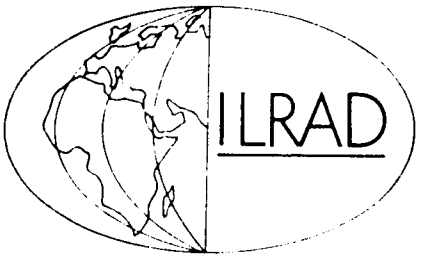

INTERNATIONAL LABORATORY FOR RESEARCH ON ANIMAL DISEASES

PROGRAM AND BUDGET 1982-1983

MID-TERM REPORT

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1982-83 PROGRAM AND BUDGET
MID-TERM REPORT

The mid-term report of the Program and Budget for 1982-83 was prepared by the ILRAD staff and management, and was approved by the Board of Directors at the annual meeting in Nairobi on 5 - 7 April 1982.

This proposal constitutes a formal request to the Consultative Group on International Agricultural Research for donor support for 1983.

K. F. Wells

K F Wells
Chairman
Board of Directors

1982-83 PROGRAM AND BUDGET
MID-TERM REPORT

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1. STATEMENT OF OBJECTIVES

The International Laboratory for Research on Animal Diseases (ILRAD) has the mandate to develop safe, effective and economically feasible control measures for livestock diseases which seriously limit world food production. Two disease complexes of major economic importance in many developing countries were chosen by the CGIAR, TAC and ILRAD's Board of Directors as the original focus of ILRAD's research program: trypanosomiasis and East Coast fever, a form of theileriosis.

Different forms of trypanosomiasis occur over large areas of Africa, Latin America and the Middle East, affecting most types of domestic livestock, several wildlife species and man. In Africa, the major pathogenic species of trypanosomes for domestic ruminants are Trypanosoma congolense, T vivax and T brucei brucei. These are transmitted by several species of tsetse flies (Glossina spp) or occasionally by other biting flies. Trypanosomiasis occurs over about 10 million km^2 in tropical Africa, or roughly one-third of the continent. Affected areas often have relatively high rainfall and considerable potential for animal and crop production but due to trypanosomiasis very few ruminants are actually produced, and arable farming is also limited by the absence of draught animals.

At present, measures available to control trypanosomiasis include regular treatment with trypanocidal drugs and reduction of tsetse populations by insecticide spraying. However, both of these approaches are expensive and neither is completely effective in areas of heavy infestation. Further drawbacks include increasing drug resistance and the possibility of environmental pollution due to large-scale spraying. ILRAD's goal is to develop alternative control methods which are cheaper, more effective and without negative side effects.

Research to date indicates that immunological control of trypanosomiasis will be difficult, because the parasite surface antigens change rapidly through a large repertoire of variant types. Metacyclic traypanosomes, which develop in the tsetse fly, show fewer surface antigens than the parasites which develop in the mammalian bloodstream at a later stage in the disease cycle, but the prospects for developing immunization procedures based on metacyclic trypanosomes do not appear promising for field use in the near future. Research therefore covers several possible avenues of trypanosomiasis control, including an investigation of genetic and acquired disease resistance in different hosts.

East Coast fever (ECF) is a cattle disease which causes enormous losses in East and Central Africa. This form of theileriosis is caused by the protozoan parasite Theileria parva parva, which is transmitted by the brown ear tick Rhipicephalus appendiculatus. Other pathogenic Theileria species are a serious constraint on livestock production in extensive areas of Asia and the Middle East.

ECF is currently controlled by dipping or spraying cattle to kill the tick vectors. In areas of high infestation, animals must be dipped or sprayed at least twice a week. Drugs to cure ECF are being developed by commercial firms, but neither frequent treatment with acaricides nor regular drug treatment is feasible for many African livestock producers, and tick resistance to currently available acaricides is potentially a serious problem.

The prospects for developing an ECF vaccine appear promising, since cattle which recover from natural or experimentally-induced infections show long-lasting immunity to the same or similar Theileria strains, even when the initial infection is mild. However, the epidemiology of the disease is complex, especially when wild animals are present as disease carriers. Numerous parasite strains need to be isolated and characterized and cross-immunization patterns determined. The major objective of ILRAD's theileriosis program is to improve current experimental immunization procedures which only protect against one or a small number of strains and which require the use of fully virulent parasites. The successful use of non-viable parasite material or attenuated parasites in a vaccine would represent a major advance in the control of this disease complex.

ILRAD's training and outreach activities are designed to support the development of scientific and field personnel who can extend research on trypanosomiasis, theileriosis and other pressing veterinary problems and carry out the most effective control programs possible with currently available methods. These personnel will also be ready to implement field programs when new control methods are ready for introduction.

2. CURRENT STAGE OF DEVELOPMENT

ILRAD's development in all areas was examined in 1980 by a TAC Quinquennial Review Panel whose final report was presented to the CGIAR at the end of 1981. The Review Panel expressed satisfaction with the scientific progress made by ILRAD and commended the initial development of the theileriosis and trypanosomiasis field programs. The Panel recommended continuation of the laboratory research program with present areas of emphasis on both diseases and urged expansion and strengthening of the field program, including the epidemiology of ECF and the study of trypanotolerant cattle.

In line with these recommendations, ILRAD's research program will continue to focus on improved measures to control trypanosomiasis and theileriosis. As the prospects for improved control of theileriosis appear more promising in the short term, this program is being strengthened with the recruitment of scientific staff in immunochemistry, cellular immunology and epidemiology. Investigations have focused on different phases of the Theileria life cycle, with the aim of identifying the stages which are most likely to be vulnerable to immunological control. Research will now concentrate on the development of immunization procedures based on antigens from two stages of parasite development - the sporozoite and the schizont forms. The third research area will be theileriosis epidemiology, beginning with present work in a well-defined field situation at the Kenya coast and including collaborative research on the role of buffalo and other wild animals as disease carriers.

As the development of immunization procedures for trypansomiasis appears to be a longer-term prospect, research on this disease will continue on a broader base. Areas of emphasis will include possibilities of interfering with trypanosome metabolism and antigen synthesis and the genetic regulation of antigenicity. To support this work, the development of better parasite culture systems will continue.

Research on host responses to trypanosomiasis will also be emphasized, including immunological and other aspects. Work will focus on the mechanisms of disease resistance displayed by the trypanotolerant cattle breeds of West and Central Africa and certain wildlife species. ILRAD scientists will carry out field work in collaboration with ILCA and other national and international organizations, and appropriate numbers of trypanotolerant cattle will be obtained for research work at the laboratory. The role of chemotherapy in the acquisition of resistance may also be examined and appraised in field situations.

Increasing emphasis will be placed on the dissemination of ILRAD's research results to national and regional institutions concerned with the control of animal diseases in Africa. Opportunities for training scientists and senior technicians will increase as the scientific staff is enlarged to previously approved levels. A greater effort will also be made to include francophone African countries affected by trypanosomiasis and theileriosis in ILRAD's training and outreach programs.

In response to a recommendation by TAC, an outline of priority research areas is being prepared. This will provide the basis for ILRAD's 5-year research program which will lead to an overall plan for the future. As agreed by the TAC Quinquennial Review Panel, research efforts will not extend to other major animal diseases until at least one of the present research programs is satisfactorily concluded.

The construction program at ILRAD is largely complete. The research laboratories and supporting facilities are for the most part well equipped and functioning, and only minor alterations are required as laboratory functions and needs change. The construction of staff housing will be completed in 1982, with the exception of the proposed house for the Director General. ILRAD also provides offices for regional staff of four other CGIAR centres. Because this was not anticipated in the original plans, the construction of additional offices is considered necessary.

A 13 000 ha cattle breeding ranch was purchased late in 1981 to provide an assured supply of cattle for experimental work, and the first batches of calves were received from the ranch in February 1982. Certain facilities on the ranch have to be renovated or remodeled to meet the new production requirements: most of the urgent work should be completed in 1982.

In 1981, a new management team took up appointments, including a Director General, a Director of Administration and a Financial Controller. A new Chairman of the Board also took office. As of March 1982, only 68% of approved senior scientific and administrative staff positions were occupied. The shortage of senior staff affects both research progress and training activities, and steps are being taken to recruit appropriate staff to fill the vacancies by late 1982.

3. SUMMARY OF ACHIEVEMENTS AND CURRENT ACTIVITIES

THEILERIOSIS

The T p parva parasites which cause ECF undergo a complex life cycle in the tick vector and the bovine host. When an infected tick feeds, sporozoites of T p parva are ejected in the saliva and invade the bovine white blood cells (lymphocytes). Parasites develop in the lymphocytes into a schizont form and some of the lymphocytes are stimulated to transform into lymphoblasts. The parasitized lymphoblasts multiply rapidly, leading to severe pathological symptoms and frequently death. If the animal recovers, it will subsequently resist infection with the same T p parva strain, but may be partially or wholly susceptible to other strains.

ILRAD scientists made significant advances in 1981 in delineating host responses to the disease and the interactions between parasites and host cells and in developing techniques for identifying T p parva strains. Electron microscope studies have shown how the Theileria sporozoites invade target cells. As more information is gained on the biochemical mechanisms involved, it may be possible to develop ways of obstructing parasite entry.

It has been found that cattle produce antibodies which can neutralize Theileria sporozoites, and this may similarly open up possibilities of inhibiting parasite establishment in the host. A major achievement of ILRAD's research program in earlier years was the application of techniques for raising monoclonal antibodies to solve the problems associated with the identification of specific host cell types and parasite antigens. Monoclonal antibodies are secreted by hybrid cells which are created experimentally by the fusion of spleen cells, which produce antibodies, and myeloma cells derived from bone marrow. The hybrid cells are capable of growing and dividing in culture. A major effort is now being made to raise monoclonal antibodies which recognize Theileria sporozoites so that the neutralization process can be studied in more detail. It should also be possible to analyze the antigenic composition of sporozoites and identify antigens with potential for stimulating bovine immunity.

The use of monoclonal antibodies has confirmed that sporozoites invade different types of white blood cells, but only develop into schizonts in a small proportion of the cell population. These cells appear to be a specific subset of T-lymphocytes. Now that the target cells can be identified, the possibility of blocking their proliferation may be another approach to controlling the disease.

The proliferation of parasitized lymphoblasts appears to depend on the presence of schizonts: when daughter cells are produced which do not contain parasites they do not continue to multiply. Recent work at ILRAD has shown that as parasites and host cells multiply the synthesis of their nucleic acids is closely synchronized, but takes place at different times. If this difference in timing reflects the operation of different mechanisms in host cell and parasite it may be possible to identify drugs which act selectively on the parasite without disrupting host cell function.

Recent studies have shown that an animal can only generate protective immunity to ECF in response to parasites within its own cells. However, as an immunization procedure, the establishment of parasites within the host's cells is difficult to achieve, and an animal immunized in this way may develop clinical symptoms and die. Methods are thus being explored to immunize animals with cell membranes or with sporozoites or parasitized lymphocytes rendered non-infective by gamma-irradiation.

An important protective response appears to be the generation of cytotoxic lymphocytes which kill parasitized cells. In cattle with no previous exposure to ECF, these cytotoxic cells may be generated too late in the course of the infection or they may fail to identify the parasitized cells and kill other cells indiscriminately. When immune cattle are infected, the cytotoxic lymphocytes appear rapidly and kill the parasitized cells before they can proliferate.

Techniques for differentiating T p parva strains are important because animals which are immune to one strain may be partially or fully susceptible to another. This may relate to the highly specific cytotoxic response generated in immune animals: a new strain may be less effective in stimulating cytotoxicity. Previously, ECF strains were differentiated on the basis of cross-immunity trials in cattle, but these were time-consuming, expensive and imprecise. Recent work at ILRAD has shown that a battery of monoclonal antibodies, raised against different schizont antigens, can provide a profile of the antigens present in different T p parva isolates as a basis for strain differentiation.

A field program was initiated in 1980 in cooperation with the Ministry of Livestock Development, to investigate the epidemiology of ECF in Kenya's Coast Province. Ticks and blood samples were collected in 1981 from about 100 sites in Kilifi District, and five T p parva isolates were made. When these isolates were screened with monoclonal antibodies, two distinct antigen profile types were identified. These seem to reflect strain differences, since cattle immune to an isolate of one profile type were solidly immune when challenged with another isolate of similar type, but susceptible to challenge by an isolate of a different type.

Work is now in progress to substantiate this correlation and to see if experimental immunization of cattle with strains of the two profile types will provide effective protection under field conditions in the area where the strains were isolated. Work will

then extend to other areas using the same approach: isolation of parasites, characterization in the laboratory, experimental immunization trials and finally field trials.

A collaborative project is also being carried out with the Kenya Veterinary Research Laboratory on the role of buffalo as ECF carriers. Studies focus on the apparent antigenic change which occurs in Theileria schizonts in buffalo, with important implications for the mechanisms involved in the induction of the immune response.

TRYPANOSOMIASIS

Studies of trypanosome antigenic variation have now confirmed that parasites of similar genetic backgrounds (a serodeme) can display a large number of surface antigens during an infection. Cattle infected with trypanosomes in the field sometimes recover and are subsequently immune to metacyclics of the serodeme with which they were originally infected. Protective immunity to a specific serodeme can also be conferred by treating animals with trypanocidal drugs 15 days or more after infection. Animals which are treated earlier than 15 days after infection remain fully or partially susceptible. These studies of immunity and other work in the laboratory confirm that the variable surface antigens of T b brucei and T congolense metacyclics are characteristic for specific serodemes. In the case of T b brucei infections, it has been shown that the antibodies produced against bloodstream forms of the parasite are capable of recognizing and reacting with the metacyclic forms of the same serodeme. Animals treated with trypanocides shortly after infection probably do not develop sufficient antibodies to confer immunity to subsequent infection.

Variable surface antigens have been identified and counted in the metacyclics of two trypanosome serodemes, using highly specific monoclonal antibodies. For a T b brucei serodeme, 80 to 90% of the metacyclic population displayed only six variable antigen types. For a T congolense serodeme, only three different variable antigen types were displayed by approximately 60% of the metacyclic population. The observation that the number of metacyclic variable antigen types present in any serodeme is likely to be limited is encouraging because modern techniques in genetic engineering may make it possible to produce a limited repertoire of antigens in vitro.

It is important to determine how many serodemes of each trypanosome species are likely to be encountered in a given field situation. This work is being initiated at a site in Kenya's Coast Province. Besides determining the number of serodemes present for each major trypanosome species, the role of acquired resistance to metacyclic trypanosomes is being assessed in a cattle herd at the site.

Studies have been carried out on the genetic events underlying the phenomenon of antigenic variation. Four genes were identified from one serodeme of T b brucei which code for four different

variable antigens. At least two complex types of gene rearrangement are observed when different surface antigens are expressed. Both of these rearrangements are unusual: the way in which they occur is probably related to the large number of variable antigens involved and the mechanism of variation.

Research has continued on ways in which variable T b brucei and T congolense antigens are synthesized and maintained on the surface of the trypanosomes. Though the variable antigens are proteins, two types of carbohydrate (CHO) side chains are important for the development and stability of the antigen molecules. One CHO side chain is constructed and attached to the protein by a linkage found in mammalian and other systems. The second is linked to the antigen at a site close to the trypanosome surface membrane by a mechanism which has not yet been described in any system. The enzymes which are probably involved in its synthesis and attachment have been partially characterized. It might be possible to use drugs to interfere with this process, disrupting the stability of the surface coat and rendering the trypanosome susceptible to a range of host defenses.

ILRAD scientists are investigating the role of trypanosome components other than variable surface antigens in the disease process and possibly in stimulating host immune response. Work focuses on parasite components which affect blood elements, such as platelets, contributing to the circulatory disorders which can be a prominent feature of the disease. Special attention is also being given to trypanosome components recognized immunologically by resistant, but not susceptible, animals.

Significant progress continues in the development of techniques to cultivate and maintain trypanosomes in vitro. A major achievement in 1981 was the growth in culture of a population of T vivax which retains the morphology and animal infectivity of the parasite bloodstream form. This work was carried out in collaboration with the Swiss Tropical Institute. The culture system for parasites which resemble the T congolense bloodstream form has also been improved. With the addition of new technology developed at the University of Edinburgh's Centre for Tropical Veterinary Medicine, ILRAD now maintains forms similar to all stages of the T congolense life cycle in vitro. The development of a system to maintain forms of T b brucei similar to all stages of the life cycle was a major achievement in earlier years. These in vitro culture systems will be used in work on the biochemical, immunological and chemotherapeutic aspects of trypanosomiasis.

Research on parasite-vector interactions is aimed at elucidating the role of tsetse flies in the epidemiology of trypanosomiasis in different environments and developing more effective methods of disease control. Studies in 1981 showed that trypanosome infections do not significantly impair the tsetse's feeding ability, nor alter the ultrastructure or function of the gut. It was also shown that survival, fecundity and mean pupal weight of G m morsitans do not differ significantly when flies are fed on defibrinated blood from several different mammalian species.

Investigations continue on the mechanisms of both innate and acquired resistance to trypanosomiasis. Different degrees of susceptibility have been observed between strains of laboratory rodents, breeds of domestic ruminants and species of wildlife. Susceptible mouse strains produce large amounts of antibodies in the course of trypanosome infection, but a very small proportion of these antibodies is directed against the parasite. In contrast, resistant mouse strains produce high levels of antibodies against the parasite.

Normally after infection with T b brucei, the number of parasites increases rapidly in the bloodstream, declines and increases again in a series of waves. The severity of the disease is often related to the level and duration of these parasitaemic waves. It has been shown that control of parasitaemia depends on parasite growth rate, as well as the induction of immune responses in the host. Declines in the trypanosome population are associated with a change in the parasites from a rapidly dividing long, slender form to a nondividing short, stumpy form. The short, stumpy parasites are senescent. As they die, their presence appears to stimulate host antibody production.

Some factor in the host appears to play a role in the timing of parasite transition, because when identical parasites are introduced into mice and cattle the timing of the transition differs dramatically in the different host species. The genetic basis of resistance to trypanosomiasis thus appears to have at least two components: a host resistant to T b brucei is characterized by its ability both to induce rapid parasite differentiation and to mount a protective immune response. It may be possible to develop marker systems which correlate with genetic or acquired resistance.

Host responses to trypanosomes of more than one serodeme or species are important under field conditions where animals are exposed to mixed parasite populations. When cattle are infected with a serodeme of T congolense and then infected with another serodeme of the same species, the establishment of the second infection is significantly impaired. In 1981, this phenomenon was shown to operate in laboratory rodents in sequences of infection involving different trypanosome species. The virulence of a T b brucei infection was substantially reduced when it was superimposed on an existing T congolense infection, though it was still sufficient to induce an antibody response. This finding suggests that levels of parasitaemia are influenced by other factors besides immune response.

Significant progress has been made in elucidating processes which may contribute to both innate and acquired resistance to trypanosomiasis. Studies are now being initiated to determine the relevance of these experimental findings to the resistance, either innate or acquired, exhibited by certain trypanotolerant and other varieties of cattle in field situations in East, Central and West Africa.

RESEARCH SUPPORT

Tsetse Laboratory

Thirty species and subspecies of tsetse are found in tropical Africa. All of these are potential vectors of trypanosomiasis, though the actual vectorial capacity of many species is not fully established. ILRAD's tsetse laboratory maintained breeding colonies of five species in 1981. Because Glossina morsitans morsitans is available elsewhere, ILRAD's colony was reduced to 1200 breeding females. The colony of G m centralis, which has been expanded to 10 000 breeding females, now provides material for all experimental work involving use of the vector. Colonies were also established in 1981 of G austeni, G tachinoides and G fuscipes fuscipes. Colonies of G pallidipes, G brevipalpis and G longipennis are being established in 1982. These tsetse species are all being evaluated in terms of their capacity to transmit T vivax, T congolense and T b brucei to ruminants. In addition to tsetse produced for research at ILRAD, flies were supplied in 1981 to the Centre de Recherche et d'Elevage at Avetonou, Togo, and to the Swiss Tropical Institute at Basel.

Tick laboratory

ILRAD's tick laboratory maintains breeding colonies of three strains of Rhipicephalus appendiculatus and one strain of R evertsi. These ticks transmit T parva and T lawrencei. A third tick species is also maintained, Amblyomma variegatum, the vector for T mutans. The tick laboratory routinely provides ILRAD scientists with infected and uninfected ticks, tick organs and tick-derived Theileria stabilates.

Farm animal production

The ILRAD calf-rearing facility provided 200 calves for research in 1981, and 110 weaned calves were purchased from ranches in Kenya. A total of 380 cattle were provided for research throughout the year, including animals which were available at the end of 1980. Roughly 60% of the animals were used for ECF experimentation and 40% for work on trypanosomiasis. This increase over previous years in the proportion of cattle designated for ECF research partly reflects the implementation of ILRAD's ECF epidemiology program at the Kenya Coast, with animals used for the isolation and characterization of ECF strains and for cross-immunity trials. ILRAD scientists also carried out collaborative research with the Kenya Veterinary Research Laboratory on trypanosomiasis in cattle. In 1981, 80 animals were used for this work, housed in cattle facilities at the government laboratory.

A total of 337 sheep and goats were used for trypanosomiasis research throughout the year. The fly-proof, screened accomodation available at ILRAD for trypanosomiasis experiments can accomodate 300 small ruminants at one time. This has been sufficient in the

past, but an increase in trypanosomiasis work with the development of an epidemiology program may require the construction of additional fly-proof facilities.

As in previous years, research was constrained to some extent in 1981 by a shortage of cattle, partly because of difficulties in purchasing suitable animals and partly due to a shortage of accomodation. Both of these problems were overcome at the end of the year with the completion of a new experimental cattle holding unit and the purchase of the ranch on the Kapiti Plains about 80 km from Nairobi. Over 2000 Boran (Bos indicus) cattle were purchased with the ranch, including a breeding herd of about 750 mature cows and 220 heifers. Plans are to increase the breeding herd to 1200 animals, and offtake should meet most of ILRAD's research needs. In the first 2 months of 1982, 58 2- to 3-day-old calves and 46 18-month-old steers were provided from the ranch. Specific requests by scientists for cattle of European (Bos taurus) breeds will still be met by purchase.

Laboratory animal production

ILRAD's breeding unit supplied nearly all the laboratory animals used for research in 1981. Overall, 38 516 laboratory animals were used during the year, compared with 30 443 in 1980 - an increase of 21%. This comprised 21 931 mice, 16 040 rats and 167 rabbits bred at ILRAD, plus 378 rabbits purchased from outside. In 1982, ILRAD should become self-sufficient in rabbits.

Five inbred mouse strains and one inbred rat strain are maintained. The mice are used to study the mechanisms of resistance to trypanosomiasis. The rats are used primarily to produce the trypanosomes required for ongoing research. Rabbits are bred to produce sera used for research and diagnostic purposes and to support the tsetse and tick colonies.

In 1981, ILRAD supplied laboratory animals as available to ICIPE, the Kenya Trypanosomiasis Research Institute, UNESCO's Integrated Project in Arid Lands, the University of Nairobi and the National Museums of Kenya.

Clinical and diagnostic services

In 1981, ILRAD's veterinary services continued to provide routine analyses for the research laboratories and animal production facilities. During the year, a total of 11 645 samples were received: 10 161 for serological, 839 for haematological, 385 for bacteriological and 260 for helminthological analysis.

Serological screening and titration were provided for seven bloodstream parasites found in cattle - Trypanosoma brucei brucei, T congolense, and T vivax, Theileria parva parva and T mutans, Anaplasma marginale and Babesia bigemina. Most routine screening was by the indirect fluorescent antibody test (IFA) and the enzyme-linked immunosorbent assay (ELISA). The ELISA test was used for the routine screening of bovine sera for the three trypanosome

species. This technique will also be applied to detect antibodies to T parva schizonts and T mutans piroplasms. The card agglutination test is used to screen sera for A marginale antibodies.

A capacity was developed in 1981 to screen sheep and goat sera for antibodies to the three trypanosome species. Requests for routine bacteriological screening of small laboratory animals were fewer than in previous years as ILRAD became increasingly self-sufficient in this area and very few laboratory animals were purchased from outside.

Apart from services provided to ILRAD scientists, diagnostic assistance was given to other centres and projects. Tests for A marginale antibodies were performed for a German aid project in Somalia, and T parva schizonts and T mutans IFA antigens were provided to FAO projects in Zambia and Mozambique and a German aid project in Burundi.

Clinical and diagnostic services at ILRAD will be expanded in 1982 with the employment of a veterinarian. In addition to diagnostic activities, clinical services will include an expanded surgical component and treatment of research animals.

Radioisotope laboratory

ILRAD's radioisotope laboratory is a controlled area where scientists can carry out experiments requiring the use of radioactive tracers. Often experimental work is initiated here which can be continued in the other laboratories once the radioactivity of the material has returned to safe levels.

Besides ordering and dispensing radio chemicals and managing radioactive wastes, the staff of the radioisotope laboratory are responsible for a continuous monitoring program, covering ILRAD personnel, laboratory areas and the environment at the ILRAD site.

Central core laboratory

The central core laboratory is a specialized support facility which prepares cell culture media for the trypanosomiasis and theileriosis programs. The central core also prepares solutions and purified water and includes washing and sterilization facilities for the glassware used in the laboratories.

Library

The library provides support for ILRAD's research and training activities and is used by scientists from other research institutes. The highly specialized collection included subscriptions to 202 scientific periodicals at the end of 1981, as well as over 2000 books. Journals are received in the fields of biochemistry, parasitology, immunology, pathology, cell culture and entomology, among others. The library also receives articles

requested by ILRAD staff members through a regional inter-library loan system and by purchase from the British Library Lending Division.

Conference papers and journal articles published by ILRAD scientists are held in the library, and copies distributed on request. Close cooperation is also maintained with the libraries of the University of Nairobi's Faculty of Veterinary Medicine, the Veterinary Research Laboratory of the Kenya Agricultural Research Institute, ICIPE and the Kenya Trypanosomiasis Research Institute.

TRAINING AND OUTREACH

Recent science graduates and higher-level technicians participated in ILRAD's research program in 1981, receiving training in specialized scientific areas and laboratory techniques. These trainees were working in areas within the scope of ILRAD's research mandate, and most were from African countries. The number of trainees who can be accomodated at any level depends on the availability of supervisory staff, laboratory space, equipment and accomodation. Within budgetary limits, a few individuals are also sponsored for training at other institutions.

Eight post-doctoral fellows worked at ILRAD in 1981 - one from Belgium, one from India, two from Kenya, one from Japan, one from the Netherlands, one from the USA and one from Zaire. These scientists are recruited on an international basis and generally stay at ILRAD for 2 years. Their work falls directly within ILRAD's research program. This program is currently being expanded, with provision in the budget for 13 positions in 1982-83.

At the post-graduate level, 14 trainees worked with ILRAD scientists in 1981, half of them from Kenya. Graduates undertake research projects whch last from 1 to 3 years, and they generally submit work done at ILRAD for a higher degree. In 1981, one graduate was working at ILRAD from Australia, two from Germany (Federal Republic), seven from Kenya, one from Rwanda, two from Sudan and one from Uganda. It is anticipated that opportunities for post-graduate training will increase in 1982-83, with a special effort to identify suitable candidates from francophone countries in Africa.

Ten scientists and senior technicians from four African countries received training at ILRAD in 1981 in specialized laboratory techniques. Two Kenyans were trained in immunodiagnostic techniques, and two others in trypanosomiasis pathology. Four Ethiopians were trained in parasitology, one Togolese worked on tsetse flies as trypanosomiasis vectors and one Nigerian learned in vitro cultivati techniques. All were staff members of university laboratories or national research centres. ILRAD will become more involved in training scientists and technicians from francophone African countries in 1982, beginning with the training of personnel engaged in the ILCA/ILRAD collaborative research program on trypanotolerant cattle in Zaire, Gabon, Ivory Coast, Senegal and Benin, as well as anglophone personnel engaged in the program in Nigeria.

ILRAD provided support for three scientists to attend the Third Training Seminar on Trypanosomiasis, sponsored by the OAU, FAO and WHO in Arusha, Tanzania. Two of these participants were from Togo and one was from The Gambia. In addition, 18 ILRAD technicians were sponsored for training courses at the Kenya Polytechnic.

A 6-week training course will be held in 1982 for senior technicians from African countries on the use of immunological methods in the diagnosis of haemoprotozoan diseases. In future, it is planned to hold one course a year on topics covered by ILRAD's research program which are directly relevant to the work of researchers and technical personnel in Africa.

A regular seminar series is conducted at ILRAD, initiated in 1981. Seminars are held every 2 weeks, providing a forum for researchers from centres in Nairobi and visiting scientists to discuss their current research projects. These seminars are well attended by ILRAD staff and researchers from the University of Nairobi and other national and international centres.

An international conference was held in February 1981 on Advances in the Control of Theileriosis, sponsored by ILRAD, FAO, UNDP, IAEA and DANIDA. Altogether, 185 participants attended - 85 from Kenya, 48 from other African countries and the remainder from Australia, Brazil, India, Israel, Pakistan, the UK and the USA. Papers presented at the conference were published in a proceedings volume.

Another international conference is planned for 1983 on ruminant immune systems. This conference will cover various aspects of ruminant immunology, as well as experimental approaches and techniques in human immunology which could be applied to research on ruminants. Participants will be scientists actively involved in immunological aspects of veterinary research in developing countries.

An exhibition of ILRAD's scientific work was prepared for the Nairobi International Show in September 1981. This show is sponsored by the Agricultural Society of Kenya. ILRAD's exhibit was visited by thousands of Kenyans, including farmers, businessmen, government officials and school children, and received a second prize from the show committee. A booklet on ILRAD's activities was distributed at the show and to visitors to the laboratory. An exhibition is planned for the Nairobi International Show in 1982.

Publications by ILRAD scientists in 1981 included 59 journal articles, chapters in books and published conference papers. Reprints of journal articles and other publications are distributed to scientists and research centres around the world. ILRAD's 1980 annual report was also prepared in 1981 and distributed to libraries, scientific institutions, ministries of livestock development and other interested organizations and individuals in Africa and elsewhere. In addition to the 1981 annual report, brochures describing ILRAD's major research programs are being prepared in 1982 in English and French, and a scientific newsletter is being initiated.

ILRAD staff members have been instrumental in setting up the Nairobi cluster, an organization to promote collaboration between scientists in Kenya working on trypanosomiasis and ECF and their vectors. Current members of the cluster include ICIPE, the Kenya Veterinary Research Laboratory, the Veterinary Research Department of the Kenya Agricultural Research Institute, the Kenya Trypanosomiasis Research Institute, the OAU's Inter-African Bureau of Animal Resources, ILCA, UNESCO's Integrated Project in Arid Lands, The University of Nairobi's Faculties of Medicine and Veterinary Medicine and the Clinical Research Centre of the Kenya Medical Research Institute, as well as ILRAD. ILRAD scientists serve on the WHO Steering Committee on Immunology and Pathology of African Trypanosomiasis, the FAO Panel of Experts on the Ecology and Technical Aspects of the Program for the Control of Animal Trypanosomiasis and Related Development, and the FAO Expert Panel on Ticks and Tick-borne Diseases.

In addition to the institutions in the Nairobi cluster, research and technical collaboration is under way with the Kenya Ministry of Livestock Development, the Centre de Recherche et d'Elevage in Togo and the national veterinary laboratories of Botswana, Burundi, Malawi, Mozambique, Rwanda, Tanzania and Zimbabwe. Outside Africa, ILRAD scientists are collaborating with colleagues at the Prince Leopold Institute for Tropical Medicine, the Vrije Universiteit Brussel and the Libre Université de Bruxelles in Belgium, the Swiss Tropical Institute, Cambridge, Glasgow and Edinburgh Universities in the UK, and the Universities of California, Iowa, New York (Stony Brook), Washington and Washington State in the USA.

4. 1981 PERFORMANCE

Table 1. 1981 BUDGET SUMMARY (US $'000)

	Final Revised	Actual
Core operations	8 171	7 445
Contingency	165	-
Capital	2 404	2 340
Total	10 740	9 785
Less funds brought forward	2 131	2 768
earned income	200	184
Net requirement	8 409	6 833

Total expenditures for core operations in 1981 were US $1 million less than the final revised estimate. This under-utilization of funds was primarily due to the fact that fewer international staff were employed than anticipated. In addition, insufficient information on actual costs in 1980 led to some over-estimates for 1981. Also, some decisions were delayed, affecting the implementation of programs, because of temporary and changing management during the year.

A total of 51 senior scientific and administrative positions was budgeted for 1981. Of these, 36 manyears were used, with 32.3 supported completely by ILRAD. Support level positions were heavily staffed by temporary appointments in 1980 and an effort was made in 1981 to reduce total support staff manyears. The emphasis in 1982 will be on recruiting international staff so that ILRAD will be nearer full strength by the start of 1983.

Since ILRAD was established, a number of non-core-funded scientists have contributed to the research program, including associate experts, visiting scientists and post-doctoral fellows. These scientists contributed 3.7 manyears in 1981 and will provide 3.4 manyears in 1982. Normally they receive salaries and travel support from other sources. ILRAD provides research facilities and in some cases contributes towards living costs by providing on-site housing.

The 1981 operating costs for the research units were less than the final estimates except for the Tsetse Vector Laboratory and the Central Core Laboratory, which exceeded estimated expenditures. In the case of Central Core, a radiation officer was employed early in the year and there were added expenses as the facilities for handling and disposing of radioactive material were improved.

In administration, the Office of the Director General and the Finance Office had considerable extra expenses associated with recruitment, staff changes, use of consultants, and the extra effort required for reorganization. Expenditures should return to normal in 1982.

The expenditures for Food and Housing were well below the anticipated level only because income was credited against cost (instead of listed separately as earned income). Thus, the net, rather than gross, costs are shown. This procedure was initiated in 1981 and will be more detailed and complete in 1982 as this section moves towards a self-sustaining operation.

Total capital expenditure in 1981 was about US $100 000 less than planned, but this was due to the fact that anticipated housing construction, valued at US $400 000, was not completed during the year. Actual expenditures on equipment purchased and construction completed exceeded projections for certain items.

Late in 1981, ILRAD purchased the Kapiti Plains Estate Ltd, a 13 000 ha ranch with a herd of over 2000 Boran cattle. This ranch was identified in 1979 as a suitable facility for the production of cattle required for research, and negotiations were initiated with plans to complete the purchase in 1980. The transaction was delayed, however, and the purchase was finalized on 1 December 1981. The ranch is now operating and is providing ILRAD with adequate numbers of cattle for experimental use.

ILRAD ended 1981 with US $2.7 million in funds to carry forward, some US $1.5 million more than expected. This was partly due to the fact that the research program did not reach its expected level during the year. Also, operating costs were substantially less than expected, based on accounts available at the end of 1980. Finally, the reconciliation of past accounts produced about $600 000 in additional funds to carry forward. The improved organization of past accounts and the accumulation of more accurate financial data in 1981 should make it possible to provide much more accurate estimates in future.

5. 1982 CURRENT BUDGET

Table 2. 1982 BUDGET SUMMARY (US $'000)

	1981 Actual	CGIAR Approved	Current Estimate
Core operations	7 445	9 627	8 189
Contingency	-		150
Capital	2 340	1 200	1 350
Price change	-	0	0
Total	9 785	10 827	9 689
Less funds brought forward	2 768	1 158	2 693
earned income	184	200	190
Net requirement	6 833	9 469	6 806

The new Director General assumed his post on 1 October 1981 and started to determine program direction and staffing requirements early in 1982. It is anticipated that most of the vacancies in the scientific staff will be filled during the second half of 1982.

The 1982 budget has been reviewed and all cost estimates have been reconsidered in relation to 1981 expenditures and the research program now anticipated for 1982. The budget is structured along ILRAD's current administrative and research lines. The two main research programs are not costed separately, but it is estimated that expenditures for the trypanosomiasis program are about 60% of the total.

In the presentation of the core operating budget for 1982, the staff of certain laboratories are aligned differently than they were for 1981 (Table A4). In addition, starting in 1982 the costs for post-doctorate positions have been charged to training rather than research, though the manyears are still shown in the appropriate research departments. Approximately 14 manyears are anticipated in this category in 1982.

The names of three laboratories were changed in 1982 so that now there are two Parasitology Laboratories, one for trypanosomiasis and one for theileriosis, and one Immunobiology Laboratory. Certain staff assignments have been shifted among laboratories as well. All laboratories are expected to have more senior manyears in 1982 than in 1981. About 4.0 additional manyears are expected for research as a whole. Costs will be in the same range as in 1981 except for the Parasitology Laboratory/Trypanosomiasis which includes an expanding epidemiology program. It should be noted, however, that the current estimates for all laboratories are less than those originally proposed for 1982.

Costs for research support will increase in 1982 primarily because of expanded activities in the Central Core Laboratory which includes research activities using radioactive materials.

Costs for farm animal production will also increase somewhat, due to initial costs of some modifications on the ranch and the importation of trypanotolerant stock from West Africa. N'Dama cattle will have to be introduced by ova transplant procedures, which has added US $50 000 to the 1982 budget for farm animals. However, once a breeding herd is established at ILRAD, further transplants will not be necessary.

A timely reporting system for expenditures was activated in 1981. Better financial control and more effective use of funds by each of the cost centres was possible in 1981, and more gains in efficiency are anticipated in 1982. Thus, administrative and general operating costs are expected to be less in 1982 than in 1981. These sections have been reorganized and are expected to operate normally in 1982. Special attention will be given to purchasing, stores and employment procedures.

The major capical item in 1982 is the construction of staff housing. At present ILRAD can house 40 staff members and trainees on site in different types of housing, ranging from single hostel rooms, to two- and three-bedroomed semi-detached houses. Increasing housing pressure in Nairobi has dictated the need for additional facilities. The 1982 project calls for eight two-bedroomed semi-detached units. The completion of these units will help meet the needs of the majority of the international staff who wish to live on site.

The 1982 budget also includes funds required to construct additional animal holding space in the Tick Laboratory. Smaller construction projects for 1982 include an engineering, paint and carpentry shop, additional vehicle maintenance facilities, and a barn for fodder and feed storage.

At its March 1982 meeting, TAC allocated ILRAD US $9 870 000 and US $7 929 000 for the 1982 gross and net budgets respectively. The current estimate for gross requirements for 1982 is in line with the TAC allocation. Because the funds brought forward into 1982 are substantially more than expected, the net requirement is well below the amount allocated.

6. 1983 BUDGET REQUEST

Table 3. 1982 CURRENT BUDGET AND PROPOSED AND CURRENT REQUESTS FOR 1983 (US $'000)

	1982	- 1983 -	
	Current Estimate	Approved by Board April/82	Current Request
Core operations	8 189	8 986	8 267
Contingency	150	179	125
Capital	1 350	1 326	450
Price change	-	733	660
Total	9 689	11 224	9 502
Less funds brought forward	2 693	-	-
earned income	190	200	200
Net requirement	6 806	11 024	9 302

In 1981, ILRAD had anticipated a gross requirement for 1983 of US $12 807 000. However, during the first half of 1982 the budget request was reduced to US $9 502 000 in response to anticipated availability of funding. The process of budget trimming which has been carried out is described in detail in Section 9 of this report. Table 3 gives both the new and the original approved figures to show how the 1983 budget has been restructured and how it compares to the budget for 1982.

The new total requirement is almost US $200 000 less than the figure for 1982. However, ILRAD had a larger capital budget in 1982 than is now forseen for 1983. The operating budget is essentially the same as in 1982, but with allowance for an 8% increase to meet inflation.

The trypanosomiasis and ECF research programs have been reorganized, and specific projects and sub-projects have been defined in keeping with ILRAD's research mandate. This reorganization has not changed the fundamental emphasis on the

development of immunological solutions for trypanosomiasis and ECF. However, epidemiology projects and the study of genetic resistance to trypanosomiasis will receive more attention in 1983. In line with this reorganization, descriptions of each scientific post have been developed and recruitment has been initiated as required. Eight posts should be filled in 1982, including the position of Director of Research, resulting in an increase in senior manyears in research from 34 in 1982 to 38 in 1983. With no real growth in operating funds, the increase in manyears will have to be funded through reduced operating costs. Since full funding will not be available in 1983, further recruitment of new staff will be curtailed and some present contracts will not be extended.

By the beginning of 1983, ILRAD will have managed the Kapiti Plains ranch for 1 full year. At this time, accurate information should be available on expenses and it should be possible to evaluate the impact of the ranch on ILRAD's research program. Operating expenses for the ranch should be met by income by the end of 1982. Capital development costs are being charged to ILRAD in 1982 and 1983.

The original program for 1983 requested funds for an addition to the administrative block. At present ILRAD provides 25% of its total administrative office space for regional staff of CIP, CIMMYT, and IBPGR, and has made one three-bedroomed house available for ILCA offices. In addition, ILCA constructed a prefabricated building on the ILRAD site in 1981 to provide another 15 offices. At least one other centre in the CGIAR system has also expressed an interest in placing a staff member at ILRAD.

Because Nairobi is an appropriate location for regional staff in East Africa, office space requirements for staff of other CGIAR centres is likely to continue and even expand. ILRAD also anticipates increasing needs for administrative offices. So far, ILRAD has been able to meet the needs of other centres, but this may not be possible in future. If existing office space is ever inadequate, no doubt ILRAD will have to put its own needs first. Because this item is largely in support of other centres, it was designated as the first to be omitted if full funding was not available. However, the donors may wish to consider construction of additional office space at ILRAD as a broader need of the system as a whole.

Funding was requested to build a house for the Director General. If needed, a plot away from the ILRAD site should be available as a result of negotiations with the Nairobi City Council. The City Council used some of ILRAD's land for a water development project and, in return, was asked to provide an appropriate site in a residential district for the construction of a house for the Director General. If land is not provided, construction at the ILRAD site will be considered. The request has now been moved back to 1984.

7. 1984-85 BUDGET PROJECTION

Table 4. 1983 CURRENT REQUEST AND 1984-1985 BUDGET PROJECTION (US $'000)

	1983 Current Request	1984 Projected	1985 Projected
Core operations	8 267	9 180	9 483
Contingency	125	185	190
Capital	450	792	525
Price change	660	1 447	2 320
Total	9 502	11 604	12 518
Less funds brought forward	-	-	-
earned income	200	200	200
Net requirement	9 302	11 404	12 318

No additional senior staff positions are requested for 1984-85. It is likely that existing positions will be reallocated to meet needs or shifts in emphasis. However, scientific staff numbers need to be brought up to full strength, and additional requirements for technicians are anticipated.

No major shifts in the direction of the research program are planned. The most likely areas for increased emphasis will be training and field projects in epidemiology and trypanotolerance. Any expansion of field work outside Kenya will likely be funded by special projects.

Since not all approved senior staff positions will be filled in 1983, substantial real growth in core operating costs will be required in 1984 if these positions are to be filled and supported. Real growth for 1985 is projected at a much lower rate.

Capital purchases in 1984 and 1985 will primarily be equipment. The construction projects anticipated include a holding facility for sheep and goats and the house for the Director General which was delayed from 1983.

8. PRICE CHANGES

Approximately half the ILRAD budget is exposed to inflation in Kenya for the purchase of local supplies and services, construction and salaries of locally recruited staff. The other half is exposed to world inflation rates for the purchase of imported - primarily capital - equipment and for salaries of international staff.

The rate of inflation in Kenya for the past 2 years has been fairly modest relative to rates in some countries of the world. The official rate for 1981 was 12%. It is believed that the rate in 1982 will be in the same range, or perhaps up to 16%.

The Kenya currency lost value against the US dollar in 1981. There was an 8% devaluation early in 1981, and a second devaluation later in the year brought the total for the year to 20%. It is not possible to anticipate further devaluations since the exchange rate is fixed by the government, but some devaluation is likely at some point in 1982.

Considering all these factors, ILRAD has estimated annual price changes at 8% from 1983 through 1985.

9. RESPONSE TO THE 1982 AND 1983 BUDGET GUIDELINES

ILRAD met the budget guideline figures provided by TAC for 1982 and kept its initial 1983 request within the budget ceiling that was provided early in 1982 by the CGIAR Secretariat.

Originally, the gross requirement for 1983 was anticipated at US $12 807 000. However, at the annual meeting of the Board in April 1982, the 1983 budget was approved at US $11 224 000. To help TAC bring total requests from all centres more closely in line with anticipated funding, the Board also identified items at a total cost of US $1 464 000 which could be omitted if funding for the complete program were not available. These items are as follows:

delayed office construction	US $500 000
reduced laboratory equipment	$100 000
delayed staff recruitment	$200 000
delayed construction of Director General's house	$200 000
delayed equipment replacement	$64 000
delayed staff recruitment	$400 000.

After its June 1982 meeting, TAC asked ILRAD to develop a budget with a gross requirement of US $9 502 000, to meet anticipated funding limitations for the CGIAR system as a whole. This is US $1 722 000 less than approved by the Board, so a reduction of US $258 000 had to be found in addtion to the items already identified which could be omitted. To do this, ILRAD had to reduce its capital budget and contingency fund further and omit funding for an international conference. Also, a total of 5 senior scientist positions will be left vacant in 1983.

By mid-1982, ILRAD had developed a budget for 1983 based on the level of funding which could reasonably be expected. This budget supports a research and training program for 1983 which is a logical extension of activities carried out in 1982. If a different level of funding becomes available in early 1983, appropriate changes will be made at that time.

10. SPECIAL PROJECTS

WILDLIFE DISEASE RESEARCH TO CONTROL DISEASES OF ECONOMIC IMPORTANCE

A 3-year wildlife disease research project was initiated in 1981. Funding is from the Netherlands Government and research is conducted at the Kenya Veterinary Research Laboratory at Kabete. Funds for the project are administered through ILRAD.

Table 5. WILDLIFE DISEASE RESEARCH PROJECT BUDGET (US $)

	Actual 1981	Proposed 1982	1983
Salaries	59 800	83 000	83 000
Supplies	12 700	28 000	28 000
Travel	3 300	3 500	5 500
Capital	31 300	4 000	4 000
Training	3 700	10 000	10 000
Contingency	12 200	12 050	12 050
Total	123 000	140 550	142 550

STUDIES ON THE INFECTION RATES AND TRANSMISSION CHARACTERISTICS OF PATHOGENIC TRYPANOSOMES IN LABORATORY-REARED TSETSE

A research project, 'Studies on the Infection Rates and Transmission Characteristics of Pathogenic Trypanosomes in Laboratory-Reared Tsetse as Part of the SIT Programme', was initiated in December 1979 and is scheduled to continue through October 1982. As partial support for this project, IAEA provides US $5500 a year as a research contract. This project is part of a larger IAEA program aimed at tsetse eradication in Nigeria.

APPENDIX: TABLES

Table A1. SUMMARY OF CAPITAL BUDGET (US $'000)

	1981	1982		1983		1984	1985
	Actual	Recommended	Current	Proposed	Current Est.	Projected	Projected
CATEGORY I: CONSTRUCTION							
Cattle Holding Unit	180.5						
Addition to Small Animal Unit	71.9	120.0					
Farm Purchase	1 521.0						
Staff Housing		300.0	700.0	200.0		200.0	
Addition to Tick Unit		100.0	80.0				
Development of Kapiti Plains Ranch			100.0		50.0		
Additional Administrative Offices				500.0			
Sheep and Goat Holding Unit						50.0	
Small Projects & Site Improvement	99.8	100.0	170.0	150.0	95.0	100.0	100.0
TOTAL CATEGORY I	1 873.2	620.0	1 050.0	850.0	145.0	350.0	100.0
CATEGORY II: EQUIPMENT							
Laboratory	286.3	240.0	204.0	240.0	100.0	200.0	220.0
Farm	19.8	100.0	50.0	150.0	50.0	50.0	50.0
Office	79.0	20.0	15.0	20.0	20.0	10.0	10.0
Vehicles	41.7	30.0	16.0	30.0	30.0	30.0	30.0
Food & Housing	30.0	10.0	5.0	5.0	5.0	5.0	5.0
Engineering	10.0	5.0	10.0	5.0	55.0	5.0	10.0
TOTAL CATEGORY II	466.8	405.0	300.0	450.0	260.0	300.0	325.0
ADDITIONAL WORKING CAPITAL		143.0		98.0	45.0	146.0	100.0
TOTAL CAPITAL	2 340.0	1 168.0	1 350.0	1 398.0	450.0	796.0	525.0

Table A2. DETAILS OF CAPITAL BUDGET: CATEGORY I - CONSTRUCTION (US $'000)

	1981	1982		1983		1984	1985
	Actual	Recommended	Current	Proposed	Current Est.	Projected	Projected
SMALL PROJECTS AND SITE IMPROVEMENT							
House Remodeling and Landscaping	24.6						
Recreation Area	23.0						
Eating Area	1.4						
Vehicle Park & Workshops			80.0				
Hay Barn		15.0	20.0				
Fire Control		30.0	15.0		15.0		
Farm Roads		5.0	15.0	5.0	10.0		
Laundry Facility		45.0					
Radioisotope Laboratory Improvements			20.0		10.0		
Site Improvements					15.0		
Grounds Staff Facility					10.0		
Cold Room - Laboratory 4			15.0				
Small Modifications & Unidentified	48.5		5.0	135.0	30.0	100.0	100.0
Contingency	2.3	5.0		10.0	5.0		
TOTAL	99.8	100.0	170.0	150.0	95.0	100.0	100.0

Table A3. DETAILS OF CAPITAL BUDGET: CATEGORY II - EQUIPMENT (US $'000)

	1981	1982		1983		1984	1985
	Actual	Recommended	Current	Proposed	Current Est.	Projected	Projected
LABORATORY EQUIPMENT							
Freezers	24.8	6.0					
Spectrophotometer	17.0						
Rotor - Beckman	18.0						
Fluorescent Spectrophotometer	32.5						
Fraction Collector	3.6						
Spectrophotometer	17.2						
Liquid Chromatograph	37.0						
Gamma Counter	41.6						
Vacuum Evaporator	14.2						
Stereo Zoom Microscope	5.6						
Electrophoresis Chamber	4.2						
Minifuge		9.5					
Spectrophotometer (Model 5270)		45.0	35.0				
Rotor - Beckman SW 41 Ti		13.5	13.5				
Rotor - Beckman SW 50.1		10.5	10.5				
Spectrophotometer UV/VIS		22.5					
Time Lapse Camera, Phase		16.0					
Automatic Bioassay Controller		9.0					

Table A3, cont.

	1981	1982		1983		1984	1985
	Actual	Recommended	Current	Proposed	Current Est.	Projected	Projected
LABORATORY EQUIPMENT (CONT.)							
Incubator, CO 2		15.0	6.0				
Liquid Nitrogen Tanks		12.0	9.0	18.0	5.0		
Laminar Flow Bench		3.5					
Freeze Driers (2)			22.0				
Centrifuge RT 6000			6.0		16.0		
Combi Cold Rac, LKB			6.0				
Centrifuge, RC - 3B, Sorvall			18.0				
Cytocentrifuge			4.0				
Fluorescence Monitor			6.5				
Densitometer			5.5				
Osmometer			5.0				
Media Preparation Pump			5.0				
Microcomputer			15.0				
Laminar Flow Hood				5.0	10.0		
Fluorimeter Farr				55.0	40.0		
Multiscan, Flow				16.0			
Multiwasher, Flow				8.0			
Liquid Nitrogen Plant						100.0	
Autoclave							100.0
Other	70.6	77.5	37.0	138.0	29.0	100.0	120.0
TOTAL LABORATORY EQUIPMENT	286.3	240.0	204.0	240.0	100.0	200.0	220.0

Table A3, cont.

	1981	1982		1983		1984	1985
	Actual	Recommended	Current	Proposed	Current Est.	Projected	Projected
VEHICLES							
Toyota Diesel Land Cruisers	23.6						
Minibus	9.5						
Work and Staff Vehicles	8.6	30.0	16.0	30.0	30.0		
TOTAL VEHICLES	41.7	30.0	16.0	30.0	30.0	30.0	30.0
FOOD AND HOUSING							
Catering and Laundry Equipment	30.0	10.0	5.0	5.0	5.0	5.0	5.0
ENGINEERING							
Maintenance Equipment	10.0	5.0	10.0	5.0	5.0	5.0	10.0
Incinerator (Radioactive Waste)					50.0		
TOTAL ENGINEERING	10.0	5.0	10.0	5.0	55.0	5.0	10.0

Table A3, cont.

	1981	1982		1983		1984	1985
	Actual	Recommended	Current	Proposed	Current Est.	Projected	Projected
FARM EQUIPMENT							
Tractor	6.1						
Planting and Harvesting Equipment	3.7						
Small Equipment	10.0	100.0	40.0	150.0	40.0		
Development of Kapiti Plains Ranch			10.0		10.0		
TOTAL FARM EQUIPMENT	19.8	100.0	50.0	150.0	50.0	50.0	50.0
OFFICE EQUIPMENT							
Memory Typewriters	33.0						
Office Furniture		2.0	2.0	2.0	1.0		
Mini Computer		15.0					
Word Processing Equipment	45.0		10.0		5.0		
Smaller Items	1.0	3.0	3.0				
Unidentified				18.0	14.0		
TOTAL OFFICE EQUIPMENT	79.0	20.0	15.0	20.0	20.0	10.0	10.0
TOTAL ALL EQUIPMENT	466.8	405.0	300.0	450.0	260.0	300.0	325.0

Table A4. SUMMARY OF COSTS BY PROGRAM AND ACTIVITY, 1980-85 (US $'000)

	1980 Actual		1981 Actual		1982 Recommended		1982 Current Est.		1983 Proposed		1983 Current Est.		1984 Projected		1985 Projected	
	M-Y	Cost	M-Y	Cost	M-Y	Cost	M-Y	Cost	M-Y	Cost	M-Y	Cost	M-Y	Cost	M-Y	Cost
1. RESEARCH																
Parasitology-Tryps	3.4	447	5.0	469	3.0	698	5.7	524	4.0	725	6.0	543	6.5	587	7.0	596
Biochemistry	3.6	419	4.7	554	5.0	555	5.5	502	5.0	565	7.0	545	6.8	581	7.0	598
Cell Biology	3.2	414	2.7	344	4.2	531	3.6	393	5.0	547	4.0	380	5.3	406	5.0	428
Immunobiology	5.0	378	4.9	455	4.8	541	4.1	458	5.0	546	4.0	330	5.5	420	6.0	436
Parasitology-ECF	5.0	381	4.8	493	7.3	696	6.2	516	8.0	746	7.0	552	7.8	645	7.0	668
Pathology	3.0	433	4.2	483	5.0	570	4.9	485	5.0	572	5.0	500	4.6	536	5.0	550
Tsetse Lab	1.3	250	1.3	312	1.0	327	0.7	322	1.0	336	1.0	320	1.0	343	1.0	357
Tick Lab	1.0	49	1.0	76	1.0	131	1.0	101	1.0	140	1.0	115	1.0	156	1.0	161
Electron Microscopy	1.0	83	1.0	117	2.0	181	1.3	163	2.0	143	1.0	145	1.0	152	1.0	158
Coop. Research		78		64		297		133		297		130		162		169
TOTAL	26.5	932	29.6	3367	33.3	4527	33.0	3597	36.0	4617	36.0	3560	39.6	3988	40.0	4121
RESEARCH SUPPORT																
Kabete Farm	1.0	433	0.6	458	1.0	488	1.0	537	1.0	500	1.0	515	1.0	597	1.0	622
Kapiti Ranch						190		-		195						
Small Animal Unit		117		128		100		137		101		110		122		126
Veterinary Services	1.0	156	0.9	84	1.8	167	0.4	86	1.0	170	1.0	86	1.0	94	1.0	96
Central Core Lab		177		303		185		282		190		254		268		273
TOTAL	2.0	883	1.5	973	2.8	1130	1.4	1042	2.0	1156	2.0	965	2.0	1081	2.0	1117
TOTAL RESEARCH	28.5	3815	31.1	4340	36.1	5657	34.4	4639	38.0	5773	38.0	4525	41.6	5069	42.0	5238
2. TRAINING & CONFERENCES	1.0	88	1.0	301	2.0	388	1.0	689	2.0	345	1.0	830	1.0	994	1.0	1050
3. LIBRARY & INFORMATION		162		166		210	1.0	352		211	1.0	355	1.0	371	1.0	379
4. GENERAL ADMINISTRATION																
Board of Directors				81		63		85		63		87		87		87
Office of D.G.	2.0		1.8	416	3.0	320	2.3	338	3.0	322	3.0	390	3.0	437	3.0	455
Finance	1.0		1.0	509	1.0	423	1.0	422	1.0	427	1.0	430	1.0	466	1.0	475
Purchasing				223		308		246		309		240		248		250
Personnel				54		76		108		78		112		114		116
TOTAL	3.0	2300	2.8	1283	4.0	1190	3.3	1199	4.0	1199	4.0	1259	4.0	1352	4.0	1383
5. GENERAL OPERATIONS																
Engineering	1.0	441	1.0	536	1.0	507	1.0	519	1.0	513	1.0	550	1.0	600	1.0	618
Transport				206		179		189		211		190		217		220
Services				313		449		306		458		265		280		280
Food & Housing	1.0	420	1.0	233	1.0	468	1.0	241	1.0	475	1.0	235	1.0	238	1.0	255
Stores				67		71		55		72		58		59		60
TOTAL	2.0	861	2.0	1355	2.0	1674	2.0	1310	2.0	1729	2.0	1298	2.0	1394	2.0	1533
6. ALL OTHERS																
Contingency						180		150		185		125		185		190
Price Change						930				1967		660		1447		2320
TOTAL						1110		150		2152		785		1632		2510
TOTAL CORE	34.5	7226	36.9a	7445	44.1	10229	41.7b	8339	46.0	11409	46.0c	9052	49.6	10812	50.0	11993
SPECIAL PROJECTS				123		130		141		133		143				

aIncludes 3.7 M-Y from other funds. bIncludes 3.4 M-Y from other funds. cIncludes 3.5 M-Y from other funds.

Table A5. SUMMARY OF COSTS BY OBJECT OF EXPENDITURE, 1980-83 (US $'000)

	1980	1981	1982		1983		1984	1985
	Actual	Actual	Recom-mended	Current Est.	Proposed	Current Est.	Projected	Projected
Personal Services	3673	4129	5294	4887	5440	5150	5824	6105
Supplies	1911	2106	2048	1887	2026	1880	2012	2014
Services	1281	749	1086	776	1108	640	664	674
Equipment Replacement	-	151	245	245	280	160	220	225
Travel	361	310	446	394	403	437	460	465
Other/Contingency	-	-	1110	150	2152	785	1632	2510
TOTAL	7226	7445	10229	8339	11409	9052	10812	11993

Table A6. SUMMARY OF SOURCES AND APPLICATIONS OF FUNDS: SOURCES (US '$000)

	1980	1981	1982		1983		1984	1985
	Actual	Actual	Recommended	Revised	Proposed	Current Est.	Projected	Projected
CORE OPERATING FUNDS								
1. UNRESTRICTED								
IDA	2500	1910		280				
West Germany	892	770		663				
United Kingdom (ODA)	760	540		532				
Canada (CIDA)	505	505		533				
Switzerland	410	412		357				
Norway	380	380		311				
Belgium	481	258		165				
Rockefeller Foundation	300	100						
Netherlands	250	230		250				
Australia	210	265		262				
Sweden	165	185		185				
Ireland	100	100						
Unidentified			10039		12607	9302	11404	12318
UNEXPENDED BALANCES								
From Previous Year	985	2131	1158	2648				
Earned Income Applied in Year	339	184	200	190	200	200	200	200
TOTAL UNRESTRICTED	8077	7970	11397	6376	12807	9502	11604	12518
2. RESTRICTED								
USAID	2850	3100		2400				
UNDP	716	694		842				
BELGIUM		77						
TOTAL RESTRICTED	3566	3871		3242				
TOTAL UNRESTRICTED/RESTRICTED	11643	11841	11397	9618	12807	9502	11604	12518
Transfer to Capital Funds	(2286)	(1749)	(1168)	(1305)	(1398)	(450)	(792)	(525)
TOTAL OPERATING FUNDS	9357	10092	10229	8313	11409	9052	10812	11993
CAPITAL								
Transferred from Core	2286	1749	1168	1305	1398	450	792	525
Unexpended Balance from Previous Year		637		45				
Balance of Working Funds from Previous Year	454	709	709	709	852	709	754	900
TOTAL CAPITAL FUNDS	2740	3095	1877	2059	2250	1159	1546	1425
SPECIAL PROJECTS								
Netherlands		52	130	212	133	143		
TOTAL FUNDS	12097	13239	12236	10584	13792	10354	12358	13418

Table A7. SUMMARY OF SOURCES AND APPLICATIONS OF FUNDS: APPLICATIONS (US $'000)

	1980	1981	1982		1983		1984	1985
	Actual	Actual	Recommended	Revised	Proposed	Current Est.	Projected	Projected
APPLICATION OF FUNDS								
Core Operations	7226	7445	10229	8339	11409	9052	10812	11993
Capital	1394	2340	1025	1350	1300	450	792	525
Special Projects		123	130	212	133	143	-	-
Unexpended Balances								
Unrestricted Core	2131	2648	-	-	-	-	-	-
Capital	637	45						
Working Funds	709	709	852	709	950	709	754	900
Special Projects		(71)						
TOTAL APPLICATIONS	12097	13239	12236	10610	13792	10354	12358	13418
MEMO								
Total Core Operating Funds Required	7226	7445	10229	8339	11409	9052	10812	11993
Less Unexpended Balance from Previous Year	(985)	(2131)	(1158)	(2648)				
Less Earned Income Applied	(339)	(184)	(200)	(190)	(200)	(200)	(200)	(200)
NET CORE OPERATING FUNDS REQUIRED	5902	5130	8871	5501	11209	8852	10612	11793
Total Capital Funds Required	2103	3049	1877	2059	2250	1159	1546	1425
Less Unexpended Balance From Previous Year		(637)		(45)				
Less Previous Working Funds	(454)	(709)	(709)	(709)	(852)	(709)	(754)	(900)
NET CAPITAL FUNDS REQUIRED	1649	1703	1168	1305	1398	450	792	525
TOTAL FUNDS REQUIRED FROM CGIAR	7551	6833	10039	6806	12607	9302	11404	12318

Table A8. SUMMARY FINANCIAL DATA, 1980-83 (US $'000)

	1980	1981	1982		1983
	Actual	Actual	Recommended	Revised	Current Est.
CURRENT ASSETS					
Cash	3520	3505	102	709	765
Receivables	286	272	200	250	300
Other Receivables	120	208	50	190	190
Inventories	849	406	600	300	350
Prepaid Expenses	457	110	600	110	110
Other Current Assets		191			
TOTAL CURRENT ASSETS	5232	4692	1552	1559	1715
FIXED ASSETS					
Operating Equipment	282	352	292	452	602
Research Equipment	3801	4150	4297	4390	4640
Vehicles	298	330	370	360	390
Furnishings and Office Equipment	472	507	537	527	547
Buildings and Land	8413	8765	11033	11456	12256
Investment in Ranch		1521			
Other Fixed Assets	593	292	383	307	317
TOTAL FIXED ASSETS	13859	15917	16912	17492	18752
TOTAL ASSETS	19091	20609	18464	19051	20467
LIABILITIES					
Accounts Payable	1556	305	400	600	650
Payable to Donors					
Other Liabilities	575	601	300	250	300
TOTAL LIABILITIES	2131	906	700	850	950
GRANTS RECEIVED IN ADVANCE		384			
CAPITAL GRANTS					
Fully Expended	13859	15917	16912	17492	18752
Unexpended	709	709	852	709	765
TOTAL CAPITAL GRANTS	14568	16626	17764	18201	19517
UNEXPENDED CORE OPERATING GRANTS	2392	2693			
TOTAL LIABILITIES & GRANTS	19091	20609	18464	19051	20467

Table A9. POSITIONS AND MANYEARS, 1982-83

	SCIENTIFIC AND SENIOR ADMINISTRATIVE STAFF								SUPERVISORY STAFF								SUPPORT STAFF							
	Positions				Manyears				Positions				Manyears				Positions				Manyears			
	Actual		Budget		Actual		Budget		Actual		Budget		Actual		Budget		Actual		Budget		Actual		Budget	
	1980	1981	1982	1983	1980	1981	1982	1983	1980	1981	1982	1983	1980	1981	1982	1983	1980	1981	1982	1983	1980	1981	1982	1983
Research	42	41	41	41	26.5	29.6	33.0	36.0	16	19	20	20	15.0	16.8	18.6	20.0	64	66	68	68	62.8	63.0	68.0	68.0
Research Support	3	3	2	2	2.0	1.5	1.4	2.0	3	3	4	4	2.0	2.5	4.0	4.0	97	97	97	97	96.0	94.0	90.0	95.0
Training & Conferences	1	1	1	1	1.0	1.0	1.0	1.0	1	1	1	1	1.0	1.0	1.0	1.0	1	1	1	1	1.0	1.0	1.0	1.0
Library & Information			1	1			1.0	1.0	1	1	1	1	1.0	1.0	2.0	1.0	5	5	5	5	5.0	5.0	5.0	5.0
Administration	3	4	4	4	3.0	2.8	3.3	4.0	9	9	10	10	8.0	8.6	9.5	10.0	15	15	16	16	15.0	13.0	16.0	16.0
General Operations	2	2	2	2	2.0	2.0	2.0	2.0	3	4	3	3	3.0	3.0	3.0	3.0	106	115	115	115	104.5	105.0	115.0	115.0
TOTAL	51	51	51	51	34.5	36.9	41.7	46.0	33	37	39	39	30.0	32.9	38.1	39.0	288	299	302	302	284.3	281.0	295.0	300.0
OF THESE: NON-ILRAD FUNDED					7.1	3.7	3.4	3.5																

SUMMARY

Year	Positions	Manyears	% Positions Filled
1980	372.0	348.8	94
1981	387.0	350.8	91
1982	392.0	372.1	95
1983	392.0	385.0	98