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KENYA TRYPANOSOMIASIS RESEARCH INSTITUTE

(KETRI)

P.O. BOX 362, KIKUYU, KENYA

STRATEGIC PLAN FOR KETRI

1989 – 2000

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THE KENYA TRYPANOSOMIASIS RESEARCH INSTITUTE (KETRI)

STRATEGIC PLAN 1989 - 2000

FOREWORD

The Kenya Trypanosomiasis Research Institute, KETRI, has been in existence for over ten years to-date. In these ten years, emphasis has been placed on infrastructure and staff development as part of the efforts to get critical mass of researchers to be able to carry out research in fairly well-equipped surroundings. These efforts have now borne fruit.

However, apart from these developments, KETRI has been able to carry out research which has advanced our knowledge of the understanding of the vector, the agents of disease, the host mechanisms during infection and therapy of the disease. Past work at KETRI and results obtained elsewhere suggested that further research on chemotherapy, vector control using traps or targets and on the use of trypanotolerant cattle may contribute significantly to improvement in the control of the disease.

It is with this background in mind that it was decided to carry out a review of the past work in KETRI with a view to paving the way for future activities in the Institute. Being, a national institution, KETRI's activities must help solve short and long-term developmental problems of Kenya.

According to Sessional Paper No. 1 of 1986, Kenya's population will be 35 million by the year 2000 - twice what it was in 1979. The beef requirements for this population are estimated at 540,000 tons (three times the present level). However, using the present technology, and if no other land is opened up, beef production by the year 2000 is estimated at only 420,000 tons, a shortfall of over 120,000 tons. The only way of trying to forestall the occurrence of this shortfall seems to lie in the evolvement of effective technologies for tsetse and trypanosomiasis control so as to reclaim the tsetse infested semi-arid lands for livestock production.

It is thus in the light of these enormous challenges facing the nation that this strategic plan for KETRI is being produced in order to help pave the year 2000.

The document has attempted identify gaps in knowledge in various areas of the disease and its vectors, enumerated the current work going on in KETRI to help solve some of the problems identified and isolate programme areas and priorities, for each programme that will form the basis for future activities. For each programme, an indicative budget that would help translate that programme into reality is presented.

It is hoped that KETRI staff and visiting scientists will then formulate fundable projects from these priorities and that donors will be able to fund activities in KETRI either on the basis of programmes or projects.

Signed ----------

DIRECTOR

1. TRYPANOSOMIASIS

1.1 Introduction:

Trypanosomiases are a group of closely related diseases that affect man and his domestic animals. They are caused by a single celled organism, the trypanosome, and are transmitted from one animal to another by mainly, the tsetse flies. Different forms of the disease occur over large areas of Africa, South America, Asia and the Middle East. Trypanosomiasis is unique among diseases in that it is the only one which, by itself, has denied vast tracts of Africa's land to all domestic animals other than poultry.

Tsetse infest over ten million square kilometers, or about one quarter of the African continent. If this area were cleared of tsetse, it would be able to support an additional 120 million head of cattle which would be able to generate about one billion US dollars per annum. In East Africa alone, 60% of rangeland cannot support cattle because of trypanosomiasis.

1.2 Trypanosomiasis Problem in Kenya

1.2.1 Human Trypanosomiasis

This problem is currently confined to the shores of Lake Victoria in South Nyanza, Siaya and Busia Districts. The South Nyanza focus is localised at Lambwe Valley while the Siaya focus was localised at Sakwa, Yimbo and Alego and the Busia Focus is localised in Samia and South Teso.

Annual sleeping sickness returns show that human trypanosomiasis is not a serious problem in Kenya at the moment but remains a threat. Lambwe Valley will continue to be an endemic area while Samia will remain a potentially dangerous area, as will the whole length of the Kenya-Uganda border, especially bordering Busoga where an epidemic has been on-going for the past decade.

The greatest concern on human trypanosomiasis is the sudden and unpredictable flare-ups of epidemics. A close surveillance must thus

be kept on the disease all the time, especially since the disease continues to be a problem in the neighbouring countries.

1.2.2. Animal Trypanosomiasis

The distribution of the animal disease follows that of tsetse with greatest extent being in the Northern, North-Eastern and Coastal Provinces. The disease is found beyond tsetse-infested areas where biting flies have been implicated in transmission.

It is estimated that approximately 60% of the Kenya's rangelands which is about 25% of the landmass cannot support livestock because of trypanosomiasis and where they can be kept despite the disease, losses of upto 30% are experienced.

The disease due to *T. evansi* in camels has a mortality rate estimated upto 70%. Despite this, the extent of the problem is not fully understood. As camels are important economic animals in arid and semi-arid lands, and are likely to be an important source of foreign exchange the importance of this disease in camels cannot be underrated.

According to the Kenya Government Sessional Paper No. 1 of 1986, Kenya's population will be 35 million by the year 2000, twice what it was in in 1979. Animal protein requirement for that population are estimated at 540,000 tons, three times the present production. With the present production and technology, it is estimated that the country will only be able to produce 420,000 tons by that time. The only way to significantly increase beef production for local consumption and export lies in effective tsetse and trypanosomiasis control. In general, however, the problem caused by tsetse flies and the diseases they transmit in Kenya is poorly understood because of the lack of knowledge of fly dynamics and epidemiology of the diseases transmitted by the same. The present tsetse distribution map in Kenya dates back to 1956 and even then did not include distribution of the diseases themselves. It is important that accurate tsetse and trypanosomiasis distribution awareness be maintained in Kenya so as to isolate tsetse

infested lands into three potentially economic zones. These zones include:

(a) Those lands not capable of development because of lack of other resources _ e.g. water, fodder.

(b) Those lands capable of productive development by small scale animal production techniques.

(c) Those lands capable of productive development by the introduction of new technologies of mixed farm production - e.g. feedlots, irrigation etc.

It is only with this knowledge that rational and logical land use patterns can be evolved in Kenya and elsewhere in tropical Africa.

2. HISTORICAL PERSPECTIVE

2.1 History of Trypanosomiasis Research in East Africa:

One of the major constraints in the construction of the Kenya/Uganda Railway was the difficulty experienced in moving construction materials, as the draught animals intended for the job were wiped out by the tsetse-borne disease. At the turn of the century, around the Uganda shores of Lake Victoria more than 250,000 people died in one of the largest epidemics in Africa. A Royal Society Commission sent out to investigate the undiagnosed deaths mysterious disease found that it was caused by trypanosomes and that tsetse flies were responsible for its transmission. A laboratory set up at Entebbe to study this disease continued to function until 1926.

The loss of horses and mules during the First World War in Tanganyika led to further research. In 1921, Mr. C.F.M. Swynnerton set up a laboratory at Shinyanga from which the foundations of most of the current tsetse control methods were initiated. He, however, concentrated only on tsetse. Consequently, a trypanosomiasis laboratory was set up at Tinde, 50 miles away from Shinyanga. The two laboratories continued operating until the Second World War period.

After the war, three units were set up: one at Shinyanga dealing with

tsetse another with trypanosomiasis at Tinde and the third with Nairobi. Later, the three merged to form the East African Tsetse and Trypanosomiasis Research and Reclamation Organization as an interim arrangement. In 1945, the Colonial Office sent out Professor Buxton of the London School of Hygiene and Tropical Medicine to examine and recommend on the control measures and Research against tsetse fly and trypanosomiasis. He visited all the African countries affected with trypanosomiasis and in his report, 'Trypanosomiasis in Eastern Africa, 1947', he recommended the setting up of a multidisciplinary institute. As a result of another recommendation by him, Dr. H.E. Hornby was sent out to make a more detailed examination and recommendation on the animal trypanosomiasis problem. Hornby's report, 'Animal Trypanosomiasis in Eastern Africa, 1949', reinforced Buxton's recommendations. The two reports have, in many ways, been the basis of trypanosomiasis research planning in the whole of Africa.

As a result of these recommendations, a multidisciplinary institute was set up at Tororo, Uganda, in 1956, using the Colonial Welfare and Development Funds. The stations at Shinyanga, Tinde and Nairobi, were closed and reclamation became a national responsibility. The terms of reference of the East African Trypanosomiasis Research Organization (EATRO), became:

> "to undertake research which would lead to the control and treatment of trypanosomiasis in man and animals and to practical reclamation of tsetse infested land."

1.3 The Kenya Trypanosomiasis Research Institute (KETRI)

The Kenya Trypanosomiasis Research Institute (KETRI) was formed in 1977 following the demise of the East African Community. It is now one of the six semi-autonomous research institutes established under the Science and Technology (Amendment) Act of 1979 to promote research and technology development in Kenya.

KETRI has a mandate to carry out research into all aspects that would

eventually lead to the effective control of human and animal trypanosomiasis, and to effective reclamation of tsetse-infested lands.

KETRI is administered by a duly constituted Board of Management with The Director as the Chief Executive of the Institute. The composition of the Board is such that the most appropriate talent is tapped from both the private and public sector of the economy. This ensures that the research activities are focused to answer and try to alleviate those limitations caused by trypanosomiasis in the socio-economic development of Kenya.

The Institute has its headquarters in Muguga (about 40 km West of Nairobi) where the majority of its activities take place. Human trypanosomiasis work is based at Alupe in Busia where there is a clinic and laboratory facilities. There are also field facilities at Galana Ranch in Kilifi District, Marsabit, Nguruman and Lambwe. A new field station is in the process of being opened in Witu, Lamu. Other field stations will be opened as and when research activities expand.

At the Institute headquarters, the administrative center as well, the Veterinary, Primate, Entomology, Protozoology and Biochemistry sections all operate from modern physical facilities that have been put up under the financial auspices of the Kenya Government. The Institute is now steadily equipping the modern laboratories that are at its disposal in Muguga plus all the support services to enable KETRI become a fully developed research institution with international reputation in the field of human and animal trypanosomiasis.

Apart from KETRI there are other Kenya Government Institutions involved in Tsetse and Trypanosomiasis control. These include the Tsetse Survey and control division of the Department of Veterinary Services in the Ministry of Livestock Development, the Department of Veterinary Services that carries out routine treatment of animal trypanosomiasis and the Division of Vector-Borne Diseases in the Ministry of Health that carries out surveillance and case finding of human

trypanosomiasis. Research in KETRI is thus designed to support and improve the activities of these national institutions.

In carrying out its work, KETRI collaborates closely with the International Laboratory for Research into Animal Diseases (ILRAD); the International Centre for Insect Physiology and Ecology (ICIPE); the International Livestock Centre for Africa (ILCA) and the national universities.

3. THE OBJECTIVES OF RESEARCH IN KETRI

The objectives of research in KETRI are guided by the mandate set for KETRI by the Government of Kenya: "To carry out research into all aspects that would eventually lead to the treatment and control of human and animal trypanosomiasis, and to effective reclamation of tsetse infested lands." The interpretation of this mandate must be based on the fact that trypanosomiasis should be viewed in relation to other diseases of man and his livestock and secondly on the understanding that KETRI is first and foremost a Kenyan public institution with a mission defined for it by the government for the benefit of Kenyans and others further afield.

Trypanosomiasis and tsetse control and eradication should only be carried out after an exhaustive and comprehensive land use plan has been drawn up. In drawing up such a plan cognizance should be taken of the fact that the fragile environments of tsetse infested lands must either maintained or enhanced. Kenya's geographic location puts its in a favourable position in so far as livestock products markets in Europe, Middle East and Africa.

The primary objectives of KETRI's research has thus got to be to discover effective strategies for utilization of these vast potential areas by the most cost-effective methods possible. The appproach has to be integrated with measures aimed at the agent of disease, the vectors, the hosts and the environment in which the interplay takes place. The Board of Management in 1977 laid down the following broad

guidelines that KETRI would follow in pursuance of its mission: 3.1 To study the dynamics of tsetse and trypanosome infections in different areas of Kenya with a view to developing ways and means of predicting major outbreaks of the disease.

3.2 To carry out tsetse and trypanosomiasis surveys with the aim of delineating areas of varying challenge of the disease.

3.3 To study the epidemiology of animal trypanosomiasis with a view to elucidating the existence and development of trypanotolerance in the country.

3.4 To develop, in conjunction with farmers, strategies for integrated management of livestock in trypanosome endemic areas.

3.5 To study the disease in man and animals with the view to developing new compounds in collaboration with the WHO, pharmaceutical firms and other research institutions, and evaluating the use of existing drugs.

3.6 To maintain a Trypanosome and Serum Bank, a laboratory colony of major tsetse species so as to provide reference and uniform materials for researchers both in Kenya and abroad.

3.7 To provide a forum for dissemination of research findings and discussion of research needs through seminars, workshops and conferences.

3.8 To provide an opportunity for training in order to build a critical mass of researchers and technical staff in the Institute.

4. PRESENT KNOWLEDGE AND STATUS

4.1 THE TRYPANOSOME

A review was given of the present state of knowledge of trypanosome biology and behaviour in both the tsetse fly and the mammalian host. It was noted that research on the trypanosome is sometimes hindered by unsatisfactory techniques. The need for improvements in methods of collection of field isolates and preparation of stabilates was thus stressed.

Aspects of the biology of the parasite requiring further research were

identified. More information is required on the factors affecting establishment of the parasite within the fly and the interaction between different species of trypanosomes and other pathogenic organisms (bacteria, viruses, etc) in the vector. Further investigations into factors involved in the development of the haemorrhagic T. vivax syndrome are needed. Comparative studies on the different trypanosome forms seen especially in late stage human trypanosomiasis and a comparison between the cerebro-spinal fluid and the blood-stream forms is required.

Finally the importance of the continued expansion and improvement of the trypanosome stabilate bank at KETRI was stressed.

4.2 VECTOR BIOLOGY AND CONTROL

Glossina is economically important from its ability to transmit trypanosomiasis to man and his livestock. The Tsetse flies are generally classified as forest, riverine and savana species and the incidence and severity of infection is closely related to the species present in a given area. In Africa in general and in Kenya in particular, knowledge of tsetse distribution is incomplete and imprecise. It is important to have precise knowledge of the species present, their density, the type of trypanosomiasis transmitted and their relationship to infestation in man and livestock.

The distribution of the species of the G.palpalis and G.morsitans group in Africa is fairly well understood. The same is not true of the G. fusca group. In the case of Kenya, the tsetse distribution map in use is based on material collected in the early 50's. There is thus an urgent need for continual updating of tsetse distribution if proper control measures are to be taken and accurate assessment of the success or otherwise of such methods is to be obtained.

The second area that needs attention is sampling techniques. Over time traps of different designs and colours have been used. Observations in the field show that certain designs are effective in sampling only

certain species of flies. Recently, incorporation of odours has greatly enhanced the effectiveness of these traps. Electric grids/nets are also being used widely with success all over Africa. In the light of field experiences, it is therefore imperative that further work be done in improving, developing and enhancing methods of fly sampling.

The vectorial capacities of different fly species is an area that needs attention. Various factors have been shown to affect the development of trypanosomiasis in tsetse, among which are source of feed. Efforts at identifying tsetse blood meals should shed some light in this but there is need to expand this work to include other haematophagous arthropods.

Laboratory colonization of tsetse aims at providing uniform material for use in experimental work and should, if successful, provide large numbers of flies for biological control. KETRI intends to mass rear G. pallidipes which has not been successfully reared hitherto. Cost seem to be a hindrance and as such efforts should be made to find cost effective methods of in vitro rearing systems for this fly.

Finally, the role of biting flies in trypanosomiasis epidemiology needs closer attention. This can only be effectively done if sampling techniques are improved and they can be reared in the laboratory.

4.3 DISEASE, PATHOLOGY AND IMMUNOLOGICAL REACTIONS

The African trypanosomiases are a disease complex in man and animals caused by salivarian trypanosomes that are transmitted by tsetse flies. The major features of the disease in man and animals include chronicity and wasting (acute syndromes do occur especially in T. vivax), fluctuating parasitemias, pyrexia, progressive anemia, tissue damage and immunosuppression.

The establishment of the disease in both man and animals begins with the development of chancres at the bite sites of infected hosts. The observation that trypanotolerant animals develop less severe reactions

at bite sites lends itself to this being an area for future research in mechanisms of trypanotolerance.

Although anaemia is a major presenting sign, the mechanisms involved, especially in chronic anaemia, are as yet unclear. What is clear is that the peripheral circulation reveals basically a non-regenerative anemia while the bone marrow shows a tremendous increase in precursor cells.

Work on pathological mechanisms of African trypanosomiasis has shown that tissue and organ damage is principally mediated by immune complexes through the release of autotoxoids, activation of plasminogens and complement and eventually leading to a disseminated intravascular coagulopathy syndrome (DIC).

The involvement of the reproductive system during infection needs to be given serious attention since this has a direct bearing on the expansion of the beef industry. It is imperative to know the extent of reproductive dysfunction under field conditions, and have comparative data in different species and breeds of animals.

As regards immune mechanisms, studies have shown that antibodies are produced but that the phenomenon of antigenic variation needs further elaboration if it is to be overcome. Antigens expressed on the metacyclic trypanosomes provide wider but serodeme specific immunity. The practical significance of this would depend on our ability to identify the serodemes present in a given area. Consideration should thus be given to cost effective and efficient methods of serodeme identification in the field. Finally, the question of immunosuppression in African trypanosome infections needs close attention since it has a bearing on the treatment and possible development of immunity to the disease following infection.

4.4 EPIDEMIOLOGY OF TRYPANOSOMIASIS

An attempt was made to identify fields for possible research on ani trypanosomiasis in Kenya. It was noted that active research in field on trypanosomiasis was limited to a few areas of the count The problems of cost of maintaining field research studies w mentioned but it was stressed that field work must be encouraged if true understanding of the state of trypanosomiasis and its control the country is to be obtained.

The epidemiology of trypanosomiasis can vary greatly from area to ar and locations for field research should be selected on the basis their potential to significantly increase animal production trypanosomiasis was controlled.

Up-to-date information and the incidence of infection in livestock the country is required. In order to provide uniform data, the use standardized techniques of detecting infection is needed and metho best suited for local conditions should be selected. Much of t information on tsetse distribution in the country also needs updating

Techniques such as improved methods for blood meal analysis, isoenzy analysis, the use of DNA probes, tests to detect circulating antige and other recent developments should be evaluated in the fielc Collaborative studies between KETRI and other institutes should l encouraged to examine such techniques under field conditions.

There is a need to determine the degree of trypanotolerance shown b local cattle in endemic areas of Kenya. To date, only one breed c cattle, the Orma Boran, has been proved to show trypanotolerance i Kenya but studies are required to examine other cattle breeds in th country.

Drug resistance continues to be a serious problem and careful fiel studies are needed to obtain information on the occurrence an implications of resistance in the country.

4.5 CHEMOTHERAPY

Animal Trypanosomiasis: The number of drugs available for treatment of animal trypanosomiasis is limited. The last compound to be developed was introduced 25 years ago. Meanwhile, problems due to drug resistance are increasing.

A primary aim of many researchers is to develop entirely new compounds but results to date are not encouraging. Studies leading to a more rational use of existing drugs are of value. Improved formulation of compounds can also improve efficacy.

The knowledge of the pharmacokinetics of existing drugs needs to be increased. Further basic research on the structure and biochemistry of trypanosome drugs could be useful in the development of new compounds. The mechanisms of drug resistance need further study. Research on drug residues in the tissue will provide information relevant to the consumer and add to our knowledge of development of drug resistance.

With particular reference to Kenya, it was felt that data on the prevalence of drug resistance in the country was needed. Drug trials in the field are required and also the establishment of a large animal drug testing unit should be considered. Cheaper methods of drug testing are needed and the development of *in vitro* methods should be encouraged. The long term effects of strategic dosing and chemoprophylaxis need to to be examined. A survey of drug availability and drug usage within the country would provide important information.

4.6 Human trypanosomiasis

It is estimated that in Africa, 30 - 50 million people are at risk from infection with trypanosomiasis and 25 - 30,000 new cases are reported each year. There are three recognized drugs for treatment of human trypanosomiasis. These drugs have to be used with care both for reasons of toxicity and due to their variable efficacy depending on the stage of the disease. The cost of developing new drugs is prohibitive.

Single dose oral therapy is the ideal but this is a distant possibility.

Methods to improve the passage of compounds to the brain are needed and better understanding of the blood brain barrier is required. The mechanisms of encephalopathy is poorly understood. Studies are needed on T. rhodesiense and its effect on the heart.

The use of DFMO, a recently developed compound, was described. This drug has been shown to be successful in treating T. gambiense infections. Trials are presently underway in T. rhodesiense infections.

Priority should be given to the methods of early diagnosis of the disease in man.

4.7 Trypanotolerance of African Wild Bovidae

African wild bovidae thrive in areas endemic for tsetse and trypanosomes. Speculations have been made that their ability to live unharmed under the continued challenge of trypanosomes was due to an acquired immune response. Recent research carried out has shown a complex of factors involved in trypanotolerance shown by experimental exposure to tsetse and trypanosome challenge.

Observations on host-tsetse interactions under natural challenge and on experimental infections with trypanosomes using tsetse transmission or needle inoculation have shown that different wild animals have varying attractiveness to tsetse with the buffalo being the most attractive and the waterbuck the least attractive.

Tsetse challenge of buffalo with T. congolense resulted in minimal local skin reactions, a prepatent period almost twice as long as in Boran cattle and the presence of neutralizing antibodies before trypanosomes could be detected in the blood. Needle challenge with T. brucei in buffalo and eland resulted in a first wave of parasitaemia similar in appearance and size as in cattle, but followed by partial or complete control of the parasitaemia. No differences in antibody to

input variant antigenic types (VATs) or other VATs from the same repertoire were detected between the wild hosts and cattle suggesting parasite growth control induced by the first wave of parasitaemia in eland and buffalo being independent of antibody. Other experiments in wildebeest (Connochaetes taurinus) suggested antibody mediated phagocytosis as a parasitaemia controlling mechanism. When waterbuck were intravenously inoculated with T. brucei, high parasitaemia ensued, similar to control cattle, but there was no drop in packed cell volume.

In conclusion it can be stated that wild bovidae express a high level of trypanotolerance, which could be the result of a number of innate and parasite induced mechanisms ranging from the unattractiveness to tsetse, differences in immune response or possibly the lack of growth factors required for the in vivo propagation of the parasite.

4.8 Trypanotolerance in Cattle

The trypanotolerance observed in certain breeds of cattle is best described as reduced susceptibility. There are three possible approaches to the utilization of trypanotolerant cattle.

1. They can be used to investigate the mechanisms of trypanotolerance although these mechanisms may often be better studied in wildlife where they are more clear cut. The emphasis is usually placed on investigations of the control of parasitaemia and anaemia. Other questions of interest include:

a) Are trypanotolerant cattle bitten less often like certain species of wildlife and if so what are the factors involved? and

b) Why is there a difference in the vivax ratio in trypanotolerant and susceptible cattle under field challenge?

2. Trypanotolerant cattle can be used more widely in Africa through the multiplication of the currently known trypanotolerant breeds through multiple ovulation and embryo transfer techniques or through simple crossbreeding/upgrading. Indigenous breeds in the tsetse areas of eastern Africa should be studied with the aim of identifying other trypanotolerant breeds.

3. Trypanotolerance can be increased through selection. A selection program requires first a definition of both trypanotolerance and what is required in a trypanotolerant animal. There must be genetic variation in trypanotolerance or whatever criteria of trypanotolerance are to be used in the selection programme. Consideration must also be given to the genetic correlation between trypanotolerance and production and it must be decided whether selection should be under natural or artificial challenge.

4.9 Environmental considerations relating to tsetse and trypanosomiasis control.

Of Kenya's total landmass of 580,000 km^2 80% (464,000 km^2) constitutes arid and semi-arid lands (ASAL) best suited to livestock production at our present level of technology. Of the ASAL, 52% (240,000 km^2) is rangeland, 60% (145,000 km^2) of which is tsetse infested and therefore unsuitable for livestock production. The major limiting factors in the rangelands apart from tsetse infestation include shortage of water, shortage of fodder and the presence of livestock diseases. Among the major livestock diseases in these areas is trypanosomiases, tsetse or non-tsetse transmitted. It is estimated that at the present carrying capacity of 10 animals per square kilometer, these lands, through reclamation by vector and disease control would take an addition 2.5m cattle worth Kshs. 6 billion in addition to sheep, goats and camels.

Large scale tsetse control programmes are not without their critics, the major criticism being that lands infested by tsetse are in many cases too fragile to support intensive cattle ranching and other agricultural activities for more than a few years. In any case, critics argue that tsetse control/eradication will not neccessarily get rid of trypanosomiasis as the prasite can be kept going by mechanical vectors as is happening with T. vivax in S. America and T. evansi in the Far East.

It is therefore imperative that planning of tsetse control programmes must take into account land use and water management patterns that will help preserve and even enhance the environment, if only to dispose the critics contention that the tsetse fly has been the "saviour" of the African environments. Practices like vegetation clearing, bush burning to provide fresh grazing and the use of foliage from the surviving trees as emergency fodder in the dry season which exarcebate the disappearance of forests and woodlands should therefore be carefully regulated so as not to lead to the dropping of the water table and subsequent desertification.

5. ON-GOING WORK - SECTION REPORTS

5.1 PROTOZOOLOGY

Activities in the division centre around the trypanosome bank. The bank is maintained as a service as well as research utility. Collection, maintenance and distribution of stabilates is continuing at the moment the collection stands at 3105 primary isolates and their derivatives.

Research Activities in the section include drug trials, isoenzyme trials and kinetoplastic DNA analysis using restriction enzymes. So far seven *T. b. rhodesiense* isolates have been detected that are classified as Mel B resistant, of which two are transmissible through *G. m. morsitans.* 100 *T. b. brucei* isolates have been tested for Mel B and Suramin sensitivity. Testing of *T. evansi* sensitivity to Suramin, Antrycide, Samorin and berenil is completed and so far the majority of the isolates are insensitive to the trypanocides tested.

Twenty *T. congolense* stabilates have been characterised by enzyme electrophoresis and work is in progress for *T. b. brucei* subgroup. Limited kinetoplastic DNA restriction analysis has indicated that *T. b. brucei* is very distinct from *T. b. evansi.*

5.2 BIOCHEMISTRY SECTION

This section is involved in elucidating biochemical and immune mechanisms occuring during infection.

The section has been involved in the development, adaptation and improvement of serological diagnostic tests. Previously the section has been involved with Haemagglutination (HT), Procyclic Antigen Trypanosome Test (PATT) and Complement Fixation Test (CFT) but now the emphasis is on Antibody - Elisa, Antigen-Elisa and PATT. So far Ab-Elisa has been developed for goat, cattle, camels, human and mouse systems. Antigen-Elisa has been developed for all livestock and man. Also in progress is the validation of Ag-Elisa technique using IAEA reagents.

Work is on-going in molecular biology with the objective of construction of a genomic library to be used in diagnosis. At the moment there is a search for a more active vector.

Future work in the section is expected to include studies on the role of various antigenic types (VATs) of *T. b. evansi* stocks from Kenya and their application for a vaccine production for this species. Development of drug resistance and the mechanisms involved in immunosuppression will also be studied.

5.3 Trypanosoma

Culture Section

Three donor-funded projects are either on-going or about to be established in the section.

5.3.1 Ketri/ODA Animal trypanosomiasis project

The specific objectives of the trypanosomes culture component are:

(a) to establish culture systems for *T. congolense* (and *T. vivax*), to be used for screening for drug sensitivity,

(b) to determine the drug sensitivity of field isolates from livestock (and tsetse flies) to the current trypanocides and

(c) to screen new drugs for trypanocidal activity using the culture systems developed.

It is now possible to isolate and grow in culture trypanosomes from cryopreserved infected blood samples collected from livestock in the field. Also using an in vitro assay developed, metacyclics have been used to test drug sensitivity. The results so far obtained compare favourably with in vivo results obtained in mice and cattle for berenil and samorin.

5.3.2 Ketri/Berlin University Animal Trypanosomes Project

This is a new project whose objective is to use in vitro trypanosome culture of T. b. brucei, T. b. evansi (and T. simiae) for drug screening. An assay has been developed for initiating cultures directly from swine or bovine blood. This system is going to be used for in vitro evaluation of a new compound from Rhone Merieux shown to be trypanocidal in mice against drug-sensitive and drug resistant T. b. brucei. The compound is going to be evaluated against 6 different T. b. brucei stocks with known spectrum of drug resistance especially to Mel W.

DFMO is going to be evaluated against drug resistant T. b. brucei stocks following in vivo demonstration of susceptibility to oral DFMO. Plans are also underway for the improvements for the T. b. evansi cultures which are not so readily initiated in cell-free cultures and for evaluation of DFMO against T. b. evansi both in vitro and in vivo.

5.3.3 KETRI/USAID Human Trypanosome Project

A project with the objectives of establishment of T. rhodesiense in culture and the use of the same in development of new anti-trypanosome therapy by use of combinations of existing drugs predicted to be synergistic on the basis of known biochemical pathways. A stock of T. rhodesiense is in culture and drug assays have just begun.

In addition to the above three, culture systems are being used to differentiate stocks that transform to procyclics as an in vitro method to identify stocks of T. evansi. T. evansi does not differentiate into procylics in vitro. Procyclic cultures are also being used as a source of trypanosome antigens in diagnosis.

5.4 VETERINARY

The Veterinary section is presently carrying out work with a haemorrhagic strain of T. vivax. This strain has been able to reproduce the haemorrhagic syndrome by both fly and needle challenge, although the latter proved more virulent. The syndrome is expressed better in young animals under 1 year old. The disease syndrome has displayed classic signs although in some cases, it has reverted to a chronic form. It is expected to carry this work to the field where this syndrome is seen in fatal episodes every so often.

An experiment is underway to study the effect of trypanosome infections on reproduction in trypanotolerant and trypanosensitive breeds of cattle.

5.5 ENTOMOLOGY

Activities in the section are both laboratory and field oriented. In the laboratory the main activity is the colonisation of Glossina species with the objective of providing uniform material for research.

At the moment, a colony of G. morsitans morsitans and G. m. centralis are held at the "colony" side of the unit. The two are maintained in vivo. However two attempts to rear G. m. morsitans on the experimental side have been unsuccessful due to a number of reasons that are currently under investigation.

An attempt to rear G. m. morsitans in vitro had to be discontinued after very high mortality was observed. It is hoped to re-intiate such a colony once the reasons for the high mortality have been established. The ultimate aim is to rear G. pallidipes in vitro for possible use in biological control.

Field studies in the section include control trials in Galana and Lambwe Valley; an ecological study of G. longipennis in Galana and updating the Kenya tsetse distribution map.

Galana

The target control experiment that has been on-going for the last three years has demonstrated that targets can be used effectively for control of tsetse in Kenya resulting in a drop in treatment costs.

Work has begun on the development of an effective barrier to protect areas cleared of tsetse from reinvasion.

Lambwe Valley

The project started in July, 1988 following the success achieved in Galana. The valley has been divided into three blocks that have all been covered by targets at varying densities. Within a month of installation of the targets the numbers have dropped from 100-2400 to 0-200 flies/trap/day. The effect has also been seen in a sentinel herd being grazed in the control area. An "effective" barrier is also being investigated as in Galana.

Preliminary studies on G. longipennis in Galana, have shown that baited F_3 trap is more efficient than the biconical trap in terms of absolute numbers as well as the total number of females caught. So far only T. vivax has been detected in the fly on dissection and further studies have shown that the odours in use in Galana are just as effective for G. longipennis as for G. pallidipes. A proposed Deltamethrin trial for using cattle as live targets has not yet taken off the ground.

Updating of Tsetse Map

A proposal for funding of this activity submitted to IDRC has been approved though the work has not yet started.

5.6 PRIMATE

The development of the monkey model for the "rhodesian" form of human trypanosomiasis and the establishment of a protocol to be followed in the drug trials has been successfully completed. Work has been started on a "gambian" sleeping sickness model using sykes monkey, but the problem here is the long period before the onset of CNS symptoms.

Drug trials

Screening of compounds in the rodent and primate model is continuing. Out of the 80 compounds screened so far 10 have been shown to be active against human trypanosomiasis caused by T. rhodesiense either singly or in combination. It has been established that the lowest effective dose of Mel B is 1mg/kg body weight and that half the recommended dose (1.8mg/kg body weight) is effective in late state T. rhodesience infections (encephalopathy). Work is also in progress on combination therapy of various doses of Mel B and Suramin. Oral Mel B at 10mg/kg cured three out of five monkeys. Work with DFMO in the unit so far shows little promise on the efficacy of the drug in T. rhodesiense infections. In monotherapy, all doses tried failed except at 800mg/kg when slight clinical improvement was observed in the monkeys although trypanosomes were still detectable in the CNS. At lower doses trypanosomes persisted even in the blood. The 800mg/kg dose is therefore being used in combination therapy with Suramin and Mel B. Combination with Nifurtimox is anticipated although there are problems with palatability.

Future activities include:-

Pharmacokinetics study of Mel B using ELISA

Studies using Mel W

Encephalopathy and toxicity

Testing of five new compounds from Walter Reed

Cardiology of brucei group in monkey

Neuropathology.

5.7 HUMAN TRYPANOSOMIASIS

KETRI Hospital Alupe is the national eferral centre for management of Human Trypanosomiasis in Kenya. Active surveillance and treatment are the two main activities. Human trypanosomiasis is confined to the shores of Lake Victoria in South Nyanza, Busia and Siaya Districts. An average of fifteen cases are seen annually although 46 patients were seen in 1983.

In 1987, no patient was seen from South Nyanza whereas in 1988, three new patients were picked up. So far one new case has been diagnosed this year. A new focus of disease identified in South Teso in mid-1987 has continued to be an active focus up to the present moment. There is thus need for active surveillance in the active foci, especially Lambwe and South Teso.

A DFMO trial has been started using three Mel B refractory patients. Results with low and high dose DFMO therapy have resulted in success with only one out of three patients. The remaining two patients, when treated with Lampit at 15mg/kg relapsed at four and six months respectively but when given a combination of DFMO and Lampit have so far not relapsed three months later at the first follow up. The need for improved detection was stressed and possible use of antigen detection was recommended.

Future work in the section revolves around DFMO and areas proposed include:- Combined DFMO + Suramin, DFMO + Mel B + Suramin, Nifurtimox monotherapy and possibly other drugs eg Metronidazole, anti-cancer drugs.

The fact that there is free movement across borders calls for collaboration effort in combating Human Trypanosomiasis. There is also need for general awareness by the health workers and the public on the dangers paused by the disease in Kenya.

5.8 CAMEL TRYPANOSOMIASIS

Work carried out by KETRI over several years has shown that camel trypanosomiasis is an important disease. Studies have shown that there is a problem of drug resistance. Presently there is characterisation of the stabilates in the bank as well as development of serological tests for diagnosis.In the field work is going on on strategic chemo prophylaxis. Future work includes studies on camel production under optimum management, and the transmission cycle of the disease in camels and vectors. The role of blood groups in relation to disease susceptibility and drug resistance will also be studied.

5.9 EPIDEMIOLOGY

This is a new section which aims to bring together all field studies on animal trypanosomiasis being carried out by the Institute. Field studies have been going on in Galana for the last ten years while the Nguruman station was established at the end of 1987.

5.9.1 GALANA

Epidemiology

Data on cattle trypanosomes have been collected in two areas of the ranch since 1981. One of the herds is grazing in an area where odour-baited targets have been installed since beginning of 1986 to control tsetse flies whereas the other herd is in an area where there is no control. These herds provide information on the seasonal incidence of trypanosomiasis, year to year fluctuations in incidence of the disease, the effectiveness of vector control using targets in animal trypanosomiasis control, and on the efficacy of berenil in the treatment of disease. Rainfall and entomological data is also monitored.

Chemotherapy

Both new and already available compounds have been studied. Strategic treatment regimes are being continuously examined for treatment and

prophylaxis, especially in light of the recent observed shortening of prophylactic protection provided by conventional prophylaxis (samorin) during periods of high trypanosome challenge. Regimes examined include the use of prothidium, samorin and Ethidium bromide. New trials are assessing the efficacy of Novidium and samorin in prophylaxis.

Other compounds that have previously been tested for effectiveness in trypanosomes control include Asuntol, pyrethroid impregnated ear tags and pour on formulations. Monitoring for drug resistance is going on and "resistant" strains are being collected for further laboratory testing.

Trypanotolerance - The Orma Boran has been studied in a series of field trials on Galana Ranch and has been shown to be trypanotolerant. Several studies have been conducted in which it's performance has been compared to that of the improved Kenya Boran under varying levels of trypanosomiasis challenge. The importance of acquired and innate immunity under field conditions has been investigated and a breeding herd of Orma Boran has been established. This herd is used to study the response to trypanosomiasis in Orma cattle reared from birth in tsetse infested areas and to attempt to improve their trypanotolerance and productivity through selection. The data collected will enable measurements to be made of the genetic parameters associated with trypanotolerance.

In addition to the Orma breeding herd, two sentinel herds, Orma and Galana, are being compared to obtain further information on the degree of trypanotolerance shown under conditions of different trypanosome challenge. A group of Orma steers has also been moved to Nguruman to assess its performance elsewhere in the field and is being compared to a similar herd in Galana.

Korobo disease - has been recognised in the ranch where it is associated with severe liver disease and high mortality in cattle. An attempt is underway to reproduce the syndrome under controlled experiments in the ranch.

Rinderpest vaccine and Trypanosomes

An experiment has been designed to investigate whether rinderpest vaccination can cause immunosuppression. This will be done in collaboration with other Institutes.

5.9.2 NGURUMAN

Epidemiology

Baseline data on trypanosomiasis incidence, livestock movement, disease problem and animal productivity is being collected by monitoring livestock belonging to five farmers.

Drug sensitivity

The efficacy of Berenil, Novidium and Samorin is being assessed in treatment of trypanosomiasis in a traditional husbandry system.

Productivity of Masai and Orma Boran cattle.

The performance and incidence of trypanosomiasis are being compared for Orma and Masai cattle of a similar age.

Collection of stabilates for *in vitro* drug sensitivity testing is going on. In collaboration with ILRAD and Biochemistry section detection of circulating antigens is going on to test this method in sera of naturally infected animals.

In addition to the studies on cattle, trypanosomiasis in camels and goats has also been investigated. KETRI has also assisted Galana Ranch with other disease problems.

5.10 DONOR -AIDED PROJECTS

5.10.1 KETRI/ODA ANIMAL TRYPANOSOMIASIS RESEARCH PROJECT

This is a project funded by the Government of the United Kingdom (ODA) to the tune of about pound 860,000 sterling with the broad aim of reducing morbidity and mortality due to animal trypanosomiasis and in the process open up land, presently tsetse infested, for livestock production.

The project has three components - an entomology component in Galana and Nguruman, a strategic chemoprophylaxis component under small scale conditions in Nguruman and an in vitro culture component for drug screening.

So far two technical cooperation officers are in place, equipment has arrived and a field station has been set up in Nguruman. Counterparts have been identified and some have gone for further training through the auspices of the British Council.

5.10.2 FATE OF TRYPANOCIDAL DRUGS IN CATTLE

This project is a cooperation between the IAEA and the Government of Kenya in the area of metabolism and pharmacokinetics of trypanocidal drugs in African cattle.

The five year project is funded by an Italian extra-budgetary contribution of US$ 1.300.000 to the IAEA and is carried out at the Kenya Trypanosomiasis Research Institute with technical support provided by the FAO/IAEA Agricultural Biotechnology, Laboratory Seibersdorf Seibensdorf, and other laboratories.

This project was funded due to the fact that these drugs are extensively used in Africa with more than 25 million treatments being applied annually without any knowledge of the residue-toxicity for human beings.

The objective of the programme is to determine the fate of trypanocidal drugs, such as Berenil^{R}, Samorin^{R}, Ethidium^{R}, etc. in cattle using radiolabelled and unlabelled chemicals. Rates of excretion, accumulation in organs, bloodlevels and length of residual activity will be determine' Precise data on the fate of trypanocidal drugs in cattle will assist in giving recommendations for the use of meat containing residues and in improving the use of these drugs in chemotherapy and prophylaxis of trypanosomiasis.

Pharmacokinetic and residue experiments with radiolabelled Berenil,

Samorin and Ethidium have been carried out in cattle (both intravenous and intramuscular treatement) mice and rats, vervet monkeys and in cattle using application of slow-release formulations. Follow-up experiments are continuing. The results so obtained are comparing favourably with those obtained in tissue culture assays.

An analytical method for berenil in plasma and tissue has been developed and evaluated. The development of similar methods for Samorin and Ethidium is presently going on. Field studies are also being initiated at the Kenya Coast in collaboration with Veterinary Investigation Laboratory, Mariakani. Bioavailability studies and studies of drug metabolites are due to be started soon.

5.10.3 OTHER DONOR FUNDED PROJECTS

Other donors that have funded projects in KETRI include WHO which has funded work on the primate model and is further interested in funding work on setting up an Isoenzyme screening facility. The Walter Reed Army Institute has been carrying out work at Alupe while IDRC and USAID have supported work on sero-diagnosis of human trypanosomiasis and attempts at developing novel immunization techniques.

Local institutions that have been active in supporting research in KETRI include Wellcome (Kenya) Ltd in the target work in Galana and May and Baker with the camel work in Ngurunit.

An important aspect of KETRI work in future will depend on the facilitative efforts of various agencies. In this respect, we expect facilitative efforts from IBAR, FAO and other organizations in order to raise funds for future activities.

6. PROGRAMMES AND PRIORITIES FOR RESEARCH

The suggested programmes are meant to rationalise existing work and to propose broad guidelines that will form the basis of future work in the Institute. The programmes, their broad goals and the priority areas for research under each programme as follows:

6.1 PROGRAMME 1:- HUMAN TRYPANOSOMIASIS

GOAL:

To carry out research into effective surveillance, rapid diagnosis and management of human trypanosomiasis with a view to controlling and possibly eradicating the disease from Kenya.

Research priorities are:

6.1.1 Improvements of methods of surveillance, diagnosis and management of trypanosomiasis in the community with special reference to areas of human trypanosomiasis on the shores of Lake Victoria and cases imported into the country.

6.1.2 Studies on effective treatment regimens (ref. Programme 8) including the continued search and development of effective compounds for treatment of late cases of trypanosomiasis.

6.1.3 To foster regional & collaborative studies on clinical, diagnostic and managemental aspects of human trypanosomiasis.

6.1.4 Studies on vectors and reservoirs of human trypanosomiasis (ref 2.1, 2.2, 2.6, 2.7 and 7.5)

6.1.5 Studies on the monkey model and other animal models for human trypanosomiasis.

6.2 PROGRAMME 2:- VECTOR BIOLOGY AND CONTROL

GOAL:

To carry out studies,both in the field and laboratory, on tsetse and other fly biology and behaviours so as to propose appropriate measures for breaking the transmission cycles and thus assist in effective control through methods that enhance the environment. The programme will pay particular attention to colonization of various tsetse species in the laboratory for more effective manipulation of the same.

Research priorities are:

6.2.1 Establishment of laboratory colonies of Glossina for use in various experiments and for the sterile insect technique (SIT).

6.2.2 Survey of tsetse species in the country for the purpose of updating maps of tsetse distribution.

6.2.3 Application and improvement of traps and trapping methods to allow better assessment of the distribution, density and infection rates of the various tsetse species in the country.

6.2.4. Development and application of traps, targets and other methods for tsetse control (ref. 9.2).

6.2.5 Blood meal analysis to identify host preference of tsetse and other hematophagous flies to assess the importance of various animals in transmission of the diseases.

6.2.6 Studies on fly behaviour and host tsetse relationships with particular reference to the factors affecting the attractiveness or repellence of different animal species (domestic and wild) to the tsetse fly.

6.2.7 Studies on the involvement of other biting flies in the transmission of trypanosomiasis with special reference to T. evansi transmission.

6.3 PROGRAMME 3:- THE DYNAMICS OF THE TRYPANOSOME

GOAL:

To carry out field and laboratory studies on trypanosomes in order to elucidate more clearly the mechanisms of transmission, infectivity and drug resistance with a view to evolving more effective control measures. A well documented Trypanosome Bank will be maintained as part of the activities of the programme.

Research priorities are:

6.3.1 Studies on trypanosome tsetse interactions with regard to possible factors that influence vectorial capacity.

6.3.2 Continued expansion and improvement of the trypanosome bank and development of a computer - based information system.

6.3.3 Further characterization of stabilates held in the bank with special reference to the development of sensitive typing methods and continued testing of drug sensitivity in mice.

6.3.4 Improving and standardizing procedures for stabilate preparation.

6.3.5 Comparison of cerebro-spinal fluid, blood-stream and tissue forms of trypanosomes.

6.3.6 Cryopreservation of primary isolates from game, naturally-infected livestock and vectors.

6.3.7 Investigate possible factors associated with the enhanced virulence of haemorrhagic T. vivax stocks including the possible role of inclusion bodies.

6.4 PROGRAMME 4:- PATHOGENESIS AND PATHOLOGY OF TRYPANOSOMIASIS

GOAL:

To study the pathogenesis and pathology of Trypanosomiasis with a view to improving our knowledge of pharmacokinetics, therapeutics, and general management of trypanosomiasis under different conditions that could be applicable to both humans and animals.

Research priorities are:

6.4.1 Investigations on the anaemia of trypanosomiasis and the mechanisms involved in its development.

6.4.2 Studies on the effect of trypanosome infections on reproduction in various livestock species.

6.4.3 Comparison of the pathology of infection in livestock breeds and wildlife with differing susceptibility to trypanosomiasis including the haemorrhagic T. vivax syndrome.

6.4.4 Studies on immunosuppression following trypanosome infection with special reference to the response to vaccination and intercurrent and other infections.

6.4.5 Neuroendocrinological studies in relation to trypanosomiasis infection (ref. 6.5).

6.5 PROGRAMME 5:- CAMEL PRODUCTIVITY AND TRYPANOSOMIASIS

GOAL:

To carry out studies on the effect of trypanosomiasis on camel physiology, production, reproduction and management in order to propose strategies by which the camel is made more productive in its natural

habitat. The social, cultural, nutritional, management and other disease control aspects of camel productivity will also be studied with the aim of alleviating the constraints identified.

Research priorities are:

6.5.1 Studies on the effects of trypanosomiasis on productivity in camel herds under different systems of management.

6.5.2 Study of susceptibility of different breeds of camels to trypanosomiasis.

6.5.3 Studies on the occurrence of drug resistance in camel trypanosomiasis.

6.5.4 Identification and characterization of trypanosome species isolated from camels.

6.5.5 Investigation into possible reservoirs and vectors of infection of T. evansi

6.5.6 Epidemiology of Camel Trypanosomiasis.

6.6 PROGRAMME 6:- BIOCHEMICAL AND IMMUNOLOGICAL MECHANISMS OF TRYPANOSOMIASIS

GOAL:

To study the mechanisms that enable a trypanosome be an efficient parasite with the aim of evolving efficient and cost-effective methods of manipulating, diagnosing and controlling the parasite. In carrying out its activities, due cognisance will be given to emerging technologies that may lead to a breakthrough in vaccine production and effective control measures.

Research priorities are:

6.6.1 The application of molecular biology techniques to the study of trypanosome differentiation and trypanosome antigens.

6.6.2 Improvement and application of in vitro culture methods for the different trypanosome species.

6.6.3 The provision of a serological diagnostic service.

6.6.4 Establishment of a service to provide iso-enzyme characterization of trypanosomes (ref. 3.3).

6.6.5 Endocrinological studies related to trypanosome infections. (ref. 7.4.5)

6.6.6. Development of Diagnostic Techniques.

6.7 PROGRAMME 7:- EPIDEMIOLOGY OF TRYPANOSOMIASIS

GOAL:

To consolidate data and make available information on vector and disease dynamics within the various agroecological zones so as to propose mechanisms for predicting epidemics and outbreaks in Kenya and elsewhere. The programme will further aim to test and evaluate technology diffusion and application and ensure that proposed control measures are compatible with complementary to control measures for other diseases of man and animals.

Research priorities are:

6.7.1 Studies on the epidemiology of trypanosomiasis in cattle under different management systems.

6.7.2 Studies of the epidemiology of haemorrhagic and non-haemorrhagic T. vivax.

6.7.3 Establishment of a serum bank at KETRI.

6.7.4 Development and evaluation of diagnostic and other epidemiological techniques in field studies.

6.7.5 Studies on the role of livestock and wildlife as reservoirs of trypanosomiasis.

6.7.6 Studies on the epidemiology of T. simiae in domestic pigs, wild pigs and other species.

6.7.7 Studies on the epidemiology of trypanosomiasis in small stock.

6.8 PROGRAMME 8:- CHEMOTHERAPY OF TRYPANOSOMIASIS

GOAL:

To test newly developed and improve on existing drugs, through laboratory and field trials, with a view to recommending effective regimens for prophylaxis and therapeutics of Trypanosomiasis. It will also aim to elucidate the understanding of the pharmacodynamics and fate of antitrypanosomal drugs currently used and those that may be

developed in future from natural and synthetic sources.

Research priorities are:

6.8.1 Development and Evaluation of analytical methods for Trypanocidal Drugs Analysis.

6.8.2 Continued studies on the treatment of human trypanosomiasis using existing and new drugs and differing treatment schedules.

6.8.3 Studies, using the monkey and other animal models, on compounds and treatment regimes for management of human trypanosomiasis.

6.8.4 Studies of pharmacodynamics of compounds used for treatment of trypanosomiasis.

6.8.5 Studies on reactive encephalopathy associated with drug treatment.

6.8.6 Studies on the blood/CSF/brain barrier and drug treatment.

6.8.7 Studies on the fate and residues of trypanocidal drugs and their metabolites in livestock..

6.8.8 Studies on the efficacy, strategic use and regimes of trypanocidal drugs and experimental compounds in livestock.

6.8.9 Studies on drug resistance.

6.8.10 Application of in vitro culture techniques for drug screening.

6.9 PROGRAMME 9:- MANAGEMENT OF LIVESTOCK IN TRYPANOSOME AND TSETSE ENDEMIC AREAS

GOAL:

To adopt and adapt technologies to the needs of large and small scale farmers in an integrated manner with a view to recommending measures that are both cost-effective, affordable and sustainable.

A critical element of the Programme will be the identification and development, through organized selection and breeding of Trypanotolerant species and breeds of livestock.

Research priorities are:

6.9.1 Development and testing of methods of strategic chemoprophylaxis under different livestock management systems (ref. 5.6, 7.1 and 7.4).

6.9.2 Evaluation of tsetse control methods, such as targets and traps suitable for use under different livestock production systems.

6.9.3 A survey to identify trypanotolerant livestock from different areas and evaluation of their performance under various farming systems.

6.9.4 Studies on ways to increase meat production in tsetse infested areas through selection within trypanotolerant breeds and multiplication of trypanotolerant animals by cross-breeding.

6.9.5 Comparative studies on the productivity of trypanotolerant and non-trypanotolerant livestock under different farming conditions.

6.9.6 Studies on trypanotolerance in wildlife and the potential for wildlife utilization in trypanosome endemic areas.

6.10 PROGRAMME 10:- ENVIRONMENTAL CONSIDERATIONS RELATING TO TSETSE AND TRYPANOSOMIASIS CONTROL

GOAL:

To develop and evaluate cost effective control measures that take into account environmental and land use considerations in the varied agroecological zones of the country.

Research priorities are:

6.10.1 Workshop to focus research attention and evolve an agenda for future research

6.11 PROGRAMME 11:- ADMINISTRATIVE SUPPORT PROGRAMME

GOAL:

To facilitate and set a climate conducive to creativity and productive research in order to enhance national development. Further to

effectively mobilise and manage resources aimed at achieving the mission of KETRI and positively advocate on behalf of KETRI.

Priorities are:

6.11.1 Training and retraining of Administrative and other support staff.

6.11.2 Continual evaluation of administrative and financial systems.

7. MANPOWER DEVELOPMENT AND TRAINING

There is no doubt that manpower is the greatest and probably the most critical of all resources in any establishment. The welfare and development of this resource is paramount to the success or otherwise of the institution. In the case of research institution like KETRI, the development of such individuals includes formal training on-the-job training, refresher courses and skill sharpening attachments. It is generally agreed that as such individuals advance to higher grades, they assume more demanding responsibilities which in many cases include administrative responsibilities. Some training at the higher levels in administrative acumen may thus be necessary from time to time.

Presently KETRI has a core establishment of 20 scientists. These are augmented by another 8 scientists on special projects. Because of the current manpower restriction in the country, it is unlikely that there will be a substantial increase in the core establishment in the near future. Additional inputs can only come through visiting scientists or through donor funded projects. Consideration should however, be made for donor funded postdoctoral and postgraduate research workers both Kenyan and non Kenyan.

It should be clear from the onset that KETRI is not a training institution. Training in KETRI should thus be based on the manpower requirements of the Institute. The training schedule over the next 5 years is as indicated.

STAFF DEVELOPMENT TRAINING PROJECTION

1987 TO 1991

DESIGNATION	TOTAL No. TO BE TRAINED	TOTAL No. IN POST	WHERE TO TRAIN: LOCALY	WHERE TO TRAIN: OUTSIDE	DURATION OF PROPOSED TRAINING	1987	1988	1989	1990	1991	PROPOSED COURSE
RESEARCH OFFICERS AND POST DOCTORAL (SABBATICAL ATTACHMENTS ETC)	22 3	29		USA, UK, CANADA EUROPE.	6 MONTHS		1	2			ATTACHMENT TO VARIOUS LABORATORIES
Ph.D.	6 7		KENYAN UNIV.	USA, UK, CANADA EUROPE & ODA PROJECT	3 YEARS 3 YEARS		3 3	3 2	2		Ph.D. Degrees
M.Sc	5			UK., USA, CANADA	2 YEARS	4	1	-	-	-	M.Sc Degrees
M. MED.	1			UNIV. OF LIVERPOOL	2-3 YEARS		1				M. Med. Degrees
ADMINISTRATIVE OFFICERS. A: SUPERVISORY GRADE.	7	7		UK., ESAMI, USA JAPAN	6 MONTHS	2	3	2	-	-	SKILL SHARPENNING IN VARIOUS FIELDS
B: OTHER ADM. SUPPORT. (i.e. ADM. OFFICER, ACCOUNTS, SUPPLIES, ENGINEERS, MED. ILLUSTRATORS, LIBRARIANS AND SECURITY OFFICERS)	30	51	GTI, KIA, INST. OF TECHNOLOGY, KIMC, WATER TRAINING SCH., MTC, POLYTECHNICS & A.P. TRANING				10	10	10		
LAB. TECHNOLOGISTS	11	10		UK, USA, GERMANY, AUSTRALIA, INDIA CANADA, MEXICO, BELGIUM, BRAZIL	3-6 MONTHS		3	3	3	2	SKILL SHARPENNING OF LAB. FIELDS.
LAB. TECHNICIANS	24	24	KENYA POLYTECHNIC		2 YEARS	5	5	5	5	4	ORDINARY & HIGHER NAT. DIPLOMAS
MEDICAL SUPPORT STAFF.	5	7	MTC & K. POLY		6-12 MONTHS	2	2	1	-	-	SKILL SHARPENNING
COMPUTER PROGRAMMER	3	5	KENYA POLY.		1-2 YEARS	1	1	1	-	-	DIPLOMA
SECRETARIAL AND OTHER SUPPORT STAFF.	10	10									SKILL SHARPENNING

BEST AVAILABLE DOCUMENT

8. FINANCIAL IMPLICATIONS

Financial resources are dwindling at every stage of development. Research activities are no exception to this.

The economy is expected to grow at between 5 and 7% per annum up to the year 2000 if it is to contain the projected population growth. It is expected that the budget would therefore grow at the rate of 5% p.a in the ensuing years. The difference between the funds accrued nationally and the required funds would have to be expected to be met from external funding. External funding, on the other hand, is usually for 6 - 10 years by which time the depreciation of the equipment calls for replacement of the same. At such a time, the Government has to take over the project recurrent expenditure and replacement. At the same time since the taking over of such projects has recurrent budget implications, it becomes imperative that such donor projects be properly planned so as not to unduly increase the budgetary requirements of the Institute.

The budgetary provisions for the Institute have been tentatively pegged for the next 5 years through the forward budget process. However, it should be noted that every year, the forward budget goes through scrutiny during the annual budget exercise in order to align the requirements to the economic realities of the country at the particular time. KETRI being a national institution depends for a large measure of its operating funds on the Kenya government. However, government subventions are limited both in absolute amounts and in particular on a year to year basis.

A global budget indicating the needs of KETRI up to FY 1992/93 is presented which has taken into account the proposed programmes and projects, the increase in manpower, materials and equipment.

TABLE I

SUMMARY PROGRAMME BUDGET FOR KETRI 1989-94 IN KENYA POUNDS '000

	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94
PROGRAMME BUDGET		4493	1675	1945	2295	2735
GOK RECURRENT BUDGET	1305	1917	2016	2142	2300	2500
PERSONAL EMOLUMENTS AND RELATED ACTIVITIES	1000	1500	1600	1700	1800	1900
OPERATIONAL BUDGET FROM GOK	305	417	416	442	500	600

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TABLE II

DETAILED PROGRAMME BUDGET 1989/94 IN KENYA POUNDS '000

PROGRAMME NO.	PROGRAMME NAME	88/89	89/90	90/91	91/92	92/93	93/94
1	HUMAN TRYPANOSOME		200	70	95	120	135
2	VECTOR BIOLOGY AND CONTROL		400	145	165	200	240
3	DYNAMICS OF TRYPANOSOME		385	155	180	210	255
4	PATHOGENESIS AND PATHOLOGY		470	130	150	175	220
5	CAMEL PRODUCTIVITY AND TRYPANOSOMIASIS		275	130	145	170	210
6	BIOCHEMICAL AND IMMUNOLOGICAL MECHANISMS		753	440	500	600	700
7	EPIDEMIOLOGY OF TRYPANOSOMIASIS		355	155	180	210	255
8	CHEMOTHERAPY		700	300	350	400	480
9	MANAGEMENT OF LIVESTOCK		155	60	70	80	90
10	ENVIRONMENTAL CONSIDERATIONS		100	40	50	60	70
11	SUPPORT		700	50	60	70	80
TOTAL			4,493	1,675	1,945	2,295	2,735

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