ILRAD

INTERNATIONAL LABORATORY FOR RESEARCH ON ANIMAL DISEASES

PROGRAM AND BUDGET

1987

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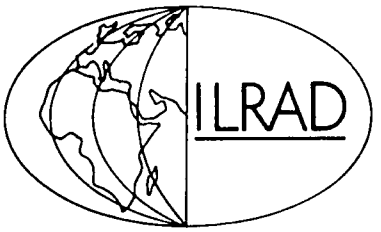

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1987 PROGRAM AND BUDGET

This Program and Budget for 1987 was prepared by ILRAD staff and management and was approved by the Board of Directors at their annual meeting in Nairobi on 14 March 1986.

This proposal constitutes a formal request to the Consultative Group on International Agricultural Research for donor support for 1987.

W R Pritchard
Chairman
Board of Directors

1987 PROGRAM AND BUDGET

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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 parasitic disease complexes of major economic importance in many developing countries were chosen by the Consultative Group on International Agricultural Research (CGIAR) as the original focus of ILRAD's research program. These are theileriosis, particularly East Coast fever and trypanosomiasis.

East Coast fever (ECF) is a cattle disease which causes substantial losses in Eastern 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*. Mortality due to ECF is estimated at 500,000 animals per year. Other pathogenic *Theileria* species are a serious constraint on livestock production in extensive areas of North Africa, Asia and the Middle East.

ECF is controlled primarily by dipping or spraying cattle with acaricides to kill the tick vectors. Proper pasture management helps keep tick populations low, and fencing and movement controls keep susceptible animals away from other cattle or wild buffalo which may carry the disease. However, in areas of heavy tick infestation, cattle must be dipped or sprayed as often as twice a week to prevent infection. A drug to cure ECF was introduced on the market in 1983. Yet neither frequent dipping in 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 ECF is complex, especially when buffalo are present as disease carriers, and parasite strains need to be isolated and characterized and cross-immunity patterns determined. The major objective of ILRAD's theileriosis program is to develop better alternatives to experimental immunization procedures which only protect against one or a small number of strains and which require the use of fully virulent parasites.

Different forms of trypanosomiasis occur over large areas of Africa, Latin America, the Middle East and Asia, affecting most types of domestic livestock, several wildlife species and man. In Africa, the major pathogenic species of trypanosome for domestic ruminants are *Trypanosoma congolense*, *T. vivax* and *T. brucei brucei*. These are transmitted by several species of tsetse fly (*Glossina* spp.) or occasionally by other biting flies. Trypanosomiasis occurs over about 10 million square kilometers 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 limited by the absence of draught animals. Trypanosomiasis

in livestock may also play a role in the epidemiology of the human disease.

Measures now 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 tsetse infestation, high rainfall or dense vegetation. Further drawbacks include increasing drug resistance and the possibility of environmental pollution due to large-scale insecticide spraying. ILRAD's goal is to develop and introduce alternative control methods which are cheaper, more effective and without negative side effects.

Research to date has established that immunological control of trypanosomiasis will be difficult. The epidemiology of the disease is complex, with animals often exposed to more than one species of trypanosome and to a large number of strains within each species. In addition, the parasites possess a unique ability to change the antigenic composition of their surface coat, so that trypanosomes of one strain may display a large repertoire of different surface antigen types. An infected animal cannot produce antibodies rapidly enough to match them all. This phenomenon - called antigenic variation - is the main reason why domestic livestock do not recover from trypanosomiasis or develop a natural immunity. It is also the main reason why it has not yet been possible to produce a trypanosomiasis vaccine. Research at ILRAD is concerned with several possible avenues of trypanosomiasis control, including studies of the parasites themselves, studies of the responses of different hosts and how useful host responses might be enhanced, and studies of trypanosomiasis epidemiology at several sites in Africa.

In addition to research on ECF and trypanosomiasis, ILRAD conducts an active training program. Training at ILRAD is designed to support the development of scientific and field personnel who can extend research on trypanosomiasis, theileriosis and other pressing veterinary problems - primarily in Africa but also in other parts of the world. Scientists and technicians are trained to carry out the most effective disease control programs possible with the means currently available. At the same time, they are prepared to initiate new field programs when improved control methods are ready for introduction.

2. CURRENT STAGE OF DEVELOPMENT

ILRAD's research program is organized in six project areas, each with a specific disease-control objective. Research results are disseminated through the training and outreach program to national and regional institutes concerned with control of animal diseases in anglophone and francophone Africa and throughout the world.

The research laboratories and supporting facilities at Kabete are equipped to support a full complement of scientists. Minor alterations and some new equipment are required as laboratory functions and needs change. An additional laboratory block will be constructed in 1986 and consideration must be given to the construction of an additional office block to accommodate the increased needs of ILRAD's training and outreach program.

In addition to facilities for its own staff, ILRAD provides offices for the regional staff of four other CGIAR centres. As this was not considered in the original building plans, additional offices had to be provided by the conversion of existing storage buildings and the lease of one of ILRAD's staff houses. The present arrangement is still inadequate. However, once ILRAD is able to add to its central facilities, more space may become available to assign to regional staff of other centres.

A 13,000-hectare cattle breeding ranch was purchased late in 1981, located on the Kapiti plains about 80 kilometres from Nairobi. The ranch was purchased to assure the supply of cattle for experimental work at ILRAD, and it has been providing calves and steers for ILRAD's research program since February 1982. Certain facilities on the ranch have had to be renovated or remodeled to meet the new production requirements. Most of the urgent work has been completed, but more staff housing and fencing are needed.

In 1983, ILRAD prepared a plan of research activities and priorities for the next decade. This provides the rationale for the research plans outlined in the program and budget documents, and will serve as a yardstick for measuring progress towards ILRAD's research goals. The plan will be revised now to accommodate the recommendations of ILRAD's second External Program and Management Reviews (EPR and EMR) which took place early in 1986.

3. SUMMARY OF ACTIVITIES IN 1985

THEILERIOSIS

1. Epidemiology and control

At present cattle can be immunized in the field by infection with *Theileria* sporozoites, the form of the parasite transmitted to cattle by infected ticks, and simultaneous treatment with a long-lasting oxytetracycline antibiotic. This approach currently offers the most immediate possibility of improved disease control while research continues in order to develop safe and effective vaccines using non-infective parasite components.

The immunity induced by the infection and treatment method of immunization is parasite strain-specific. Thus, effective immunization requires the identification of the parasite strains present in a specific field situation and of their relationship to potential immunizing strains to be used as a vaccine. Work has continued at ILRAD, using both monoclonal antibody and recombinant DNA technology, to devise methods of parasite characterization *in vitro* which correlate with protection *in vivo*.

Standardized protocols for this vaccination procedure are being developed in conjunction with international, regional and national organizations involved in control of ECF. A network of collaborating institutions in Eastern and Central Africa is being established to implement and evaluate this immunization technique.

Studies are in progress to define the reasons for the antigenic diversity of parasite strains isolated in different localities. This work will be facilitated by the development of technologies to clone individual parasites in order to produce genetically homogeneous populations. Such parasite populations are also essential to elucidate mechanisms of strain-specific host immunity to the schizont form of the parasite.

2. Sporozoite immunization

Research at ILRAD has shown that cattle which have recovered from ECF produce antibodies which neutralize the infectivity of *T.p. parva* sporozoites. A similar neutralizing effect can be obtained using highly specific monoclonal antibodies which recognize sporozoite surface antigens. Ingestion of either type of antibody by infected ticks has been shown to interfere with parasite development in the tick, thus reducing the parasites' subsequent level of infectivity to cattle.

Monoclonal antibodies have been used with immunoabsorbent techniques to purify the potentially protective sporozoite antigens. Considerable progress was made in 1985 in defining suitable conditions for the isolation of highly purified sporozoite antigen material. Sufficient material has now been obtained to begin studies on the protein structure of the antigens.

Work has continued in order to identify the parasite genes coding for the potentially protective sporozoite antigens. Over 15 relevant DNA fragments have been cloned *in vitro*. The nature of the proteins encoded by these gene sequences is being determined by direct synthesis of the proteins *in vitro* and by determination of the sequence of bases which make up the DNA fragments.

The ultimate objective is to identify, using information from protein and DNA structures, the gene(s) or part of the gene(s) which encode for the protective sporozoite antigens. Such gene(s) will be used to produce sufficient antigen *in vitro* by recombinant DNA technology to test as potential vaccines in cattle.

3. Schizont immunization

ILRAD scientists are also studying the immune response of cattle to the intracellular schizont form of the *Theileria* parasite. Schizont-infected cells are predominantly thymus-derived (T) cells of the bovine immune system. Immunity against this form of the parasite is mediated by cells rather than by antibodies.

Elucidation of the specific cell-mediated immune mechanisms responsible for the destruction of parasitized cells requires a thorough knowledge of the structure and function of the bovine immune system. To achieve this, reagents have had to be prepared which identify the various components of the bovine system. ILRAD has continued to make progress in this important area. Major achievements in 1985 included the preparation of monoclonal reagents which specifically identify both the major subpopulations of thymus-derived immune cells and the macrophage lineage of phagocytic cells. More reagents are being developed to define the various antigens of the gene complex which relate to 'self' recognition and which are fundamental to the expression of cell-mediated immunity.

Studies continue on the specific mechanisms by which immune cells recognize and kill schizont-infected lymphocytes. The recently developed technology of T-cell cloning *in vitro* has generated T-cell lines with specific immunity. Such cell lines are necessary to identify the parasite antigens relevant to the induction of protective immunity against the schizont stage of the parasite.

The use of recombinant DNA technology and specifically immune T-cell clones, together with the newly developed technologies for parasite cloning and schizont isolation, should make it possible to identify the schizont antigens relevant to acquired immunity. The feasibility of using these antigens to immunize cattle against ECF will have to be established.

TRYPANOSOMIASIS

4. Epidemiology and control

A major component of ILRAD's trypanosomiasis epidemiology program is a collaborative study with the International Livestock Centre for Africa

(ILCA) on the productivity of trypanotolerant cattle under various levels of tsetse/trypanosomiasis challenge at sites in Gabon, Zaire, Ivory Coast, Togo and The Gambia. The study in The Gambia is funded by the European Economic Community (EEC) and carried out in collaboration with the International Trypanotolerance Centre. ILCA and ILRAD also collaborate on studies to determine the possible existence of trypanoresistant cattle breeds in Ethiopia and to evaluate the benefits of routine trypanocidal drug applications for the performance of susceptible breeds of cattle exposed to trypanosomiasis at sites in the Coast Province of Kenya. ILRAD provides expertise, training and staff in the areas of animal health and entomology.

ILRAD is also currently analyzing the results of a detailed epidemiology survey carried out at a site in Kenya's Coast Province. The role of acquired immunity to metacyclic trypanosomes and the influence of drug treatment on the acquisition of immunity are primary topics. Collaborative studies continue with the University of Glasgow to define, under experimental conditions, the relationship between chemoprophylaxis and the development of acquired immunity to tsetse-transmitted *T. congolense* and *T. vivax* infections. These studies use *in vitro*-derived *T. congolense* and *T. vivax* metacyclic forms (the parasite forms transmitted to cattle by infected tsetse) for the analysis of immune responses. This has necessitated the development of new techniques for *in vitro* cultivation of trypanosomes to assay drug levels in the serum of treated cattle, as well as improved biochemical techniques for drug assays.

Work continues, using both immunological and recombinant DNA technologies, to develop improved trypanosomiasis diagnostic techniques for field use. These techniques will eventually allow simple but precise identification of trypanosome species in both mammalian and tsetse hosts and the detection of trypanosome infections with greater sensitivity than currently possible. These techniques will be tested at sites in the ILCA/ILRAD Trypanotolerance Network.

5. Trypanosome antigenicity

In view of the importance of tsetse-transmitted metacyclic trypanosomes for the induction of protective immunity, research has continued in order to develop and standardize *in vitro* culture systems which will provide adequate numbers of this form of the parasite for immunological and biochemical research. A large-scale system for *in vitro* cultivation of the metacyclic forms of two genetically different populations (serodemes) of *T. congolense* provided sufficient materials to immunize goats against tsetse-transmitted infections of the same serodemes. There was no cross-protection between the different serodemes.

Analysis of the phenomenon of antigenic variation in *T. vivax* infections has been greatly facilitated by two recent developments in the *in vitro* cultivation of this species. The first is the ability to obtain parasite populations derived from single organisms (clones) *in vitro*. This avoids expensive and unreliable *in vivo* cloning techniques using small ruminants. The second is the ability to produce much larger numbers of *T. vivax* metacyclic forms *in vitro* than can be obtained from infected tsetse flies.

Attention is now being given to the development of semi-largescale systems for cultivating metacyclic forms of *T. brucei*. *In vitro* culture systems are being used to study various aspects of the chemotherapy of trypanosomiasis, including analysing the trypanocidal activity of new compounds, assessing drug resistance and monitoring drug levels in the blood of treated animals.

Studies have continued on the molecular and biochemical basis of antigenic variation in *T. congolense* and *T. brucei*. New techniques have been used to separate chromosome-sized molecules of trypanosome DNA and to locate genes coding for several variable surface antigens. It appears that gene expression is dependent, not only on the location of the relevant variable antigen gene, but also on the nature of the non-coding gene sequences close to the gene.

Analyses of the structure of variable antigen molecules have shown that a region of the molecule common to all variable antigens of *T. brucei* studied is important to the assembly and turnover of these molecules on the trypanosome surface. The enzymatic pathways involved in these processes are being elucidated. These may provide targets for immunological or chemotherapeutic attack. A collaborative study with the University of Massachusetts, Amherst (USA) is attempting to identify possible non-variable antigens on the surface of *T. brucei* and *T. congolense* bloodstream forms and to assess their vaccine potential.

6. Comparative immunology and resistance

Research is in progress to elucidate the mechanisms of innate and acquired resistance to trypanosomiasis in domestic ruminants, wildlife and laboratory animals. Many species of wildlife, certain breeds of domestic livestock and a few inbred strains of mice have an inherent ability to control trypanosome infection. This resistance may be due to the host's ability to limit the multiplication rate of the parasite or to the capacity to mount strong protective immune responses. Certain host species can do both.

Susceptible hosts control parasite growth poorly and fail to mount good immune responses. The failure to produce an effective immune response is associated with parasite-induced disruption of the immune system and inhibition of antibody secretion by immune cells. An important finding has been that highly susceptible mice can be induced to become resistant to trypanosomiasis by prior treatment with a stimulator of the immune system, the bacterium *Corynebacterium parvum*. The mechanisms of this induced resistance are being investigated.

The N'Dama cattle brought to ILRAD as embryos from The Gambia have been exposed to tsetse-transmitted infections with a virulent strain of *T. congolense*. Control groups are East African Boran *Bos indicus*. The N'Dama were highly resistant to trypanosomiasis. They were able to control the infections and showed only mild disease signs, while the Boran cattle developed severe infections and would have died without curative drug treatment. A comparison is being made of the immune responses of N'Dama and Boran cattle to trypanosome infection.

Nonimmune factors which regulate parasite growth or limit pathogenesis are also being sought.

Parasite enzymes are being characterized which are known to be responsible for damage to host red cells, thus contributing to anaemia, a major pathological feature of trypanosome infections. A collaborative study with the University of Edinburgh (UK) has shown that trypanosome infections significantly impair the reproductive capacity of cows. However, if infections are of relatively short duration (2 - 3 months), reproductive capacity is restored following trypanocidal drug treatment.

TRAINING

International training program

ILRAD's international training program is designed to support the development of scientific and field personnel who can extend research on trypanosomiasis, theileriosis and other pressing veterinary problems in Africa and other developing countries in the world. Scientists and technicians are trained to carry out the most effective disease control programs possible with the means currently available. At the same time, they are prepared to initiate field programs when improved control methods are ready for introduction.

In 1985, 14 scientists and technicians from 9 African countries came to ILRAD for periods lasting from 2 to 16 weeks for a total of 120 weeks. Training programs were planned on an individual basis according to needs.

Three courses were held at ILRAD in 1985. Two were ILCA/ILRAD Trypanotolerance Network courses (one conducted in English and one in French), and one was a 3-month course on the preparation and use of reagents in the diagnosis of haemoprotozoan cattle diseases. These courses were attended by 16 people from 8 African countries and 3 ILCA staff members who joined network projects in 3 African countries.

Research Fellows are students working for higher degrees; in 1985 21 Fellows were in this program. In addition, one staff member from ILRAD's collaborative wildlife research project with the Kenya Government's Veterinary Research Laboratory (supported by The Netherlands) went to the USA to undertake an M.Sc. degree and another completed a Diploma of Veterinary Science in the UK. Three Research Fellows came to ILRAD to learn and apply research techniques on collaborative programs with the Kenya Veterinary Research Laboratory.

Opportunities for training at ILRAD exist at the technical, post-graduate and post-doctoral levels. At the technical and post-graduate levels, emphasis is on recruiting people from developing nations, particularly from Africa. At the post-doctoral level, candidates are selected on an international basis and are regarded as major contributors to the research program as well as recipients of training.

There are a number of good young scientists working in Africa but their research facilities do not allow them to become fully competitive on an international basis. As a result, they are rarely invited

to fill advertized post-doctoral positions. ILRAD has developed a Senior Research Fellows program to provide opportunities for these scientists to come to ILRAD for a short time to gain further research experience. Senior Research Fellows are staff members of universities and research institutes in developing countries, principally in Africa, who are undertaking research similar to ILRAD's. The program is intended for individuals who have completed Ph.D. studies in the last 5 years and would benefit from additional research experience. Successful applicants are offered fellowships for up to 6 months and on completion return to their home institutes. In 1985, ILRAD awarded its first Senior Research Fellowship to a Kenyan from the Biochemistry Department of the University of Nairobi.

A Workshop on Parasite Antigens was held at ILRAD from 13 to 17 May 1985. The objectives were to review the current status of research aimed at characterizing, producing and utilizing parasite antigens for the improved control of diseases; to identify constraints which impede the progress of this research; and to explore new approaches towards the solution of these major disease problems. The meeting was attended by 14 scientists from around the world together with 40 scientists from ILRAD, the International Centre of Insect Physiology and Ecology (ICIPE), the University of Nairobi, the Kenya Veterinary Research Laboratory, the Kenya Trypanosomiasis Research Institute, the Uganda Trypanosomiasis Research Organization, and the Department of Immunology of the University of Yaoundé (Cameroon). A report of the workshop was prepared.

An International Workshop on East Coast Fever Immunization was held at ILRAD from 23 to 25 September. This meeting was a sequel to the joint ILRAD/Food and Agriculture Organization (FAO) Workshop on Immunization against Theileriosis in Africa, held in October 1984. The group of 24 participants discussed the collection and analysis of data on the productivity of cattle immunized against ECF. Research organizations, field projects and national veterinary services in Burundi, Kenya, Malawi, Zambia and Zimbabwe were represented. Participants discussed trials in progress in widely differing field situations, focusing on methods of immunization, strategies for data collection and management, and economic evaluation techniques.

ILRAD conference facilities

ILRAD provides its conference facilities for seminars and workshops held by other organizations. In 1985, these included:

- International Atomic Energy Agency (IAEA) Research Coordination Meeting on Sheep and Goat Production in Africa and the Middle East, 4 - 8 March

- Kenya Veterinary Association Annual General Meeting, 25 April

- International Potato Centre (CIP) Regional Germplasm Training Course, 10 - 17 June

- The Department of Animal Production of the University of Nairobi PANESA Workshop on Animal Nutrition, 11 - 14 November

- ILCA/ILRAD Trypanotolerance Network internal review, 30 November - 3 December.

INFORMATION SERVICES

The primary activity of ILRAD's Information Services continues to be the publication and distribution of the annual report and the quarterly newsletter, *ILRAD Reports*, in English and French. A weekly *Internal Newsletter* is also published in English and Kiswahili for distribution to staff members and the Board of Directors.

Two updated brochures were published in 1985 describing ILRAD's training and research activities. These are intended for wide distribution. In addition, a proceedings volume was published - *Immunization against Theileriosis in Africa* - which includes papers and discussions presented at the joint workshop sponsored by ILRAD and FAO in October 1984. A summary proceedings of the 1985 international workshop on parasite antigens was produced for the workshop participants.

The four issues of *ILRAD Reports* published in 1985 included major articles on the structure and function of the bovine immune system, collaborative studies on trypanotolerant livestock, international research on parasite antigens, and detailed studies at ILRAD on the immune and nonimmune mechanisms of host resistance to trypanosomiasis. Shorter articles described the workshop on ECF immunization held in September 1985 and the establishment and institutional setting of ILRAD within the CGIAR.

Members of ILRAD's scientific staff published 36 articles in international journals in 1985, as well as 10 chapters in scientific books. These scholarly publications, plus numerous papers presented at international conferences, comprise the bulk of ILRAD's information output for specialized scientific audiences.

A major effort was initiated in the second half of 1985 to verify and update the distribution list for ILRAD publications. The goal is not to expand ILRAD's audience, but rather to increase the effectiveness and appropriateness of information distribution.

4. 1985 PERFORMANCE

Table 1. 1984 and 1985 BUDGET SUMMARY (US $'000)

	1984 Actual	1985 Final Revised	1985 Actual
Core operations	8481	9350	8653
Contingency	10	10	0
Capital	482	313	426
EPR			125
Total	8973	9673	9204
Less:			
Earned income	(255)	(150)	(344)
Funds required	8718	9104	8860
Received	9137		8719

For the 1985 financial year, donations were US $418,000 less than in 1984. Most of the decrease was due to the failure of one donor to provide an anticipated contribution. Earned income was up from 1984. Total new funds available were US $9,063,000; as a result US $141,000 of the reserve fund were needed to fulfill the requirements for the year.

Because it was anticipated that the full funding request might not be received, expenditures were carefully controlled. They were US $500,000 less than the final revised budget. The entire cost of the EPR (US $125,000) was charged to the 1985 budget even though some of the review took place in January 1986. The total expenditure in 1985 was US $9,204,000, 2.6% higher than 1984.

Direct research and research support costs accounted for 59% of expenditures for operations. These included not only the costs of operating the research laboratories, but also the costs of raising and maintaining experimental animals and providing other essential support services. Training accounted for 8.6% of operating expenses, a larger proportion than in 1984. General administration and general operation costs were 26% of operating expenditures.

Inflation in Kenya was approximately 11% in 1985. This was offset by a small decrease in the value of the Kenya shilling against the US

dollar. Slightly less than 50% of ILRAD's total revenue was spent in Kenya. The strength of the US dollar against other currencies produced an income loss of US $55,000 compared with donor support pledged at the beginning of the year.

A breakdown of capital expenditures for construction and equipment is given in Table A-1. Capital expenditures were less than in 1984 but higher than budgeted, primarily due to a construction project to enlarge the engineering workshops. Completion of this building will finally bring together all of the engineering and maintenance workshops. This will facilitate control and effectiveness of these activities which are essential to maintain a functional scientific facility. More space will be available for scientific use in the main laboratory block and some space will be free to assign to regional staff of other centres. Other small construction projects included further improvement of farm roads and the installation of pipes for the fire control system.

5. 1986 PROSPECTS

Table 2. 1986 BUDGET SUMMARY (US $'000)

	1985 Actual	1986 Final Revised
Core operations	8653	9590
Contingency	-	100
Capital	426	860
EPR	125	
Total	9204	10550
Less:		
earned income	(344)	(150)
Funds required	8441	10400
Received or pledged	8719	

The 1986 final revised budget follows the program approved by the CGIAR in October 1985. The amount approved originally by the CGIAR's Technical Advisory Committee (TAC) has been increased due to the addition of restricted core funds. Total program costs are now expected to be US $10.55 million in 1986.

ILRAD hopes to continue to attract new donors in 1986 and to receive additional funds from its traditional donors. It should be possible to obtain the funds required for the level of operations anticipated.

The effects of inflation in Kenya, where approximately 50% of ILRAD's funds are spent, were reduced in 1984 and 1985 by the decline in value of the Kenya shilling against the US dollar. However, this trend has not continued in 1986 and the real inflation rate will be higher than in past years. Depreciation of the US dollar in relation to some European currencies will also increase operating costs.

Research and research support costs will increase by 8% in 1986 over 1985 levels and will account for nearly 60% of total operating expenditure. There are no major changes in individual cost centres except for the addition of the socio-economic program (restricted core funding) which will add three positions to the core research program. Overall, no increase of senior manyears is anticipated for 1986.

Expenditures for training and conferences should increase over 1985 levels as more training activities are implemented. General administrative and operating costs will increase by US $87,000. There have been no real increases in administrative and operating costs since 1982.

Capital expenditures will be divided almost equally between new equipment and small construction and site improvement projects. Because of the nature of ILRAD's research activities, new laboratory equipment must be purchased on a regular basis. A particular concern at present is the expansion of ILRAD's data-processing capability. Requirements in this area will probably be met most appropriately by the purchase of microcomputers.

As a result of the various analyses and discussions associated with the EPR and EMR, ILRAD decided to construct an additional laboratory in 1986. There are several indications that additional space will be required to accommodate program development over the next 5 years and it seemed wise to start the effort now.

The EMR panel expressed concern about laboratory safety in laboratories already somewhat overcrowded with equipment and people. They also observed that the Clinical and Diagnostic Laboratory should be moved into the main laboratory area in order to facilitate sharing of equipment.

6. 1987 BUDGET REQUEST

Table 3. 1986 CURRENT BUDGET AND REQUEST FOR 1987 (US $'000)

	1986 Final Revised	1987 Proposed
Core operations	9590	10177
Contingency	100	100
Capital	860	613
Price change		600
Total	10550	11490
Less:		
earned income	(150)	(150)
Net requirement	10400	11340

The 1987 proposed budget exceeds the final revised budget for 1986 by US $600,000 for price increases and US $500,000 for core operations. Capital costs are US $247,000 less than projected for 1986. The net requirement of US $11.3 million is 9% higher than the requirement for 1986.

The proposal for 1987 includes the funds required to maintain the current research and training program, to bring the socio-economic program into operation, to increase research on chemotherapy of trypanosomiasis, and to increase efforts in training.

The EPR panel recommended two new positions to strengthen research on trypanosomiasis epidemiology. TAC recommended that one new position on trypanosomiasis chemotherapy be added in 1987, and this is included in the budget proposal.

An important recommendation of the EPR was that ILRAD undertake research on another animal disease, heartwater. However, an effective research program cannot be undertaken unless laboratory space and equipment are made available. ILRAD will not undertake a new research initiative at the expense of the resources now committed to the two original target diseases. Extra resources would be required to conduct research on heartwater at an adequate level. Neither the ILRAD Board nor TAC supported the recommendation and there are no plans to start a new program on heartwater.

ILRAD also sees the need, as stressed by the EMR and EPR panels, to strengthen its effort in training, outreach and information services. A new position in training and outreach has been approved for 1987. More office and teaching space is also required. Additional staff in these units be will needed as ILRAD extends more of its efforts into the field in different African countries.

Research and research support costs will comprise 60% of proposed expenditure for operations in 1987. With an added position, the parasitology (trypanosomiasis) laboratory will have a significant increase. Training will also increase substantially over 1986, and is expected to be about 9.5% of the operating budget. General administration and operation costs will stay at approximately 25%.

ILRAD continues to provide office space for regional staff of four other centres in the CGIAR - CIP, the International Maize and Wheat Improvement Centre (CIMMYT), the International Board for Plant Genetic Resources (IBPGR) and ILCA. These centres have about 20 international staff and over 50 support staff working at ILRAD. This represents a large portion of the CGIAR's efforts in Eastern and Southern Africa. The expansion of these activities, as well as ILRAD's, has resulted in considerable pressure on office space. The EPR and EMR panels commented on this issue and recommended that some means be found to add appropriate facilities.

Most of the requirements for additional space mentioned by the review panels were recognized earlier by ILRAD. However, for the past 5 years the policy has been to make small changes to maximize the effectiveness of the original facilities. There is clearly a need now for some expansion of these facilities.

7. SPECIAL PROGRAM AND BUDGET CONSIDERATIONS

OFFICE AND LABORATORY SPACE

ILRAD is experiencing an increasing need for additional office space, largely due to the requirements of regional staff from other CGIAR centres. The facilities assigned to CIP, CIMMYT, IBPGR and ILCA no longer meet their needs. Because CGIAR centres are increasing their programs in Africa, requirements for other centres are likely to increase.

ILRAD's own office space needs are also increasing, especially for training and outreach activities. So far, it has been possible to meet all needs by rearranging existing facilities. The EPR and the EMR panels reviewed the space requirements at ILRAD and noted a certain amount of overcrowding in the laboratories. The space allocated to other centres was also considered inadequate. The panels urged the ILRAD Board to seek solutions to these problems.

The Board had reviewed space requirements each year for the past 5 years and in 1986 decided to move ahead to build an additional laboratory block. This will allow reorganization of ILRAD's laboratory work and will resolve many of the space needs of the research program. The next priority will be office space to meet the needs of an expanding training and outreach effort. The guiding policy reaffirmed by the Board at its March 1986 meeting was that any construction should follow the original plans for the site. After its review of ILRAD's 1987 budget proposal, TAC recommended that construction of offices and training facilities be funded by special project sources, rather than being included in the core request.

PROGRAM DEVELOPMENT

The EPR panel recommended certain new positions for research and training and a research program for another animal disease. Although ILRAD agrees that the panel has identified areas that could be strengthened, it does not believe these new activities are more important than its current program. Thus acceptance and implementation of these recommendations will require additional resources. After discussion and review, TAC recommended approval of two new positions for 1987, one to work on trypanosomiasis chemotherapy and another to strengthen ILRAD's training and outreach program, primarily for West Africa.

In 1986, ILRAD initiated a socio-economics program to study the potential impact of new animal vaccines in Africa. This restricted core project will have a full year of operation in 1987, adding about US $500,000 to the total budget.

8. COMMENTS ON THE CORE PROGRAM FOR 1986 AND 1987

Table 4. ALLOCATION OF SCIENTIFIC MANYEARS TO PROJECT AREAS IN 1986 AND 1987

	Manyears		% Program		% Total	
	1986	1987	1986	1987	1986	1987
Theileriosis Program						
1. Epidemiology	3.1	3.1	20	19	8	8
2. Sporozoite immunization	3.6	4.3	23	26	10	10
3. Schizont immunization	8.8	8.9	57	55	23	22
Total	15.5	16.3	100	100	41	40
Trypanosomiasis Program						
4. Epidemiology	6.6	7.6	29	30	17	18
5. Trypanosome antigenicity	9.4	9.6	42	39	25	23
6. Comparative immunology	6.6	7.8	29	31	17	19
Total	22.6	25.0	100	100	59	60
Socio-economic Program	1.0	3.0				

Research at ILRAD is organized in six multidisciplinary project areas, each with a project leader and defined objectives related to improved theileriosis and trypanosomiasis control. Table 4 gives an estimate of the scientific manyears allocated to each area in 1986 and 1987. With the recruitment of 3 additional scientists in 1985 - two in trypanosomiasis and theileriosis immunology and one in trypanosomiasis immunogenetics - all 41 senior scientific positions previously approved were filled and 38.7 manyears were realized. Several positions are turning over in 1986 and 38.1 manyears are expected. Fewer changes are forseen for 1987 and 41.3 manyears are planned (including a new post in chemotherapy - project area 4). The socio-economic program is being started in 1986 and should be at full staffing, with 3 positions, in 1987.

THEILERIOSIS

1. Epidemiology and improved control

The objectives of ILRAD's theileriosis epidemiology project are to increase knowledge of the epidemiology of theileriosis in Africa and to introduce and evaluate immunological and chemoprophylactic control

methods in endemic areas in collaboration with national and international programs. This is a long-term project.

Isolates of *T.p. parva*, *T.p. lawrencei* and *T.p. bovis* from different areas of Kenya and other affected countries in Eastern and Southern Africa are being characterized at ILRAD to determine their potential for use in the infection and treatment method of immunization. A network of collaborating organizations has been established which are implementing or intend to implement this method of immunization. Collaborating laboratories have agreed on common protocols for immunization and for data collection, including assessment of potential economic benefits.

2. Immunization with non-viable sporozoite material

The objective of ILRAD's *Theileria* sporozoite project is to identify, characterize and produce antigens from sporozoite forms of *T.p. parva* and *T.p. lawrencei* which will induce protective immunity. Significant results should be obtained in 3 to 5 years.

Antigenic components of *T.p. parva* have been identified which induce protective antibody responses. One such protein on the surface of the sporozoite has been purified and its amino-acid sequence is being determined. The gene coding for this protein will be identified and recombinant DNA technology will be used to produce sufficient quantities of the antigen to test its ability to induce protective immune responses in cattle. Similar studies will be undertaken with *T.p. lawrencei* antigens when fully characterized populations of this species are obtained from suitable experimental buffalo.

3. Immunization with material from schizont-infected cells

ILRAD's *Theileria* schizont project explores the possibility of inducing protective immunity against *T.p. parva* using antigens associated with the schizont form of the parasite. The feasibility of this approach should be apparent in 5 to 7 years.

ILRAD scientists are delineating the nature of the bovine lymphoid cells which become infected and transformed by the schizont form of *T.p. parva*. Scientists are also investigating the changes induced in these cells which allow them to be recognized and destroyed by other cells of the bovine immune system. Identification of potentially protective schizont antigens will be facilitated by recent developments in schizont purification and virally-mediated insertion of parasite genes into uninfected, cloned bovine lymphoid cell lines.

Research on immunity to the schizont form of the parasite requires definition of the cellular components of the bovine immune system and their interactions. This work includes studies of the role of the antigens of the major histocompatibility complex.

4. Epidemiology and improved control

The objectives of ILRAD's trypanosomiasis epidemiology project are to identify the factors which contribute to tsetse/trypanosomiasis challenge in different climatic regions of Africa, to monitor - and if possible improve - the use of available trypanocidal drugs, and to assess the potential role of trypanotolerant livestock in improving livestock productivity in tsetse-infested areas. This a long-term project.

The interactions between chemotherapy and the acquisition of immunity to trypanosomiasis are being studied both in the field and under experimental conditions at ILRAD. The effects of trypanosome infections on the fertility of cows is also being assessed. Improved tests have been developed for the diagnosis of trypanosomiasis and identification of the source of tsetse blood meals. Collaborative studies will continue with ILCA and national organizations on the nature of trypanotolerance and the productivity of different breeds of livestock under various levels of management and trypanosomiasis risk. ILRAD and ILCA, together with FAO and the British Government's Overseas Development Administration (ODA), are participating in a large-scale special project in The Gambia on the use of trypanotolerant N'Dama cattle to increase livestock productivity. Support for ILRAD's participation is provided by the EEC as special project funds, including funding for two scientific and one technical position.

The EPR panel recommended the addition of two core positions to strengthen research on aspects of chemotherapy and trypanotolerance. At present studies on chemotherapy are carried out by a visiting scientist and a doctoral student. The scientist responsible for supervision of experimental work on trypanotolerant cattle also has the major responsibility for veterinary and entomological training and supervision within of the ILCA/ILRAD Trypanotolerance Network.

5. Trypanosome antigenicity and biochemistry

Trypanosome antigenicity and biochemistry studies at ILRAD are designed to obtain knowledge of the major pathogenic trypanosome species which can be used for the prevention or improved control of African trypanosomiasis. This is a long-term project.

Studies on the role of variable surface antigens in the induction of protective immunity will focus on *T. vivax*. The structure of the variable antigens will be determined, as will their genetic basis and synthetic pathways. The structure, synthetic pathways and genetic basis of *T. congolense* and *T. brucei* variable antigens have largely been determined. Research will now focus on determining the metabolic changes which are important to parasite differentiation and their genetic control. Parasite differentiation appears to have an important role in the induction of host resistance to trypanosomiasis.

The development of improved methods to propagate trypanosomes *in vitro* will continue, with emphasis on methods which will allow the

easy adaptation of field isolates to culture. Culture systems will also be used to determine the sensitivity of trypanosomes to chemotherapeutic and other biologically active substances.

6. Comparative immunology and genetic resistance to trypanosomiasis

Research on comparative immunology and genetic resistance concentrates on identifying the immunological and non-immunological mechanisms which contribute to resistance. This is a long-term project.

Studies on resistance to trypanosomiasis include the elucidation of reduced susceptibility to pathogenic effects, especially anaemia. The aim is to identify new approaches to alleviate or prevent the disease. Comparative studies are carried out in laboratory animals, domestic livestock and indigenous East African wildlife species. Work on resistant wild animals is being conducted in collaboration with the Kenya Government's Veterinary Research Laboratory, supported by The Netherlands. The N'Dama cattle which were imported into Kenya by embryo transfer are being used for research at ILRAD. Additional N'Dama embryos from parents of known resistance status will become available from the EEC-supported project in The Gambia.

SOCIO-ECONOMIC PROGRAM

In order to ensure the successful application of improved control measures for theileriosis and trypanosomiasis, it is necessary to develop means of determining their potential socio-economic impact. This requires identification of factors which govern the options for application of improved control measures, e.g. finance, production and distribution. Methods must be developed to determine the potential of disease control measures to improve livestock productivity under different management conditions. The study will include the socio-economic status of different segments of the population, and the potential of different management systems to alter environments.

Research will include an analysis of past successful vaccine development and implementation programs in Africa in order to identify important parameters and develop predictive models. Concurrently, the impact of theileriosis and trypanosomiasis will be assessed in selected locations or regions, along with the effects of control measures currently used for these diseases. The potential impact of improved control measures will then be estimated. Control measures against theileriosis and trypanosomiasis will be identified which give maximum benefit to direct and indirect users.

TRAINING

An average of 20 scientists and technicians come to ILRAD each year to improve their technical skills and expand their research experience. Most of them are partially or wholly funded by ILRAD. A small proportion are sponsored by other organizations such as FAO or the German (Federal Republic) Gesellschaft für Technische Zusammearbeit (GTZ).

Five courses and one workshop are being held in 1986. These include two 7-week ILCA/ILRAD Trypanosomiasis Network courses, one in

English and one in French; one 4-week course on the diagnosis of haemotropic diseases; one 3-month course in the preparation of antigens; and a 1-week IAEA course on the diagnosis of trypanosomiasis. The workshop will concentrate on genetic recombination in salivarian trypanosomes.

Four courses and one international conference are planned in 1987. Two 7-week ILCA/ILRAD Trypanosomiasis Network courses will be held, plus a 4-week course on the diagnosis of haemoprotozoan diseases with emphasis on trypanosomiasis and a 3-month course on the preparation of antigens.

The conference scheduled for 1987 will be on the biological and economic aspects of livestock production under trypanosomiasis risk and will be organized jointly by ILCA and ILRAD. New information will be presented from the ILCA/ILRAD network on the productivity of livestock under different levels of trypanosomiasis risk and on the impact of various control measures. Data will be available on the multiplication of trypanotolerant cattle, their exportation and the results of their establishment in different locations.

9. SPECIAL PROJECTS

WILDLIFE DISEASE RESEARCH TO CONTROL DISEASES OF ECONOMIC IMPORTANCE

A wildlife disease research project was initiated in 1981, involving one senior scientist. Funding is provided by the Government of The Netherlands and research is conducted at the Kenya Government's Veterinary Research Laboratory at Kabete. Funds for the project are administered through ILRAD. The project is to end in 1986.

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

	Actual 1984	Actual 1985	Proposed 1986
Salaries	87383	88000	86000
Supplies	13769	15000	24000
Travel	6258	3600	6000
Capital	21833	5100	4000
Training	20852	15000	15000
Contingency	29260	17000	30000
Total	179355	143700	165000

N'DAMA PRODUCTION RESEARCH

The EEC approved funding in 1985 for a special research project on trypanotolerant N'Dama cattle, to be conducted jointly by ILRAD and ILCA. This project is the research component of a larger regional project developed by the Government of The Gambia and funded by several donors. The goal is to increase the production and export of N'Dama cattle.

This project allows ILRAD to carry out substantial research on the mechanisms of trypanotolerance. Together with research conducted by ILCA, this work should make it possitle to evaluate the potential productivity of N'Dama cattle in areas of defined tsetse challenge. Under the project ILRAD has two scientists and one senior technician stationed in The Gambia. The project will be carried out over a 3-year period.

Table 6. N'DAMA RESEARCH PROJECT BUDGET (US $'000)

	1985-86[a]	1986-87[a]	1987-88[a]	Total
Salaries	290	360	367	1017
Supplies	91	51	65	207
Travel	10	15	15	40
Training	5	22	22	49
Supervision	26	41	48	115
Equipment	264	52	36	352
Price change	-	24	26	50
Total	686	565	579	1830

[a]Financial year starts on 1 May.

COLLABORATIVE RESEARCH ARRANGEMENTS

Three of ILRAD's donors are providing support in addition to their contributions to core funding through collaborative research agreements. One veterinarian is provided under a Belgian associate expert program, and a visiting scientist in immunology is provided by Belgian technical aid in Kenya. In both instances, the donor provides the cost of personal services and ILRAD provides research facilities and supplies. The Japanese Government supports one scientist in theileriosis parasitology and two in cell culture. In addition to personal services, Japan contributes to the purchase of equipment to support these research activities.

In 1984, the Netherlands Foundation for the Advancement of Tropical Science (WOTRO) initiated a 3-year program to support a Research Fellow at ILRAD. Funding is provided to cover personal services and research supplies. The Research Fellow is registered for a Ph.D. degree at the University of Utrecht.

10. CAPITAL REQUIREMENTS

1986

Primary capital requirements in 1986 are for the purchase of laboratory equipment. The largest amount will be for data processing equipment (Table A-1). It is also necessary to add a second autoclave to the Small Animal Unit to meet increased production requirements. Construction will include one laboratory block as well as small modifications and site improvements (See Section 5 for details). Additional water and electrical supply systems will have to be provided to meet increasing needs.

1987

Plans for 1987 will depend partly upon research progress made in 1986 and decisions concerning programs. The laboratory block started in 1986 will be completed by May 1987. If ILRAD is to increase its activities in training, information dissemination and outreach, more laboratory and office facilities will be needed. Extra core funding will be sought. It is likely that office space will be the priority because of ILRAD's needs and those of the regional programs of other CGIAR centres operating in Nairobi. Capital equipment requirements have been estimated in line with past experience. Data processing and communication equipment will be a priority need.

11. ASSUMPTIONS ON PRICE CHANGES

The Kenya shilling declined in value against the US dollar by approximately 2% in 1985. The consumer price index in Kenya increased by an estimated 11%. These trends are expected to continue in 1986. Since price increases in North America and Europe are expected to be below the level anticipated for Kenya, an overall provision of 6% for price increases has been made for 1987.

APPENDIX: TABLES

Table A-1. SUMMARY OF CAPITAL BUDGET, 1984-1987 (US $'000)

	1984 Actual	1985 Actual	1986 Final Revised	1987 Proposed
CONSTRUCTION				
Laboratory (starting 1986)	-	-	300	200
Development of Kapiti Plains Ranch	58	-	25	20
Small Projects & Site Improvement	158	243	175	100
TOTAL	216	243	500	320
EQUIPMENT				
Laboratory	88	106	140	150
Farm	1	14	10	15
Office	48	27	25	10
Vehicles		9	15	10
Food & Housing	1	5	10	5
Engineering	1	17	10	10
Training Laboratory	36	5	5	5
Autoclave (Small Animal Unit)			100	
TOTAL	175	183	315	205
ADDITIONAL WORKING CAPITAL	91	-	45	88
TOTAL CAPITAL	482	426	860	613

Table A-2. DETAILS OF CAPITAL BUDGET: CONSTRUCTION, 1984-1987 (US $'000)

	1984 Actual	1985 Actual	1986 Final Revised	1987 Proposed
SMALL PROJECTS & SITE IMPROVEMENT				
Fire Control	-	27	5	-
Farm Roads	16	18	-	-
Site Improvements	27	16	25	-
Oxidation Pond Expansion	20	-	-	-
Water Supply System	69	-	50	-
Electrical Supply	-	-	30	-
Liquid Nitrogen Supply Tank	-	3	-	-
Engineering Workshops	-	139	-	-
Small Modifications & Unidentified	26	40	65	100
TOTAL	158	243	175	100

Table A-3. DETAILS OF CAPITAL BUDGET: EQUIPMENT, 1984-1987 (US $'000)

	1984 Actual	1985 Actual	1986 Final Revised	1987 Proposed
LABORATORY EQUIPMENT				
Laminar Flow Hoods	-	3	2	-
Horizontal Hood	-	4	-	-
Fluorescence Activated Cell Sorter Equipment	12	-	3	-
Microcomputers	10	23	50	20
Microscopes	-	6	-	-
Incubator	-	-	6	-
Centrifuge RC-3B (Sorvall)	20	-	-	-
Eppendorf Centrifuge	2	-	-	-
Incubator (low temperature)	7	-	-	-
Paper Tape Punch	3	-	-	-
ELISA Plate Washer	4	-	5	-
Electrophoresis Equipment	-	10	15	-
Freezer (-80°C)	-	-	9	-
Tissue typing equipment	-	-	14	-
Other	30	60	36	130
TOTAL	88	106	140	150
FARM EQUIPMENT - Small Equipment	1	14	10	15
OFFICE EQUIPMENT				
Word Processing Equipment	41	19	17	-
Unidentified	7	8	8	10
TOTAL	48	27	25	10
VEHICLES - Work & Staff Vehicles	-	9	15	10
FOOD & HOUSING	1	5	10	5
ENGINEERING - Maintenance Equipment	1	17	10	10
TRAINING LABORATORY EQUIPMENT				
Microscopes	2	-	-	-
Photographic	9	-	-	-
LKB Fraction Collectors & Accessories	5	-	-	-
Balances	1	-	-	-
Gelman Electrophoresis Equipment	9	-	-	-
Micro ELISA Reader	4	-	-	-
Other	6	5	5	5
TOTAL	36	5	5	5
SMALL ANIMAL UNIT				
Autoclave	-	-	100	-
TOTAL ALL EQUIPMENT	175	183	315	205

Table A-4. SUMMARY OF COSTS BY PROGRAM AND ACTIVITY, 1984-1987 (US $'000)

	1984 M-Y	1984 Actual Cost	1985 M-Y	1985 Actual Cost	1986 M-Y	1986 Final Cost	1987 M-Y	1987 Proposed Cost
RESEARCH								
Parasitology-Trypanosomiasis	5.0	315	5.5	432	5.5	453	6.0	545
Biochemistry	5.8	727	5.7	656	6.6	625	7.3	674
Cell Biology	4.3	541	4.8	466	4.3	508	4.5	520
Immunobiology	5.8	356	6.9	357	6.4	532	8.0	552
Parasitology-ECF	6.5	527	6.1	516	5.7	561	6.0	573
Pathology	7.2	598	6.5	605	6.6	552	6.5	564
Tsetse Laboratory	1.0	279	1.0	297	1.0	304	1.0	305
Tick Laboratory	1.0	106	1.0	124	1.0	146	1.0	151
Electron Microscopy	1.3	150	1.2	148	1.0	156	1.0	147
Socio-economic	-	-	-	-	1.0	250	3.0	500
TOTAL	37.9	3599	38.7	3601	39.1	4087	44.3	4531
RESEARCH SUPPORT								
Research Director	1.3	562	1.2	416	1.2	508	1.2	507
Kabete Farm	1.0	623	1.0	614	1.0	633	1.0	673
Small Animal Unit	-	133	-	148	-	164	-	167
Veterinary Services	1.0	86	1.0	72	1.0	85	1.0	84
Central Core	-	303	-	341	-	367	-	362
TOTAL	3.3	1707	3.2	1591	3.2	1757	3.2	1793
TOTAL RESEARCH	41.2	5306	41.9	5192	42.3	5844	47.5	6324
TRAINING & CONFERENCES	1.0	685	1.0	752	1.0	927	2.0	980
LIBRARY & INFORMATION	1.0	313	1.6	369	1.0	392	1.0	399
ADMINISTRATION								
Board of Directors	-	91	-	83	-	98	-	98
Director General	2.0	348	2.0	394	2.0	353	2.0	379
Finance	1.0	342	1.0	332	1.0	350	1.0	365
Purchasing	-	275	-	302	-	320	-	326
Personnel	-	85	-	74	-	93	-	89
TOTAL	3.0	1141	3.0	1185	3.0	1214	3.0	1257
GENERAL OPERATIONS								
Engineering	1.0	572	1.0	660	1.0	663	1.0	670
Transport	-	252	-	214	-	234	-	229
Services	-	146	-	228	-	230	-	234
Food & Housing	1.0	14	1.0	5	1.0	36	1.0	33
Stores	-	52	-	48	-	50	-	51
TOTAL	2.0	1036	2.0	1155	2.0	1213	2.0	1217
OTHER								
Contingency/EPR		10		125		100		100
Price Change								600
TOTAL		10		125		100		700
TOTAL CORE	48.2	8491	49.5	8778	49.3	9690	55.5	10877
SPECIAL PROJECTS		236		170		508		405

Table A 5. SUMMARY OF COSTS BY OBJECT OF EXPENDITURE, 1984-1987 (US $'000)

	1984 Actual	1985 Actual	1986 Revised	1987 Proposed
Personal Costs	5075	5386	5806	6227
Supplies	2085	2116	2287	2336
Services	605	504	643	759
Equipment Replacement	394	325	330	305
Travel	322	322	524	550
Contingency/EPR	10	125	100	100
Price change	-	-	-	600
TOTAL	8491	8778	9690	10877

Table A-6. SUMMARY OF APPLICATIONS AND SOURCES OF FUNDS: APPLICATIONS (US $'000)

	1984 Actual	1985 Actual	1986 Final Revised	1987 Proposed
APPLICATION OF FUNDS				
Core Operations	8491	8778	9690	10877
Capital	391	426	860	613
Special Projects	236	167	508	405
Unexpended Balances				
Unrestricted Core	419	278	-	-
Working Funds	778	778	810	915
Revolving Fund	100	100	100	100
TOTAL APPLICATIONS	10415	10527	11968	12910
MEMO: Total Core Operating Funds Required	8491	8778	9690	10877
Less Unexpended Balance from Previous Year	-	(419)	(278)	-
Less Earned Incomo Applied	(144)	(344)	(150)	(150)
NET CORE OPERATING FUNDS REQUIRED	8347	8015	9262	10727
Total Capital Funds Required	1269	1304	1738	1523
Less Previous Working Funds	(687)	(778)	(778)	(810)
Less Revolving Fund	(100)	(100)	(100)	(100)
NET CAPITAL FUNDS REQUIRED	482	426	860	613
TOTAL FUNDS REQUIRED FROM CGIAR	8829	8441	10122	11340

Table A-7. SUMMARY OF APPLICATIONS AND SOURCES OF FUNDS: SOURCES (US '$000)

	1984 Actual	1985 Actual	1986 Proposed	1987 Proposed
CORE OPERATING FUNDS				
UNRESTRICTED				
United States (USAID)	2500	2490	2520	
World Bank	1570	1200	1400	
Germany (Federal Republic)	556	510	510	
United Kingdom (ODA)	468	552	680	
Canada (CIDA)	699	664	730	
Switzerland	437	381	474	
Norway	255	226	250	
Belgium	229	135	180	
Netherlands	264	247	280	
Australia	208	235	230	
Sweden	197	222	290	
Italy	112	253	170	
Saudi Arabia	300			
France	59	59	90	
Denmark		44	60	
Unidentified			292	9100
UNEXPENDED BALANCES				
From Previous Year		419	278	
Earned Income Applied in Year	144	344	150	150
TOTAL UNRESTRICTED	7998	7981	8584	9250
RESTRICTED				
Rockefeller Foundation			250	
UNDP	639	690	766	
Belgium	105	110	110	
Japan	150	201	340	
Italy	500	500	500	
TOTAL RESTRICTED	1394	1501	1966	2240
TOTAL UNRESTRICTED/RESTRICTED	9392	9482	10550	11490
Transfer to Capital Funds	(482)	(426)	(860)	(613)
TOTAL OPERATING FUNDS	8910	9056	9690	10877
CAPITAL				
Transferred from Core	482	426	860	613
Balance of Working Funds from Previous Year	687	778	778	823
Balance of Revolving Fund from Previous Year	100	100	100	100
TOTAL CAPITAL FUNDS	1269	1304	1738	1536
SPECIAL PROJECTS	236	350	508	405
TOTAL FUNDS	10415	10710	11936	12818

Table A-8. SUMMARY FINANCIAL DATA, 1984-1987 (US $'000)

	1984 Actual	1985 Actual	1986 Proposed	1987 Proposed
CURRENT ASSETS				
Cash	628	3190	1345	1450
Receivables	1596	828	500	500
Inventories	218	310	250	250
Prepaid Expenses	248	321	250	250
Other Current Assets (Kapiti)	133	152	100	100
TOTAL CURRENT ASSETS	2823	4801	2445	2550
FIXED ASSETS				
Operating Equipment	818	865	884	924
Research Equipment	4875	5040	5300	5500
Vehicles	302	305	320	340
Furnishing/Office Equipment	507	547	545	585
Buildings & Land	9882	10125	10200	10290
Investment in Kapiti Ranch	1786	1786	1836	1836
Other Fixed Assets	244	226	250	250
TOTAL FIXED ASSETS	18414	18894	19335	19725
TOTAL ASSETS	21237	23695	21780	22275
LIABILITIES				
Accounts Payable	828	410	800	800
Other Liabilities	698	1761	707	586
TOTAL LIABILITIES	1526	2171	1507	1386
GRANTS RECEIVED IN ADVANCE	-	1474	-	-
CAPITAL GRANTS				
Fully Expended	18414	18894	19335	19725
Unexpended	778	778	838	1064
Revolving Fund	100	100	100	100
TOTAL CAPITAL GRANTS	19292	19772	20273	20889
UNEXPENDED CORE OPERATING GRANT	419	278	-	-
TOTAL LIABILITIES & GRANTS	21237	23695	21780	22275

Table A-9. POSITIONS AND MANYEARS, 1984-1987

	SCIENTIFIC & SENIOR ADMINISTRATIVE STAFF								SUPERVISORY STAFF								SUPPORT STAFF							
	Positions				Manyears				Positions				Manyears				Positions				Manyears			
	84	85	86	87	84	85	86	87	84	85	86	87	84	85	86	87	84	85	86	87	84	85	86	87
Research	41	41	44	45	37.9	38.7	39.1	44.3	20	19	19	20	19.4	18.5	19.0	19.0	77	78	78	78	72	73	73	73
Research Support	3	3	3	3	3.3	3.2	3.2	3.2	4	5	5	5	3.5	4.5	5.0	5.0	82	82	81	80	80	80	72	75
Training & Conferences	1	1	1	2	1.0	1.0	1.0	2.0	1	1	1	1	0.7	1.0	1.0	1.0	–	–	–	–	–	–	–	–
Library & Information	1	1	1	1	1.0	1.6	1.0	1.0	1	1	1	1	0.7	1.0	1.0	1.0	7	10	10	10	5	6	9	9
Administration	3	3	3	3	3.0	3.0	3.0	3.0	10	10	10	10	10.0	10.0	10.0	10.0	23	22	23	23	23	22	20	22
General Operations	2	2	2	2	2.0	2.0	2.0	2.0	3	3	3	3	3.0	3.0	3.0	3.0	136	139	139	141	129	130	130	132
TOTAL	51	51	54	56	48.2	49.5	49.3	55.5	39	39	39	40	37.3	38.0	39.0	39.0	325	331	331	332	309	311	304	311
OF THESE: NON-ILRAD FUNDED					5.3	4.8	4.1	4.0																

SUMMARY:

Year	Positions	Manyears	% Positions Filled
1984	415	394	95
1985	422	399	95
1986	424	392	93
1987	428	405	95