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African Regional
Pest Management Research and
Development Network (PESTNET) for the
integrated control of livestock pests
and diseases

REPORT OF THE USAID PLANNING MISSION

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CREATION OF AN AFRICAN REGIONAL PEST MANAGEMENT R AND D NETWORK (PESTNET) FOR INTEGRATED CONTROL OF LIVESTOCK AND PLANT PESTS AND DISEASES

REPORT OF USAID PLANNING MISSION
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EXECUTIVE SUMMARY

CREATION OF AN AFRICAN REGIONAL PEST MANAGEMENT RD & D NETWORK (PESTNET) FOR INTEGRATED CONTROL OF LIVESTOCK AND CROP PESTS

Problem: Pests and diseases are major constraints to improved food production within the eastern and southern region of Africa (ESA). Is international cooperation through a system of networking a feasible method of maximizing the ability of research and national organizations and to develop and implement the use of new technology for increasing food production?

Background: Within the ESA area, a variety of pest species and the disease agents they transmit make efficient livestock and crop production impossible for resource-poor farmers, and complicate production for the larger growers and ranchers. East Coast Fever (ECF) is the most devastating tick-borne disease problem, causing considerable morbidity and mortality in livestock. With crop pests, the complex of borers attacking maize and sorghum are responsible for significant crop losses.

The countries in the region require additional donor funding and trained personnel to effect organized efforts to research solutions and application of new technologies. Zimbabwe has well-organized veterinary services and an effective research program in plant and animal sciences. Kenya also has strong national research facilities, including several international research organizations. Modest research programs in Zambia, Burundi, Malawi and Kenya are funded through FAO. A nucleus of scientific talent is scattered among the various countries and research organizations and, through research, much useful knowledge on various pests and diseases, including important new technology, is being produced.

In eastern and southern Africa, there is a need to promote and coordinate research, to exchange scientific information, to build the scientific and technical capacities in research and management personnel, and to transfer RD & D results to producers.

Solution: Organize a network of people from the various countries and research organizations who have in common the desire to solve the problems associated with pests and plant/animal diseases. This approach is an idea with considerable merit. It is readily apparent that no single research program can hope to solve all the major problems caused by pest and diseases. It is also apparent that within the region there are a number of productive research efforts addressing various aspects of the problems. A network would promote more rapid exchange of research results, new experimental methods, and coordination of projects to avoid undesirable overlap and duplication. Fledgling programs in some countries without well-developed research activities could receive advice and technical guidance by other members of the network.

Some countries in the region lack the scientists, managers and technicians; or resources needed to conduct basic research and to transfer technology. Training programs, organized and coordinated as a network activity, could help overcome the shortage. The combination of training programs already operational would provide network members with a program that is tailor-made for the needs of the region. The existence of training programs will greatly strengthen the network and should help insure its success. As the network evolves, it is likely that additional training needs will be identified.

At present various proposed network members have developed new approaches to the management of ticks and tick-borne diseases and crop pests. The ECF infection and treatment method is an important technology that should be taken to the farmers and livestock producers throughout the region. With the complex of pests affecting cereal crops, resistant plant varieties have been developed, behavorial regulating chemicals, or components identified, and biological control organisms discovered positive interventions exist for control of both plant and animal pests. Application of these methodologies will increase crop production and provide for increased milk and meat production and improved animal traction.

Recommendations

1. The ICIPE has exercised initiative by recommending the formation of a network, to be called "PESTNET", which would maximize the value obtained from the scarce funds and limited numbers of personnel available for research and technology transfer. The network concept has merit and we recommend that ICIPE be encouraged to assume an initial leadership role in the organization of a network.

2. Planning workshops would provide a forum for the exchange of information, as including: (a) a presentation of the general PESTNET concept, (b) the possible activities of the network, (c) a discussion of the idea, (d) the formulation of steps for developing a proposal to obtain funds to establish and finance the network in its initial steps, and (e) proposed one year buuget.

3. We recommend workshop participants be provided ample opportunity to provide information about programs and problems in their countries. We also recommend that International Agricultural Research Centres (IARCs) and research organizations be invited and included in discussing the workshop concept and formulating plans for establishing the network.

4. We recommend cooperation between international and bilateral donor organizations in promoting and obtaining funds for operational networks within the region.

ACKNOWLEDGEMENTS

The USAID Team invited to Kenya by REDSO/ESA wishes to extend their thanks and appreciation to the Director of REDSO/ESA and members of his staff who so graciously assisted the Team in arrangements for transport and provision of literature. To ICIPE, the Team is especially indebted for providing secretarial assistance, transport, logistics in arranging for field and ministry visits, and provision of technical backstopping materials and reports. Our appreciation is also acknowledged to staff of ILCA, ILRAD, FAO, OAU/IBAR, ODA, and the members of the Kenya Agricultural Research and Veterinary Organizations. The facilities provided by ICIPE at the International Conference Center and Guest House at Duduville were most appreciated. The Team was able to have a degree of privacy, and yet had all available facilities to assist in the completion of their task.

All members of the Team have previously either visited or worked in Kenya. We have enjoyed our assignment, and hope we have contributed to the development of a program in the Region.

With best wishes for the implementation and success of PESTNET.

Members of the USAID Planning Team,
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USAID PLANNING MISSION TO THE ICIPE ON THE AFRICAN REGIONAL PEST MANAGEMENT RD & D NETWORK (PESTNET)FOR THE CONTROL OF LIVESTOCK AND PLANT PESTS AND DISEASES

TERMS OF REFERENCE

Specific Tasks of the Mission

1. Review the ICIPE Livestock Ticks Research Program in terms of its accomplishments in research, development and demonstration (RD & D) and its training capabilities, and assess its practical application in the integrated approach to the control of ticks and tick-borne diseases.

2. Advise on the feasibility of a collaborative network within the eastern and southern Africa region as a method of transferring RD & D results of the Livestock Ticks Research Program to national institutions.

3. Advise on the feasibility of collaborative networking as a method for building the scientific and technical capacities in livestock ticks research and management in the region, through training of postdoctoral research fellows and research and field technicians.

4 Examine the feasibility of the collaborative network approach to RD & D and technology transfer, and suggest a workable organizational arrangement and mechanics for its implementation, including the use of planning workshops.

5. Suggest a viable budget for implementing such a Pestnet linking countries in eastern and southern Africa - Kenya, Uganda, Tanzania, Burundi, Malawi, Zambia, Somalia and the Sudan.

6. Prepare and submit to the USAID's REDSO (ESA) and the ICIPE, by the end of the Mission, a comprehensive report of recommendations on all the areas covered by these tasks in relation to the PESTNET for the Control of Livestock Ticks and Crop Pests.

LIST OF ACRONYMS

ORGANIZATIONS

ADB	African Development Bank
USAID	U.S. Agency for International Development (USAID)
ARPPIS	African Regional Postgraduate Programme in Insect Science
CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical
CIP	Centro Internacional de la Papa
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo
CSIRO	Commonwealth Scientific Industrial Research Organization
DANIDA	Danish Agency for International Development
IARCs	International Agricultural Research Centres
IBPGR	International Board for Plant Genetic Resources
ICIPE	International Centre of Insect Physiology and Ecology
ICRISAT	International Crops Research Center for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
IITA	International Institute for Tropical Agriculture
ILRAD	International Laboratory for Research on Animal Diseases
ILCA	International Livestock Centre for Africa
IRRI	International Rice Research Institute
IRTP	International Rice Testing Program
ODA	Overseas Development Administration
OAU/IBAR	Organization of African Unity/Interafrican Bureau of Animal Resources
SAFGRAD	Semi-Arid Food Grains Research and Agricultural Development
TAC	Technical Advisory Committee of CGIAR
UNFAO	Food & Agricultural Organization of the United Nations
WARDA	West Africa Rice Development Association

NETWORK FOR CONTROL OF LIVESTOCK AND CROP PESTS AND DISEASES

I. CONCEPT - NETWORKING

A. CHARGE

"Primary emphasis should, in our view, be to develop an approach, or framework, for a network that is capable of exchanging information and disseminating technology on any crop or animal pest, crop protection, IPM (Integrated Pest Management), etc. East Coast Fever (ECF) and tick prevalence management come into it because of the extensive research ICIPE and others, following an FAO initiative on ECF, have already undertaken and the fact that the technology is ready for dissemination. In a sense, ECF and ticks, while important in themselves, are a means to an end - the end being a network concept which can deal not only with ECF and ticks, but other crop and animal pests as well."(1)

B. DEFINITION

NETWORKING is the establishment of a system or arrangements to work on a common crop, commodity, or problem. The system may be comprised of individuals, groups of individuals, or institutions interested in solving a common problem.

C. TYPES

NETWORKS may be divided into two major types, informal and formal. An informal network is comprised of scientists developing "informal networks of contacts for exchanging ideas and information."(2) This type develops as a result of common interests, and is perpetuated through exchange of reprints, talks and meetings, or other means of communication. With the increase in importance and magnitude of a problem, and the necessity to exchange information outside national boundaries, informal networks become more formal. With more advanced networks there is frequently a central office or "hub" to serve as a focal point for collection, distribution, and dissemination of pertinent information. There is also the opportunity for participants to "interact with each other as well as the hub."(2) International screening and evaluation trials for crop varieties are an example of this type of network. In the most advanced networks, specific subnetworks may be established to intensify efforts to resolve a special problem or constraints. There is also need for financial support by members.

D. RATIONALE - ADVANTAGE

With increased costs and unavailability of sufficient inputs and equipment, the idea of networking is gaining wide popularity. The sharing of information contributes to decreased costs through lack of duplication. The evaluation of common materials, e.g. plant or seed varieties in other areas quite frequently uncovers useful information concerning relative susceptibility or resistance of varieties or organisms in regions remote from where they were originally produced. There is constant interaction in networks, with an information flow which communicates positive as well as negative aspects to further assist in better understanding and ultimate solution(s).

E. HISTORICAL

There exist more than 100 agricultural networks in operation throughout the world today.[2] Some of the earliest examples were research stations working with cash crops in colonial Africa. Cash crops included cocoa and coffee, groundnuts and sugarcane, and commercial crops of cotton and rubber. With the advent of independence, expertise as well as supplemental financing and market sales were curtailed sharply. Foreign exchange decreased. Former inputs into research stations were not supplied or maintained, and yields decreased. The mushrooming population of Africa (2.9% annual increase--the highest rate of increase in the world[3]), coupled with drought and food production problems has resulted in a marked food deficit (Table 4).. Countries are now required to divert a large part of their resources to food production. Consequently, cash crops are diminishing and not providing the necessary foreign exchange for essential commodities.

F. ESSENTIAL COMPONENTS

To establish a successful network, there are pre-requisite components. These are: [4]

"1. The problem should be clearly defined and a realistic agenda drawn up;

2. The problem must be widely shared by the would-be participating countries;

3. There must be self-interest, rather than mandating, by the participants;

4. Participants must be willing to commit resources, for example, personnel and facilities, to the programme;

5. There is always need for outside funding to facilitate operations, training, and international travel, particularly in the Third World;

6. Participants must have sufficient training and expertise to make a contribution; and

7. Leadership of the program should be strong and efficient, and should recognize the contribution of each participant."

II. DEVELOPMENT OF NETWORKS FOR CONTROL OF LIVESTOCK AND CROP PESTS AND DISEASES

A. NEEDS: Availability of meat for human consumption has declined in recent years as a result of slow growth in production and a rapid increase in human population. Similarly there is also need to increase crop production.

1. LIVESTOCK

a. Diseases

In Africa, tick-borne diseases of cattle are primarily theileriosis (East Coast Fever) anaplasmosis, babesiosis and cowdriosis. ECF is by far the most restrictive in terms of effective animal production. The disease has been recognized since the beginning of this century and there has been a continuous effort since 1912 to control or contain it. Practical application of vaccines or drugs have a favourable influence on the control of tick-borne diseases but, until recently, an economically viable system for control of ECF has eluded scientific efforts (5). In this three quarter century interval ECF has been identified in 14 of the major livestock producing countries of Africa. The initial nine countries proposed for inclusion in the animal pest network are populated by 43,938,000 cattle (6) (Table 1). As a result of research begun in the early 1970s, a system for protecting animals against ECF has been developed at Muguga in Kenya. Although this system, based on chemoprophylactic vaccination, is practised particularly among exotic animals exposed to tick infestation and in cross-bred animals more susceptible to infection than indigenous animals, ICIPE and other research organizations are seeking more effective means of control including development of immunity in animals to ticks.

TABLE 1

CATTLE NUMBERS, MEAT AND MILK PRODUCTION, VETERINARIAN NUMBERS

	Cattle Nos.(1,000s)	Beef & Veal Prod (1000s)MT	Milk Prod (1000s)MT	Milk Impts (1000s)MT	Vets.
Kenya	11,500	194	1,300	4,000	616
Malawi	900	14	39	5,010	34
Zambia	2,380	34	64	1,100	66
Zimbabwe	5,350	84	160	3,120	97
Area Total	20,130	326	1,563	13,230	813
Burundi	560	11	58	2,836	115
Tanzania	13,446	146	387	9,100	NA
Area Total	14,006	157	445	11,936	-
Rwanda	652	14	24	7,500	NA
Somalia	4,050	47	163	5,300	250
Uganda	5,100	84	385	6,550	394
Area Total	9,802	145	572	19,350	-
TOTAL	43,938				

1983 FAO Production and Trade Year books

b. Productivity - Meat and Milk

Reducing livestock losses from tick-borne diseases is an important consideration in Africa. It is reported that, while cattle numbers have increased by 20 million head in the decade from 1970 to 1980, the individual carcass weight of 139 kg/animal remained unchanged. Total beef and veal increased during this same period by 590 metric tons, but because of a substantial human population increase the average per capita consumption of beef and veal decreased from 6.6 kg to 6.2 kg. (Table 2).

The cattle industry experiences serious losses from tick-borne diseases. For instance, Kenya reports death losses in cattle of 50,000 to 80,000 head annually from ECF alone. Such losses, plus low milk productivity have resulted in a 1970-1980 rise in imports of dairy products in sub-Saharan Africa from $8 million U.S. to over $70 million, a loss in hard currency the continent can hardly afford.

Another indication of lowered productivity, due in part to disease factors, is a decline in average annual dairy products of -3.4% for sub-Saharan Africa and -5.0% for East Africa.

It has been demonstrated in ECF endemic areas of Africa that it is impossible to introduce exotic strains of livestock, particularly dairy breeds, unless animals are protected through vaccination. Susceptible animals can no longer be protected through dipping or the application of insecticide due to widespread resistance of ticks to virtually all available acaricides. New acaricides are unavailable because of developmental costs and restrictive procedural requirements for testing new compounds.

TABLE 2

POPULATION DYNAMICS AND PER CAPITA GROSS NATIONAL PRODUCT

	Population Mid 1985 Millions	Annual Increase %	Population Doubling Time years	Population Projection 2020	% Urban Population	Per Ca GN (US$)
Category one Countries						
Kenya	20.2	4.1	17	68	16	340
Malawi	7.1	3.2	22	20.5	12	210
Zambia	6.8	3.3	21	20.7	43	580
Zimbambwe	8.6	3.5	20	28.1	24	740
Category two countries						
Burundi	4.6	2.7	26	10.4	7	240
Tanzania	21.7	3.5	20	70.7	14	240
Category three countries						
Rwanda	6.3	3.6	19	20.3	5	280
Somalia	6.5	2.6	27	14.1	34	250
Uganda	14.7	3.5	20	43.7	14	220

1985 World Population Data Sheet, Population Reference Bureau Inc.

c. Power from draft animals

Energy to convert Africa's rich land resources to productive agricultural commodities is critically deficient. Numerically, oxen are abundantly available for efficient cultivation, but they are little used, and the basic reason for this underutilization lies in the incapacity of these animals to perform. This incapacity is directly related to inherent small size aggravated by disease and poor nutrition. While control of diseases, such as ECF, and improved nutrition could compensate to some extent for the genetically inherent stature and the small size of work animals, it is necessary to introduce animals of genetically superior size to provide efficient draft power. There can be no doubt that the overriding obstacle to breed improvement in a vast area of fertile Africa is the existence of ECF, a disease to which such breeds are completely susceptible. No effective system exists for ameliorating the deficiencies of the African Zebu unless standards of disease control and adequate nutrition are improved. In the case of disease control ECF must be the primary target.

2. Crops

a. Pests and Diseases

Sorghum, maize, and cowpeas are the major food crops of Africa. Principal pests of sorghum include the sorghum shootfly, Atherigona soccata; and lepidopterous stem borers, Chilo, Busseola, Sesamia, and Eldana attacking both maize and sorghum. Cowpeas, of original African origin, are infested by several species, including: the podborer Maruca testulalis, thrips, and sucking pests such as aphids and leafhoppers. Maize streak virus, transmitted by leafhoppers, is the major disease of maize in Africa. Charcoal rot is the major fungal disease of sorghum. All three major crops are attacked by a parastic weed, witchweed or Striga.

b. Estimated Losses

Pre-and post harvest pest and disease crop losses of principal crops range from 10 to 33% or more. With heavy thrips infestation at time of flowering in cowpeas, there may be extensive sterility with virtually no grain harvested. If pest losses were cut by even 5 - 10%, there would be substantial increases in food to foster improved nutrition. Production of major crops is marginal in many areas, and with cooperative network activities can start to be substantially minimized.

c. Improved Control Methodologies

The development of plant varieties resistant to many major pests is of major importance. Crop varieties tolerant or resistant to major pests and diseases provide the farmer with a natural level of resistance. Pesticides are not necessary, and cannot be afforded in the majority of areas.

Biological control methods represent another natural method of pest control. Beneficial insect parasites/predators and fungi, viruses, bacteria and nematodes have been identified which augment pest reduction. Farmers have used cultural practices to assist in biological control for some time. In subsistence agriculture, there is a delicate balance between obtaining a harvest or no yields. If yields are obtained, it is usually the result of the interaction between natural controls.

New methods of behavioral manipulation are being uncovered with the biochemical and ecological investigations of pests. Pheromones are one of the more effective materials employed in sexual attraction, trapping, and monitoring of pest populations.

B. OBJECTIVES

1. Develop and disseminate technology

Many national and international organizations dedicated to improved agriculture exist in Africa today, and a number of these have objectives to improve agricultural productivity. Some are directly involved in improved animal health and animal disease control and plant protection. In the case of national institutions within the framework of the Ministries of Agriculture, the infrastructure, as well as a shortage of technical manpower, limit the scope of research and development, but these limits do not imply lack of capabilities or growth potential. Some of these national institutions and services are making notable headway in pest and disease investigation and control. The IARCs located in Africa, to a greater or lesser degree, have mandates for animal and plant protection and improvement. They are functioning effectively in a number of areas, but none are broadly directed to the task of field operations, widely applicable training, or continent-wide dissemination of knowledge related to plant and animal disease investigations and control. ICIPE's mandates include these needed elements in progressive plant and animal agricultural programs, with a capacity to integrate research and development.

2. Assist in development of science and technology manpower

With widespread diversity and fragmented research related to scientific and technological development, there is a pressing need for coordinated systems to maximize the talented achievements of manpower in African institutions. There is also a need to stimulate and accelerate associations and communications within the scientific community and institutions outside Africa.

C FEASIBILITY

ICIPE is a member of the "Nairobi Cluster", a network established with 12 research organizations in 1981 for communication and planning animal disease and parasite control.(9) This is a voluntary organization of research scientists and technologists, staffed by a presiding officer and a secretariat, which meets quarterly to discuss research efforts of common interest and future programs especially in respect of trypanosomiasis and ECF.

ICIPE, as a well-recognized and international supported institution, appears to be a logical choice to organize a similar "cluster" or network. This concept involves national and international institutions and agencies working in common to control debilitating animal diseases and proliferation of insect vectors.

ICIPE's outreach and training unit has collaborative research and development programs with several African countries, 7 IARC's, CSIRO, Switzerland and Israel. These projects include research on plant and animal pests and diseases.

III. ORGANIZATION OF NETWORKS

A. PARTICIPANTS

1. Countries of eastern and southern Africa to be included in the proposed livestock tick network are: Kenya, Uganda, Tanzania, Rwanda, Burundi, Malawi, Zambia, Somalia, Zimbabwe, and the Sudan. For the crop pest network, there will be countries in addition to those proposed for the livestock network. As specific needs and projects arise, the country membership will be revised accordingly.

2. Organizations invited to attend network organizational meetings include members of OAU, FAO, UNDP, IBRD, the Nairobi Cluster, EEC, CIDA, and USAID. These organizations have key regional offices in Nairobi. Similarly, representatives from IARCs operating in the region will be invited to appropriate network organizational meetings. IARCs to be considered include: CIMMYT, CIAT, CIP, IRRI, IITA, ICRISAT, ICIPE, ILCA, and ILRAD.

3. Delegates to network organizing meetings will be a senior scientific officer from each of the participating countries. For the forthcoming workshops on control of livestock tick and tick-borne diseases, the Chief Veterinary Officer from each of the proposed countries will be invited. Similarly, a senior plant protection officer or agronomist will be invited.

B. COORDINATING UNIT

1. Initial coordination of discussions on networking in October 1985 will by assumed by ICIPE. Preliminary contacts have already been made with countries in the region, and arrangements are under way to accommodate participants in ICIPE's Duduville International Guest Centre in Ruaraka, on the outskirts of Nairobi.

2. Role

a. Organization of the proposed network(s) is for ICIPE initially to play a significant role. As mentioned previously, funds have already been obtained by ICIPE for hosting the initial workshop. The topics of these workshops are included in ICIPE's present annual work programs. The Livestock Ticks Research Program and

the Crops Pest Research Program represent major areas of effort, and account for 17% and 33% (12) of the annual ICIPE budget (1984), respectively. During 1984, 2 of the 14 major seminars at ICIPE dealt with ticks and animals response, and 4 of the seminars dealt with crop pests. There were 8 ICIPE publications on tick research last year.

ICIPE is also a member of the Nairobi Cluster. The "Cluster" was founded in September 1981: "to create a forum and framework for the exchange of ideas and information, to promote collaboration between scientists, to maximize utilization of resources and expertise, to facilitate training programs, and to avoid duplicaton of effort." (5) This information supports the position of ICIPE to work on initial organization of the proposed network in cooperation with other participating groups.

b. On-going programs in tick research and crop production are being continued and expanded at ICIPE. Support for both tick and crop pests research have been received from donors. There are plans to move ICIPE from the Chiromo Campus at the University of Nairobi to the newly-established center at Duduville. An International Conference and Guest Center, with accommodation for 25 participants, is already completed and in operation. This site is located 12 km. from Nairobi center and has a high degree of privacy, a factor of importance in scheduling conferences and workshops without "competition and distractions from the bright lights of the city."

Further on-going activities of ICIPE include many types of training to be discussed in the following section. Training is regarded as one of its least expensive, but most valuable resources.

C. ACTIVITIES

1 1. Research coordination

Dealing with autonomous and widely dispersed institutions can be complex. Complications are due to multiplicity of donors, national operational regulations, funding, and the varied United Nations organizations. Research coordination must be discrete to assure cooperation and collaboration. It must be well-planned to negate jeopardizing prerogatives of the institution or organization. In reviewing research and programs under way in network target areas, it is apparent a number of institutions and organizations are carrying on similar or complementary programs. The network should facilitate communication on progress of such work, and stimulate reciprocal exchange of information and research developments.

2. Human resource development

In order to exchange or communicate research information to field trials and other laboratories, a constant and comprehensive program of training is essential. ICIPE has established an Outreach and Training Unit with extensive training programs at various levels. It has collaborated with other institutions and organizations in specialized training courses. ILRAD and ILCA have also developed core and outreach training programs with institutions and personnel in other countries.

It will be necessary for a network to expand and extend training systems as research achievements by the associated institutions and organizations develop.

a. Short-term training

Workshops held periodically at major research institutions constitute an excellent device for communicating research developments to a relatively large number of participants. A network should compile and distribute lists and agenda of pertinent workshop activities for distribution to workers at relevant institutions. In addition to workshops, a number of institutions offer specialized short courses.

b. Long-term training

A network should encourage academic training at all levels, and assist in arranging appropriate training for personnel from a wide range of institutions in Africa. As noted, ICIPE has assisted in the establishment of the African Regional Postgraduate Program in Insect Science (ARPPIS) as a collaborative venture between ICIPE and African universities.(7) This has attracted twenty four post graduate students, and the program should be continued and supported. ICIPE has maintained an active interaction with the IARCs in research on tick and tick-borne diseases. A network should encourage and promote graduate and postdoctoral fellowships from a wide range of African institutions. Post graduate and postdoctoral educational opportunities exist at most of the world's academic institutions, and there are a large number of sponsors for such training. A network should appraise the qualifications of candidates and communicate appropriate information to the institutions involved.

c. Outreach support

The concept of outreach support training refers to extension of tick and tick-borne disease and crop pest investigations to other regions or countries. Since dissimilar conditions, e.g. climate, tick species, tick densities and other ecological factors, may occur from one location to another or from one country to another, it is appropriate to test research results in more than the original location. Retesting or re-checking research in a new location may provide invaluable information.

3. Dissemination of information

a. Newsletters are considered the most effective and economical means of communication in networks. Newsletters can be short, one or two page publications prepared at minimum cost. With circulation among members, there is assurance of continued contacts and communication. Members should let the network know if there are changes of address, so there is constantly an updated and current roster. A major advantage is that it serves as a current and complete directory of members involved, a type of "old boy network." As a network grows, newsletters keep pace. Short newsletters become longer, and at times have

developed into scientific journals serving the interested group. Newsletters which do not achieve journal status frequently serve as a medium for publication of short research notes. Scientists in some countries have insufficient funds to publish in refereed journals, so newsletters fulfill a most valuable role. With the growing size of networks, and members dispersed over a large area, newsletters are a most valuable form of communication.

b. Workshops are the mechanism which bring participants together in a common place to discuss and further define and refine methods and practices. Workshops are second only to the newsletter as an essential mechanism to ensure functioning of a network. In many developing countries, workshops provide a means of network members being able to visit and exchange information first-hand. Some countries do not have national meetings in specific disciplines, but have regional meetings or workshops.

Workshops provide an invaluable means to further upgrade training and expertise of participants. Benefits are also obtained from travel and the opportunity to observe conditions in other countries. The SAFGRAD program in the Sahel is one of the more successful, and offers opportunity for national staff to travel and observe trials throughout the region. Monitoring tours, which comprise one of the main components of some networks, are indispensable. The upgrading of training and skills ensures the success of a network through increased efficiency and knowledge.

4. Technology-transfer is regarded as one of the more significant roles of networks. Today, many institutions have developed improved varieties and methods. The "missing link" is the means and capability to transfer this technology to the small farmer. This is the area in which networks must assist.

a. Demonstration projects are critical in transferring new technologies. Farmers are astute; they learn by seeing and doing. One demonstration project can serve as the focus and means of multiplying a successful intervention. Sometimes the experiment is so successful, experimental materials --- be they cattle or improved yam varieties --- are "removed" from the experimental area before breeding or harvest.

Farmer assistance and participation is also required in demonstration projects. The farmer must actually be involved in the demonstration and responsible for as much actual work as possible. He should in turn explain and demonstrate to other farmers the merits of the improved technology. Model or more progressive farmers in a village should be sought out to multiply improved seed varieties.

Care must be taken in demonstration projects to ensure that farmers receive the total crop yield. Weights of animals and drying of crops must be done in the field, and not be removed for processing. Compensation is paid to farmers only if the demonstration is a loss. Too frequently, there have been insufficient demonstration projects because compensation is offered to the farmer before the trial. With proven technologies, failures are minimal. The increased yields obtained from the improved technologies should be more than enough to compensate the farmer.

Incentives and bonuses are also effective in disseminating the improved technologies. In cowpea trials farmers have been offered fences to enclose their experimental plots; this keeps the goats and sheep out of the demonstration. The fence remains the farmers, and, after harvest, he is able to plant other crops or allow a successful fallow without overgrazing.

Many networks also provide kits or demonstration packages for dissemination throughout the region. These provide information on adaptability and performance of varieties under varied conditions, including exposure to diseases and pests. Many useful genetic traits have been discovered in network demonstration projects.

b. Extension techniques are essential to supplement demonstration projects. Too frequently there are insufficient extension aids or organizations to disseminate information and products to farmers. Vehicles and transport are a major constraint, so other communication means must be emphasized such as radio, pamphlets, and brochures.

(i). Bulletins/publications are frequently the major means of dissemination of information. Examples of the type of excellent publications available include the ILRAD/ILCA/ICIPE: "Network Training Manual/Livestock Productivity and Trypanotolerance"(13) and the IITA Manual on: "Alley Cropping, A Stable Alternative to Shifting Cultivation"(14). Witness also the popular efforts of the commercial sector, with calendar and advertising information on posters frequently displayed in many farm homes. Crop calendars, diagrams of life cycles, and posters are effective. Printed bulletins should be simple and diagrammatic. The guideline is K.I.S. (= Keep it Simple). Network publications or newsletters can serve when there is lack of printed or illustrated information. Some of the more effective network publications have been pocket-sized field manuals with abundant photographs, and the more successful of these have been published in many languages.

(ii). Field days can have an immediate impact on the transfer of new technologies. Fortunately, it is becoming a more common practice for large experiment stations or IARCs to invite farmers at time of harvest to assess performance of improved technologies. Distribution of improved seeds, cuttings, etc. resistant to some of the more common pests and diseases would be desirable. Many new varieties or techniques have been employed "outside the station gate" by adjacent farmers who have witnessed the performance of improved technologies.

One of the most important advantages of field days is the possibility of dialogue between research workers and farmers. No technology can be successful until it has proven itself in the field, in farmers' fields. Animal and crop networks must utilize field days to the maximum to actually show farmers the benefits of improved breeding and cultural practices.

The numbers of field days which institutions are conducting is increasing as the impact is realized. The transfer of technology to farmers involves a two-way process which first determines what interventions are necessary to improve farmer productivity. Field days afford farmers the opportunity to observe and evaluate first hand the developments intended for their adoption.

D. SUPPORT

1. National resources.

Commitments are required by all participants. Within the eastern and southern Africa region there exists wide variation in national resources. Some countries have significantly more facilities than others, and will be forced to assume a greater part of the responsibility and the financial burden. Prerequisite resources from each of the proposed network countries include:

a. Staff must be qualified to assist in network activities. Junior and senior staff, as well as technicians, drivers, and field hands are necessary. The national governments must be committed, without reservation, to delegate the necessary number of staff to assist in the network program for ultimate success. Further training and upgrading of staff as well as government support and financing may be required. Based on the relative numbers of cattle or pest problems, there must be an appropriate and corresponding number of staff delegated to undertake network activities.

b. Land for conducting demonstration projects and experimental trials must be supplied by host countries. In addition to the government research stations and farms, provision for experiments with cattle and crops in farmers' fields must be provided. As indicated previously, demonstration projects involving extension techniques are essential. Provision for land rent, purchase, and advance compensation is not considered an issue. The improved techniques to be extended in network activities are proven methodologies for significantly improving farmers' yields.

c. Buildings and physical plant facilities, including barns, field sheds, enclosures, tick dips, fenced areas, and holding pens are necessary to implement and support national network activities. Maintenance and repair of facilities must be ensured. One tick-infested African buffalo in an experimental cattle site or paddock can invalidate a carefully planned experiment on tick resistance and control. There must be a commitment of local government to provide supplies and labor to maintain satisfactory operation of all facilities.

d. Equipment, supplies, and vehicles must also be available in national network programs to effectively carry out trials. Transport is a major problem not only in the supply of sufficient vehicles, but also upkeep and maintenance.

2. Donor funding is a prerequisite for an effective network program. Without outside support from the international community, there is no mechanism for provision of a sustained purchase of essential supplies. Lack of recurrent expenditures has been the downfall of many programs in the developing world. Many projects have been funded by donors for 3 or 5 years at a time, with a maximum of a 10 year time frame. Progress is slow in initial years. The net result is that, when projects begin making progress, donor funds are discontinued. The ability to supply spare parts also vanishes. Equipment falls into disrepair, and becomes obsolescent junk within a relatively short time. If training has been accomplished during the program, there is at least a salvageable entity. No network should be established until sustained and continued means of funding are identified.

Donors focusing primary attention on Africa include: EEC (Great Britain), GTZ (West Germany), CIDA and IDRC (Canada), Governments of France, Belgium, Italy, Netherlands, Norway, Denmark, Switzerland, and USAID. Major international organization donors are: UNEP, FAO, IFAD, IBRD, ADB, and IMF. OAU currently is in an advisory and political role, not a donor.

A multidonor arrangement known as CDA (Cooperation for Development in Africa) might also provide significant funding for networks in Africa. CDA is an informal grouping of major donors interested in directing more attention to development in Africa. The grouping consists of the governments of Great Britain, Canada, Belgium, France, Italy, and the United States. CDA, formerly known as CADA (Concerted Action for Development in Africa) was initially discussed in 1975/76 and, after several metamorphoses, was defined in 1979. It was divided to support programs in agriculture, including research, reforestation, transport, and health.

It was further agreed that certain members of CDA would be the lead country for selected regions of Africa and be responsible for country surveys and eventual coordination of implementation of programs. Thus, five major agro-climatic zones were identified to facilitate research programs and sharing of results. These include: Sahelian - Sudanic zone (United States has responsibility), West Africa Coastal zone (West Germany), Congo Basin zone (Belgium), East African zone (Canada), and Southern Africa Plateau (United States). Other donors not listed as primary lead in zones have agreed to assist with backup support. The United States has finished assessment of the Sahel, and the survey of SADACC countries of Southern Africa will be completed within the next few months. This survey should be consulted when plans for networks in Southern Africa are considered.

Livestock provides the most significant source of foreign exchange for some countries in addition to being a source of meat, milk, and hides. Animal traction is also an important consideration in Africa. A recent USAID survey [8] indicates 85% of the tilled land in Africa is tilled and managed with the common short-handled hoe. Tractors and machines are used in 2% only of the total land preparation, and animal traction is used in 13% of the cultivation. Plans to increase food production should take into account the increasing importance of animal traction. It is for this reason healthy and stronger animals must be developed.

Evaluation and monitoring of projects is necessary. Quarterly reports should be submitted with full financial data, and there should be a comprehensive annual evaluation and summary.

3. International Institutes are, and can be, of primary assistance in the development of networks. Some of the earliest and continuingly successful networks were established by IARCs such as IRRI and CIMMYT for screening and evaluating improved cereal varieties in many regions of the world. This year, IRRI, IITA, and WARDA agreed to establish a network for evaluating rice varieties in Africa. These three international institutes joined together to form a network designated as IRTP (the International Rice Testing Program) for Africa.

In the present CGIAR (Consultative Group for International Agricultural Research), there are thirteen IARCs (International Agricultural Research Centers) throughout the world. These centers constitute a network in themselves dedicated to increasing agricultural production. They receive basic core funds from the CGIAR for annual operating expenses, and obtain additional budgets from private donors and national governments. A commendable fact is that all the 13 IARCs have programs in Africa, and the majority have programs in Sub-Saharan Africa. These centers can serve as a focal point for the research developments applicable to the small farmer.

In addition to the IARCs, there are international research institutes, such as ICIPE, using improved technologies, and whose work programs compare in size and calibre to some IARCs. These institutes have contributed significantly to past achievements in agricultural fields, and are continuing at an accelerated pace to refine and expand programs and applications of current research.

In addition to basic research, some of the institutes sponsor a variety of types of training, ranging from short courses and seminars to long-term programs. These run from several months to completion of graduate degrees. ICIPE has trained a total of 196 students in the International Group Training Course in Pest Management since 1977. Students in the course have come from 36 countries; including representation from Latin America, Asia, and the Middle East. In addition, ICIPE recently established ARPHIS (African Regional Postgraduate Programme in Insect Science) with a total of 23 students actively pursuing Ph.D. degrees and conducting research at ICIPE. These students receive their degrees from 11 major universities in Africa.[7]

Training is regarded as the single most meaningful asset which results from interaction of personnel with international research institutes.

IV. INITIATING THE NETWORKS

A. PLANNING WORKSHOPS are necessary to coordinate formation of a network. With projects of regional importance, participation and contribution from several countries must be expected.

1. Purpose of the planning workshop is to consider establishment of networks. The programs considered initially for eastern and southern Africa pertain to control of livestock ticks and crop borers. With the urgent need to increase food production in Africa, the control of pests and diseases of livestock and crops will assist in reducing major food deficits.

2. Organizer (ICIPE) of the workshop should also be responsible for provision of funding. Funding, for the first two proposed planning workshops on ticks and livestock diseases and crop borers has been applied for and received by ICIPE. ICIPE works in collaboration with members of the Nairobi Cluster on research of animal diseases and vectors. In the field of crop pests, ICIPE has several ongoing projects with African national governments and IARCs. ICIPE will host the initial planning workshops on the basis of its: (1) having received sponsoring funds, (2) involvement in current animal disease and crop pest control programs, (3) central location in the Nairobi area, and (4) the availability of conference and guesthouse facilities at the Duduville Campus.

3. Participants for the initial planning workshop will have a key role in determining its success. For this reason, the participants must be persons with administrative authority in their home countries. They should also have a technical background in order to assist in designing programs for the network activities. For the forthcoming tick and tick-borne disease and crop pest workshop, senior veterinary officers and senior crop protection officers will be invited.

4. Venue of proposed workshops will be Nairobi, October 7-9, 1985. Workshops will run concurrently at the Duduville International Guest and Conference Center.

5. Programs suggested for the workshops have been prepared in draft form. For the tick and tick-borne disease planning workshop, a proposed schedule should include:

a. Opening Ceremony
b. Country Presentations* (Concurrent sessions with crop pests group
c. Tour/Discussions
   1) ECF Tick Control Demonstrations
   2) Rusinga Island and Mbita Point Visit (latter will host Crop Pests group)
d. National Pest Problems (by country)
   1) Situations
   2) Control Strategies
e. Review Pestnet constraints for Livestock and crop Pest Research
f. Proposed African Regional Livestock and Crop Pest networks

6. Proposed Future Budget for African regional livestock and crop pest networks, and annual workshops. A sufficient budget in all probability would not be available at the outset. After the network has been established and proven to be effective, donor support for comprehensive regional networks could be found to support the following proposed future budget for livestock and crop networks.

PESTNET BUDGET

		U.S. Dollars
Personnel(1)		
Executive Secretary	35,000	
Professional Livestock Pests and Diseases 1/4 time		8,750
Professional Crop Pests and Diseases 1/4 time	8,750	
Secretary		6,000
Networking(2)		
Staff travel (30 trips x $330 Ave./trip)	10,000	
Per diem (90 days x $ 75/day)	6,750	
Steering Committee travel	2,500	
Per diem	1,000	
Technical exchanges and monitoring tours	12,000	
Per diem	4,000	
Training and Grants (3)		
Long term ($15,000 x 3 trainees)	45,000	
Short term	20,000	
Research grants	40,000	
Workshops (4)		
Participant travel (40 round trips x $330)	13,200	
Per diem (40 participants x 4 days x $75/day)	12,000	
Resource Persons travel	4,000	
Per diem	1,000	
Accident, medical insurance	1,500	
Publications (5)		
Newsletters, Workshop reports, Reproduction and distribution of publications	10,000	
Equipment (6)		
Computer (Wang or IBM PC) and software	12,000	
Contingencies	5,025	
TOTAL DIRECT COSTS	258,475	
Management costs (at 18% of direct costs)	46,525	
TOTAL Initial year	$ 305,000	

1/ An executive secretary would be employed to coordinate PESTNET programs, promote collaborative activities among scientists from participating countries, and liaison with donor organizations. Leadership and direction would be provided by scientists within the network through the steering committee and the two part-time professional staff members.

2/ The networking concept will be fostered not just by the employed staff, but also by member country scientists traveling to provide assistance within the network region as their expertise is required, and as their workloads will permit.

3/ The training and research grant monies will provide opportunity for human resource development which will strengthen participating countries cadres of research scientists and technicians.

4/ An annual workshop is important to bring concerned scientists and program managers together at least once per year for review of current scientific developments and to share in the responsibility of directing and promoting activities of their network.

5/ Newsletters and other forms of publications will help insure that scientists both within the participating countries and outside agencies will be kept abreast of the latest developments.

6/ Computer equipment can be utilized to great advantage in facilitating activities of the network including financial management, literature cataloguing and publication development.

B. POSSIBLE ACTIVITIES of a livestock network are described in detail in Annex 1 of this report. For effective control of ECF in eastern and southern Africa, there are several methodologies and approaches given in Part II. With concerted, and cooperative efforts of an integrated network operating in the afflicted countries, losses from ECF can be minimized. The farmer will be the beneficiary from this program. There will be larger cattle, increased milk production, and more effective animal traction. Likewise, with reduction in pre-and post harvest crop losses from pests, there will be more available food. Eventually, with surplus production, there will be a source of revenue.

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BRIEFING SCHEDULE FOR PESTNET PROJECT FROM
MEMBER: DR. PAUL LIPPOLD

July 9	Briefing with Nigeria AAO, Keys McManus
July 10	Initial Meeting with Dr. M.P. Cunningham, ICIPE
July 11	Initial Visit to ICIPE, USAID and REDSO/ESA REDSO/ESA, William Faught USAID, ADO David Lundberg, Assistant ADO John Thomas Dr. John Koehring, Director REDSO/ESA Dr. Robert McColaugh, Assistant ADO, REDSO/ESA ICIPE Deputy Director, Dr. M.P. Cunningham Dr. Alan Young, ODA Project Leader, Muguga Dr. David Brocklesby, Director Center for Tropical Veterinary Medicine, Glasgow, Scotland Mr. Robin Long, IBRD Consultant, Nairobi Mr. Harold White, Retired Farmer and Developer of Type 1 original resistance in oxen for tick immunity and resistance to East Coast Fever
July 12	Meeting with Team Members Drs. Nels Konnerup and John George General Team Briefing with Dr. M.P. Cunningham
July 12	Further meetings with team, also with Drs. Koehring and McColaugh
July 14	Additional meeting with Team, Drs. M.P. Cunningham, David Brocklesby, and Alan Young
July 15	Dr. Lou Williams, formerly IITA and now IFDC evaluating CIP fertilizer imports for USAID, Dr. John Thomas. Travel and meetings with several additional contacts balance of time in Kenya until completion of report and return to Nigeria on 7 August. Dr. Bill Alan, same designation Professor Thomas R. Odhiambo, ICIPE Director, Dr. Z.M. Nyiira, Station Manager, Mbita Point Field Station, and also Head, Outreach and Training, ICIPE, Dr. Abdul Mongi, ICIPE Tick Physiologist Dr. Christine Mango, ICIPE Tick Immunologist Dr. Robin Newson, ICIPE Tick Biologist Dr. T. Dhadialla, Research Scientist - Chemical analysis of candidate tick antigens Mrs. W. Ssebunnya, Systems Analyst, ICIPE Dr. M.B.A. Nyindo, Senior Research Scientist, Livestock Ticks Research Programme, ICIPE Mrs. Mary Vundla, Scientific Officer, Chemistry and Bioassay Research Unit

BRIEFING SCHEDULE FOR PESTNET PROJECT FROM
MEMBERS: DR. JOHN GEORGE/DR. NELS KONNERUP

8 July - Washington DC/Rosslyn Virginia.
Conferred with Drs. Jack Robbins S&J/FA
Dr. Anson Bertrand S&J/Agr., Mr. Phil Warren
S&J/Agr., Mr. R. Altman S&J/Agr., in the office
of Dr. Bertrand.
The S&J/Agr. group gave a general description of the PESTNET review proposal which followed a format based on correspondence including correspondence, from ICIPE to USAID officials describing a team approach to assist in the preparation of a workshop to follow some time later in the fall. This material contained some superficial material on ICIPE technology and considerable cable traffic on the organization and staffing of the team. In retrospect, considerably more detailed reports on ICIPE, a previous World Bank Report on ICIPE and other material we obtained after arrival in Nairobi would have been useful. Dr. Bertrand expressed a favourable impression of ICIPE's capabilities and achievements as an international center but impressed upon us that despite the consequences of the review team operation or other developments further AID support from Central funding could not be expected.

10 July - Rome

Drs. George and Konnerup met with Dr. Paul McCosker, FAO Tick Program Officer, and discussed briefly the FAO activities related to the PESTNET program. McCosker arranged meetings with appropriate FAO personnel for 11 July. The team contacted the FOODAG office of the American Embassy and a meeting was arranged to meet with Ambassador Millicent Fenwick at 5:30 p.m. on 11 July.

11 July - Rome

A meeting with Jan LaRoux FAO Tsetse fly officer was arranged and the FAO activities in this area was briefly reviewed. Subsequently, the meeting on the Tick Program which included Dr. Y. Ozowa, Director Animal Health, Dr. Paul McCosker, Dr. P. Atang and Mr. Frank Strong of FAO; FAO tick program relative to ICIPE including program supported by DANIDA were discussed. FAO has established tick and/or animal health programs in Malawi, Zambia and Kenya and has explored tick problems in a number of countries in East Africa, Central Africa and southern Africa as well. FAO has a close liaison with the Organization of African Unity through Dr. Atang. FAO appeared concerned that activities engendered by the PESTNET review might have some influence on matters that are considered FAO prerogatives. Otherwise the personnel participating were cooperative in describing FAO's role in the African tick and tick-borne diseases problem.

The FOODAG office at the American Embassy arranged a meeting with Ambassador Millicent Fenwick and Drs. George and Konnerup had an opportunity to spend a full hour with the Ambassador who expressed a serious interest in the PESTNET review. She was

knowledgeable about the ICIPE program, the Director and the objectives of controlling diseases in Africa. She was somewhat critical of FAO operations in general. We attempted to provide as much detail as possible about the team objectives as outlined by AID/W and the Ambassador requested that she be informed concerning our conclusions on completion of our task.

12 July Arrived Nairobi, Duduville, 9.00 a.m.

ANNEX 1

I. USAID PLANNING MISSION TO THE ICIPE ON THE AFRICAN REGIONAL PEST MANAGEMENT R & D NETWORK (PESTNET) FOR THE CONTROL OF LIVESTOCK PESTS, ICIPE TERMS OF REFERENCE

A. TEAM TASKED TO THE REVIEW OF THE ICIPE LIVESTOCK TICKS RESEARCH PROGRAM

1. Scope of Work and Research Program

a. Summary of current research activities: The ICIPE Tick Research Program is subdivided into three major interrelated areas: (1) Studies of naturally acquired resistance (type 1 immunity) to ticks; (2) Investigations of artificially acquired resistance (type 2 resistance) and; (3) Research on tick ecology. Because of its importance as the vector of East Coast Fever (ECF), *Rhipicephalus appendiculatus* is the major tick species under investigation and the goal of the program is the development of biological control technology centered around the use of type 1 and/or type 2 resistance to protect cattle against ticks.(5) Such technology could be employed in the field in concert with the use of the ECF vaccination-treatment method to permit the introduction of improved breeds of cattle without the necessity of dipping cattle twice weekly.

Presently, experiments on type 1 resistance are being performed on both rabbits and cattle. The experiments on rabbits are providing basic information on naturally acquired resistance to *R. evertsi* and *Amblyomma variegatum*, species of ticks often on cattle parasitized by *R. appendiculatus*. Investigators have determined that rabbits resistant to *R. evertsi* are cross-resistant to both *R. appendiculatus* and *A. variegatum* while rabbits resistant to *A. variegatum* were cross-resistant to *R. appendiculatus* but not the converse. By infesting tick-naive calves with ticks sterilized by gamma radiation it may be possible to induce type 1 resistance before these animals are released into tick-infested pastures.

Sterilizing doses of radiation have been determined and preliminary tests demonstrated that irradiated ticks can induce resistance in rabbits. After additional research with rabbits as the hosts, the technique is being tested on cattle. On Intona Ranch, in the Trans-Mara Division of Narok District, a long-term field experiment is investigating the effect of tick-resistant Boran calves on the population dynamics of *R. appendiculatus*, *R. evertsi*, *A. coherens*, and *Boophilus decoloratus*. Nine months after the experiment began it is obvious that in pastures restocked at regular intervals with naive calves, the populations of each of the 5 species of ticks are appreciably larger than in adjacent pastures stocked with resistant calves. The physiological condition and, concomitantly, the rate of weight gain appears to be better in the tick-resistant animals. Because the experimental pastures are fenced to prohibit introductions of ticks by large wild game animals, after approximately two years, few if any ticks should be present in the pastures containing the resistant cattle.

Current efforts to produce a tick-derived antigen that will elicit protective immunity in cattle against R. appendiculatus are focused on the midgut as a possible source of an immunogen. Extracts of crude homogenates of the midgut of ticks were antigenic in rabbits and stimulated protective immunity against subsequent challenges with ticks. A partially purified protein extract exhibited about the same degree of protective immunogenecity as the crude homogenate and this protein will be purified and tested further. If an antigen from the surface of the midgut epithelium could be identified and used to innoculate host animals, antibodies specific for this antigen could bind to the surface of the midgut and promote lysis of this tissue and the destruction of the tick. Another strategy for using host antibodies as a means of controlling ticks would be to isolate and characterize tick digestive enzymes and then use one of these enzymes as a immunogen. Host antibodies against such enzymes would be expected to neutralize or inactivate the enzyme when the antibodies are ingested as part of the blood meal. To date, one enzyme, a carboxyl proteinase, has been partially purified, its physiological activity has been investigated, and it has been tested in rabbits for antigenicity.

Unfortunately, the immune response stimulated by the enzyme did not protect against a subsequent tick challenge. Future experiments with possible immunogens will include tests of combinations of antigens with a selected variety of adjuvants and immunopotentiators.

Research on tick ecology is providing information on survival rates, infestation rates on cattle, and patterns of seasonal activity. One study on the survival of free-living R. appendiculatus is being performed at Intona Ranch in Western Kenya and a similar study is being initiated at Mbita Point. Data on the seasonal incidence of all tick species on cattle are being collected at both locations. An understanding of tick ecology and population dynamics is an essential component in the development and implementation of tick management strategies.

b. General comments about the research program

(i). The current research program has been undergoing a transition from a more broad effort that at one time included studies on tick ecology, on the physiology of both argasid and ixodid species, and, more recently, on acquired resistance of hosts to ticks. Except as it relates to the development of a method for stimulating type 2 resistance, research on tick physiology has been curtailed. A greater concentration of effort appears to be a sound strategy. Of the possibilities for developing technology for the biological control of ticks affecting livestock, artificial stimulation of acquired resistance of cattle is the approach which offers the highest probability of producing practical results in the shortest time interval.

(ii). The Intona Ranch and the Rusinga Island Projects are both important steps in the development of an integrated process of controlling ECF and developing type I resistance technology along with the demonstration of the advantages of upgrading poor-quality indigenous Zebu cattle. The scope of both of these programs should be expanded if possible. The expansion of the programs has been discussed among members of the USAID team and relevant ICIPE scientists. We agree that such projects have value as a means of perfecting technology and could be important as models for similar projects in other PESTNET countries. Also, these "model" programs could become a useful component of a training program for PESTNET participants. Broad outlines and proposed budgets for each of these projects are in the annexes to this report.

(iii). The Veterinary Research Department at Muguga has a long history of scientific achievement and is now headed by a Director who enthusiastically supports an integrated research approach by ODA, USDA, ILRAD and ICIPE and Kenya government field programs on work related to ECF and other tick-borne diseases. The major recommended thrust of the combined research activities is outlined below and it is endorsed and coordinated by the Nairobi Cluster, a group of eleven research institutes involved in research into animal diseases, their vectors and their impact on animal productivity.

Major objectives are (1) to assist in the extension of the infection/treatment method for controlling ECF, (2) to conduct evaluation of chemical, biological and ecological methods of tick control supportive to existing and planned ICIPE programs, (3) to evaluate new chemotherapeutic agents for theileriosis, (4) to continue studies on the epidemiological aspects of theileriosis and assess various interventions, (5) to evaluate and compare integrated pest management field systems including cost effectiveness, (6) to investigate and introduce immunization methods against tick-borne diseases other than ECF and explore possibilities for combined immunization use.

It is expected that the collaborative research developments and their field application may be extended through the network approach to complimentary research efforts and field trials being pursued in other countries in the regions that are supported by national and international programs.

(iv). ICIPE is acutely aware of the program limitations imposed by a lack of research facilities, but the completion of new facilities at Duduville will relieve this problem. There is also a shortage of a variety of pieces of equipment that are essential to the timely pursuit of the goal of developing an anti-tick vaccine.

(v). Overall, the research program appears to be functioning very well.

2. Development and demonstration of technology:

The scientists in the Livestock Ticks Research Program are mission-oriented. They are cognizant of the importance of applying results of research to the solution of problems caused by ticks and tick-borne diseases. The Rusinga Island and Intona Ranch Projects can be important links in the combined application of the ECF vaccination method and type 1 resistance in improved *Bos indicus* type cattle to increase the productiveness of many resource-poor farmers. We recognize the intense pressure to produce new technology placed upon institutions such as ICIPE by donors and host countries. It is difficult for people to understand that if quick easy solutions were obtainable there would be no need for the ICIPE to exist. Most of the research programs designed to solve problems related to the development of technology to control ticks are long term and involve high risks. In spite of the difficult nature of the research, at least in small quantities, an anti-tick vaccine could be available for field tests within the next 2 to 3 years. Serious research on similar vaccines by scientists in Australia (they are currently field-testing an anti-*B. microplus* vaccine), the United Kingdom, Canada, and the United States is evidence that many researchers believe that this technology has a place in integrated schemes for the control of ticks and tick-borne diseases affecting livestock.

3. Training capabilities: The ICIPE has obviously made a sizeable commitment to the task of providing training opportunities to Africans and others from around the world. The variety of programs offered provides opportunities for technicians, M.S. and Ph.D. candidates, postdoctoral students and staff. The array of programs includes the African Regional Postgraduate Programme in Insect Science (ARPPIS), the postdoctoral research fellowship scheme, the International Group Training course on Components Essential for Ecologically Sound Pest and Vector Management Systems, and the opportunities offered through the staff development scheme. We visited with two Ph.D. students who are part of the ARPPIS program. Both of these individuals felt that participation in the program had been beneficial to them. We did not review their research in detail, but our general impression is that they have selected challenging dissertation problems characteristic of quality Ph.D. programs and that they have performed well. Students trained through the ARPPIS program will add well-trained and potentially productive scientists to the limited body of scientific talent in Africa.

We have also seen the impressive outline of lectures and activities included in the 8th Pest Management course and have met a number of the students and lecturers. The program is well-organized and offers to teach the students a great deal in a short period of time. It should be a stimulating and valuable experience for students who apply themselves. The ICIPE is a key contributor to the development of scientific manpower in Africa.

B. FEASIBILITY OF A COLLABORATIVE NETWORK within the eastern and southern region of Africa as a method of promoting research, enhancing the exchange of scientific information, building the scientific and technical capacities in livestock ticks research and management personnel and transferring R & D results.

1. Background: The destructive impact of ticks and tick-borne diseases on livestock in the western and southern region of Africa is well-known and well-documented. The large variety of tick species that parasitize cattle causes considerable direct economic loss without even taking into account the high levels of livestock mortality or debilitation caused by tick-borne diseases.

A large body of scientific literature documents the efforts of researchers to produce knowledge that would lead to the successful management of ticks and the improvement of livestock production. Unfortunately, progress has been slow and technological advances have been limited in number. The control of ticks is largely dependent on close-interval dipping or spraying with acaricides. The increasing costs of acaricides, the widespread occurrence of tick-resistance to acaricides, and the dangers of creating large herds of disease-susceptible cattle are major disadvantages associated with dependence upon acaricides as a means of controlling ticks and tick-borne diseases. The need for new technology is critically important and this need demands that we concentrate limited research resources on the most important problems and on approaches that will be most likely to produce useful technology.

As research institutions make discoveries and develop technology this knowledge should be disseminated for use by other scientists or, in the case of technology, for the benefit of livestock producers. A collaborative network of national and international scientific organizations, and the national veterinary services of countries in southern and eastern Africa would be a means of maximizing the rate of progress toward the solution of region-wide problems by coordinating and collaborating on research, by sharing information, by increasing scientific and technical manpower through training, and by working together to share and implement new technology.

Among the countries in the region there is considerable variation in the amount of research on the control of ticks and tick-borne diseases and in the level of organization of national veterinary services. Kenya is fortunate to be the most highly endowed country in Africa in these respects. It is significant that the Nairobi Cluster,(9) composed of all of the national and international livestock research organizations in Kenya, is a functional network and a model of what needs to be accomplished on a larger scale throughout the region. Zimbabwe has well-staffed veterinary services and a solid national research effort. They appear to be concentrating their most major efforts on the heartwater problem. In addition to a program in Kenya, FAO has sizeable programs in Zambia and Malawi and a smaller effort in Burundi. Essentially no organized research effort is ongoing in countries such as Uganda, Tanzania, Rwanda, Somalia and the Sudan.

The ICIPE played a major role in the creation of the Nairobi Cluster and because of the concentration of scientific expertise in ICIPE, its established reputation for high quality research, and experience in a variety of training programs, the ICIPE can be the keystone around which a pest management network for the control of ticks and tick-borne diseases can be formed.

2. Promoting Research, Enhancing the Exchange of Scientific Information

a. The Overview of relevant research programs and activities within the region.

(i). The ICIPE Livestock Ticks Research Program is making major contributions to an understanding of the ecology and population dynamics of important livestock pests and disease vectors, especially Rhipicephalus appendiculatus. The practical value of this information to the development of tick and tick-borne disease management strategies should not be underestimated. The veterinary research organization in Zimbabwe is also investigating tick population dynamics and factors that limit the distribution of ticks. FAO has ongoing research on the ecology of ticks associated with livestock in both Burundi and Zambia.

(ii). The ICIPE is the only institution in Africa which is attempting to develop practical methods for using naturally and artificially acquired resistance of cattle to ticks for tick control. The belief in the potential value of this approach to control is indicated by major efforts in this research area by scientists in Australia, the United Kingdom, Canada, and the United States. The availability of the ECF vaccine makes the use of type 1 or type 2 resistance a feasible means of neutralizing the effects of ECF and R. appendiculatus on the livestock industries of East Africa. Zimbabwe, Kenya, and FAO (through research activities in Malawi and Kenya) have programs involved with efficacy tests of acaricides, diagnosis of tick-resistance to acaricides, and in some cases, the development strategic dipping systems.

(iii). Research by ICIPE in Kenya and through FAO in Zambia and Kenya is investigating the relationships between numbers of ticks on cattle and loss in productivity.

(iv). Within the region research on tick-borne diseases and their control is limited to two countries (Kenya and Zimbabwe). ILRAD and the veterinary research effort within the KARI both have ECF research programs and ICIPE is involved in several cooperative research activities with both of these organizations.

b. Feasibility and potential contributions of networking to the research effort.

It is readily apparent that no single research program can hope to solve all the major problems caused by ticks and tick-borne diseases. It is also apparent that within the region there are a number of productive research efforts addressing various aspects of the problems. A network would promote more rapid exchanges of research results and new experimental methods, and coordination of projects to avoid undesirable overlap and duplication. Fledgling programs in some countries without well-developed research activities could receive advice and technical guidance by other members of the network. Annual or semi-annual workshops would give scientists and program managers regular opportunities to share information and possibly to organize proposals for cooperative efforts. One of the 2 meetings each year could be restricted to program leaders and the second meeting could include scientists.

3. Building the scientific and technical capacities in livestock ticks research and management personnel

The combination of training programs already operational within ICIPE would provide network members with a program that is tailor-made for the needs of the region. The existance of ICIPE's training program will greatly strengthen the network and should help insure its success. As the network evolves, it is likely that additional training needs will be identified. Among the potential members of the network, ICIPE is the only research organization with a complementary training program.

4. Transferring R & D results

At the present time various network members have developed new approaches to the management of ticks and tick-borne diseases. The ECF vaccine is an important technology that should be taken to the farmers and livestock producers throughout the region. Along with the application of the vaccine to minimize the threat of ECF, producers need to understand the value of type I resistance in a management program. In some ECF areas where acaricides are regularly employed, there is a need to change management techniques and to introduce the concept of strategic dipping. Livestock management and production could be improved greatly if network members would pool their knowledge, develop literature containing information on concepts and approaches to the possibilities, built around the ECF vaccine, for improved livestock management.

5. The role of ICIPE in a network

A properly organized network is needed and could have a very positive impact on the development and application of solutions to the tick and tick-borne disease problems within the region. ICIPE is in a position to take the initiative required to begin the process of developing the network. ICIPE is recognized for excellence in research, it has an outstanding training program,(11) it already has experience in forming a network through its participation in the development of the Nairobi Cluster, Outreach Field Trials (10) and key personnel within ICIPE are widely known and respected professionals who can provide strong leadership. ICIPE is in an excellent position to initiate the proposed network and is a key to its success.

ANNEX.2

RUSINGA ISLAND DEMONSTRATION PROJECT

I. PURPOSE AND BACKGROUND

The purpose of the proposed project is to demonstrate that increased productivity of cattle can be achieved on resource-poor farms through the use of the infection-treatment method for controlling ECF; and a livestock improvement program to systematically replace indigenous Zebu cattle with cross-bred animals capable of developing a high level of type 1 resistance to ticks. The efficacy of available technology has been established through a number of field trials, most of which have involved improved breeds of cattle. However, no attempt has been made to transfer this technology to resource-poor farmers with small herds of highly inbred indigenous cattle with limited genetic potential for significantly improved productiveness.

Rusinga Island, which is located in Lake Victoria adjacent to Mbita Point, provides an opportunity for testing and demonstrating practical methods for improved production of cattle in an area with ezootic ECF. The island is approximately 10 x 5 km in size, connected to the mainland by a causeway, populated by approximately 10,000 people; and supports at a minimal level about 10,000 goats, sheep and cattle. Preliminary surveys documented the prevalence of R. appendiculatus, R. evertsi, A. variegatum and B. decoloratus as the most abundant tick species on the cattle. Blood and serum samples obtained from cattle on the island, established that ECF is widespread, but none of the samples were positive for trypanosomes. There is a high probability that other tick-borne diseases of cattle such as cowdriosis, anaplasmosis, and babesiosis are common. A wide variety of other diseases ranging from brucellosis to fascioliasis are certain to also affect the cattle. Observations on land use suggest that by planting improved grasses and forage crops in conjunction with better land management, improved animal nutrition can be achieved. However, crop and forage production will be limited by poor soil on many parts of the island and by relatively low rainfall (500-600 mm/yr). People who were interviewed expressed considerable interest in the proposed program and indicated their willingness to cooperate.

II. PROCEDURES

A. THE INTRODUCTION OF IMPROVED CATTLE

1. Livestock breeding experts at ILCA will assist in the development of a livestock breeding scheme which is relatively simple to implement and will maintain in the cattle population some of the disease resistance and stress tolerance genes present in the local Zebu stock. For the breeding program ICIPE will provide bulls of an improved breed and the local farmers will bring heifers and cows to the Mbita Point laboratory for breeding.

2. At the Mbita Point facility calves from local unimproved Zebu cattle will be maintained and provided with an ample diet. They will also be immunized against ECF and a variety of other disease agents. These animals will provide data showing the genetic potential of local cattle under a regime of proper nutrition and disease control.

3. Unimproved indigenous cattle, maintained in the traditional manner, will be studied to form a basis of comparison with other treatment groups.

4. For all the calves from dams inseminated by the improved bulls, as well as for the control calves from indigenous sires and dams, data will be collected on mortality, rate of growth and time required to achieve sexual maturity. Heifers will be bred and data on milk production and sizes of new born calves will be obtained.

B. SOCIO-ECONOMIC EVALUATION

1. A socio-economic evaluation will be conducted within the community on Rusinga Island to provide a thorough understanding of the role of livestock production in their daily lives and local economy. This information will provide a basis for working with people to test and develop an improved system of livestock management.

2. Periodic follow-up studies will measure changing attitudes and reactions to the research activities and, ultimately, will help assess the success of the program.

C. TICK ECOLOGY AND CONTROL

1. Data will be collected on seasonal population dynamics of tick-infestation on sheep, goats and cattle.

2. Rainfall and temperature will be monitored throughout the study.

3. If practical problems, such as providing animals water, can be overcome improved calves will be isolated in fenced enclosures to suppress tick populations through the action of type 1 resistance.

4. A study at Mbita Point will determine the effect of the local climate on the development times and survivorship of *R. appendiculatus*, *R. evertsi*, *A. variegatum*, and *B. decoloratus*.

D. DISEASE CONTROL

1. Cattle used in the study will be protected against ECF by the use of the infection-treatment method.

2. Standard vaccines against foot and mouth disease, rinderpest, brucellosis, etc. will be employed.

E. FORAGE IMPROVEMENT

Expertise in range management and in forage crop improvement will be obtained from other ICIPE programs and ILCA. They will evaluate the soil, present forage production and recommend procedures for improving productivity in terms of both quality and quantity.

F. LENGTH OF THE STUDY

From the date on which the first cows are bred until the heifer calves from those crosses mature and produce their first calves, a minimum of five years will be required. The study should extend at least to this point.

III. COOPERATION

As indicated in several places within this proposal, this study will not succeed without the cooperation and active assistance of the sociologist, veterinarians from the national veterinary services, and scientists from ILCA and KARI.

IV. EXPERIMENTAL SITES, FACILITIES AVAILABLE, AND BUDGET

A. SITES - The main portion of the study will be done on Rusinga Island, but much work will be done at Mbita Point.

B. FACILITIES - Laboratory space, offices, and tick rearing facilities are available at Mbita Point. Additional equipment is needed and these are presented in the budget. Some additional pens and facilities for holding and working cattle must be constructed at Mbita Point. It may be desirable to fence small pastures on Rusinga Island.

C. FIVE-YEAR BUDGET - The budget is attached.

ANNEX 2

FIVE-YEAR BUDGET

RUSINGA ISLAND

PERSONNEL	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
1 Research scientist	33,000	36,300	39,900	43,900	48,300	201,400
1 Veterinarian	33,000	36,300	39,900	43,900	48,300	201,400
1 Social Economist	33,000	36,300	39,900	43,900	48,300	201,400
1 Secretary	6,000	6,600	7,250	8,000	8,750	36,600
6 Casual labourers	4,500	4,950	5,450	6,000	6,600	27,500
3 Junior Technicians	13,000	14,000	15,000	16,000	17,000	75,000
1 Graduate Research Scientist	13,000	14,000	15,000	16,000	17,000	75,000
International Travel	2,500	2,500	2,500	2,500	2,500	12,500
Publications	1,000	1,000	1,000	1,000	1,000	5,000
Livestock						
5 Jersey bulls(1)	20,000					20,000
2 replacements		4,000	4,000			8,000
5 Sahiwal bulls			22,000			22,000
2 replacements				5,000	5,000	10,000
5 Incalf heifers(2)	2,500					2,500
2 replacements		500	500			1,000
Vaccinations(3)	12,500	13,800	15,200	16,700	18,400	76,600
Cow concentrate	1,200	1,300	1,450	1,600	1,750	7,300
Bull supplements	1,200	1,300	2,900	3,200	3,500	12,100
Indigenous cattle Supplements(4)	3,100	12,500	13,800	15,200	16,700	61,300
Insectary Service and Rabbits	3,000	3,000	3,000	3,000	3,000	15,000
Equipment						
2 Landrover type vehicles	19,000					19,000
2 Suzukis	10,000					10,000
1 trailer(5)	2,000					2,000
Running costs	10,500	10,500	10,500	10,500	10,500	52,500
Personal Computer	10,000					10,000
Fencing Materials(6)	5,000	2,500	2,500	2,500	2,500	15,000
Microscope (7)	4,000					4,000
Refrigerator, Deep freezer and centrifuge	4,000					4,000
Expendables	4,000	4,500	4,000	4,000	4,000	20,000
TOTAL	251,000	205,350	245,750	242,900	263,100	1,208,100
Indirect Costs @ 18%	45,180	36,960	44,240	43,720	47,360	271,460
GRAND TOTAL	296,180	242,310	289,990	286,620	310,460	1,425,560

NOTES

1. Bulls would be utilized for a cross breeding program on local zebu cows that would introduce both exotic and improved indigenous blood lines.

2. Females would be kept as a control to demonstrate the potential of a tick free cross breeding program.

3. Farmers cattle participating in the program would be vaccinated against common diseases, and would be immunized against theileriosis to develop type I resistance to East Coast Fever.

4. Animals would be supplementally fed to provide calves with a healthy start.

5. Cows would be examined for disease, and then transported to bulls for service.

6. Fencing is required to control tick levels and facilitate the cattle improvement program.

7. Additional laboratory equipment is required for an increased volume of work.

Annex 3

FIELD TICK RESEARCH AT INTONA RANCH

I. PURPOSE AND BACKGROUND

Successful immunization of cattle against theileriosis has been achieved at Intona Ranch, Trans-Mara Division of Narok District. Consequently, work has been carried out to assess the importance of natural infestations of ticks on weight gains and health of Boran (Bos indicus) cattle (de Castro et al., in press).

As an important follow-up, an experiment was designed to demonstrate the feasibility of using tick resistant cattle to control populations of ticks in a paddock from which alternative wild tick hosts have been excluded by means of an electric fence.

Results of the trials so far indicate that cattle are naturally achieving a good degree of tick resistance and this seems to be having an effect on the numbers of ticks in the different experimental paddocks; i.e. paddocks with resistant cattle appear to support fewer ticks than control paddocks with tick susceptible cattle.

In order to get meaningful results, the present trial should be carried out for another two years. The current experiment has given us results which will require further work in order to be confirmed. The areas of research that have been identified are as follows:

II. PROCEDURES

A. TICK ECOLOGY

1. Paddock experiment. Continue the present arrangement of 2 paddocks in which 10 resistant animals stay all the time and 2 paddocks where 10 susceptible cattle are replaced at 3-months intervals. Continue to sample the ticks on the pasture and to count the number of ticks on the cattle.

2. An unfenced pasture on which no cattle are grazing and equal in area to the 4 paddocks on which only cattle graze, will be added to the study to estimate the size of the free-living component of the tick population when only wild game are available as hosts. Tick collections from wild animals can also be carried out to assess the numbers on the different hosts and also to get new Theileria strains for TBD work.

3. In a study organized by the Nairobi Cluster observations on survival and development of R. appendiculatus are being carried out as part of a larger study organized on a country-wide basis. These observations will continue for the next 2 years.

4. The daily rate at which cattle pick-up ticks and their duration of feeding on cattle are complementary observations for "C".

5. The ecology and behaviour of A. variegatum will be studied in collaboration with an ecologist from the Universite de Neuchatel during the next 3 years.

B. TICK RESISTANCE

1. Continue the development and improvement of methods for assessing natural (or artificial) tick resistance in livestock in the field either by means of tick feeding, skin tests or serology.

2. Use the above mentioned tests to study the possible changes of resistance dependent on climate, intensity of challenge, lactation, sex, age, etc.

3. Challenge artificially immunized cattle to assess the potential use of this technique under controlled conditions. Assess the duration in cattle of tick-resistance of under tick challenge and also in high frequency dipping situations.

C. TBD AND TRYPANOSOMIASIS

1. Continue studies on infection rates and survivorship survival of *Theileria* in *R. appendiculatus* (collaboration with Dr. A.S. Young).

2. Start trials to immunize cattle against *Cowdria ruminantium* (heartwater) infections (collaboration with Dr. S. Morzarina).

3. Assess the possibility of tsetse control by the use of traps in an attempt to reduce trypanosomiasis challenge. (collaboration with Tsetse Programme at ICIPE).

III. EXPERIMENTAL SITE AND FACILITIES

A. INTONA RANCH, located in the Trans-Mara Division of Narok District of Kenya, has been selected as the study area because it offers several advantages. These include:

1. Very good collaboration from the owners.
2. Excellent conditions for tick propagation and prevalence of all important TBD and Trypanosomiasis.
3. Location adjacent to a pastoralist area.
4. A capital input by ICIPE of the following facilities: fences, crushes, stockades, and temporary personnel accommodation facilities.
5. If necessary, a partial commercial use of the farm.
6. Existence of several important facilities such as an airstrip, power generators, water pump, Farm Manager's house, personnel accommodation, a dip vat, crushes, stockades, stores, cattle loading facilities, very good grazing and permanent water laid-out in several drinking troughs. The main farm house could be used to house scientists working on the farm, visitors, students, etc.

B. STATUS. Until now the work on the ranch has been possible through an informal arrangement with the owners. This is likely to continue until September 1985 when, if an agreement between the owners and ICIPE is not reached, the farm will probably be sold.

C. THREE-YEAR BUDGET - The budget follows.

Annex 3

B U D G E T

INTONA RANCH PROJECT

	Year 1	Year 2	Year 3	TOTAL
Land and house lease	20,000	20,000	20,000	60,000
Equipment lease	10,000	10,000	10,000	30,000
Farm staff	19,600	21,560	23,720	64,880
Transport costs	6,400	7,040	7,740	21,180
Animals	6,900	7,590	8,350	22,840
Expendables	6,900	7,590	8,350	22,840
Contingencies	6,000	6,000	7,260	19,860
TOTAL	75,800	80,380	85,420	241,600
Indirect Costs @ 18%	13,640	14,470	15,380	43,490
GRAND TOTAL	89,440	94,850	100,800	285,090

Average yearly cost based on total = $80,533
Average yearly cost based on Grand Total = $95,030

The addition of a commercial steer enterprise could provide a net return in excess of $20,000 per year, which would reduce the running costs of Intona Ranch on a yearly basis to approximately $60,000.