RESEARCH PROJECT STATEMENT

1. Project Summary
   a. Statistical
      
      Project Title:
      Research on Sterility Method for Tsetse Fly Control

      New or Extension:
      Extension

      Contractor and Address:
      U. S. Department of Agriculture
      Agricultural Research Service
      Washington, D. C.

      Principal Investigators:
      Dr. David Dame
      Dr. Leroy Williamson
      Dr. David Gregory
      Mr. Dan Gates

      Duration:
      Five Years

      Request RAC Authorization:
      Three Years

      Total Estimated Cost:
      $1,348,000 (Three Years)

      FY 75 - $398,000
      FY 76 - $500,000
      FY 77 - $450,000

      Project Manager:
      Dr. Nels M. Konnerup

b. Narrative

   Trypanosomiasis vectored primarily by the tsetse fly in Africa, adversely affects human habitation and crops and animal production over 4 1/2 million square miles of middle Africa. Over the years, a number of techniques have been employed for tsetse control; none alone have been fully successful. What works with one species may not
work with another; what is effective in one geographic or
ecolonic niche may not be so in another. The lesson to be
learned is that successful control is likely to involve
several techniques used in continuation or in sequence.

Clearance or control of the tsetse fly, thereby reducing
trypanosomiasis could result in doubling cattle production
and expand for habitation some of the most fertile land for
agriculture on the continent. Efforts to achieve these
results have employed insecticides, brush clearance in areas
tsetse needs for breeding, game destruction and fences, hand
catching, trapping and sterile insect release.

Since this project was initiated in 1965 it has been
shown that distribution of sterile male flies will control
tsetse fly in an area that is isolated. The present research
is aimed at developing the system that will permit practical
and economic area by area isolation followed by control
through distribution of sterile males and continued mainte­
anence of reduced numbers of flies. The research involves
learning to rear flies in sufficient number in closed colonies
to supply large areas. This has proved to be difficult and
few have found the key to develop self perpetuating colonies
that also increase in numbers. The Tanga (Tangania) insectory
being developed over the past two and a half years has now,
under present project management, a rapidly expanding colony
of flies (G. morsitans) and the radiation sterilization
system, expected to supplant hemostereilization, is ready for
research on viability. The past slow progress on this
project has been caused by a series of personnel reassign­
ments, accident and misfortune in the rearing facility, and
a move from Morogora requested by the Tanzania government.
The record of progress has, however, accelerated markedly
in calendar 1974 and should continue if fly rearing can
continue to accelerate.

During 1975 and through 1977 studies will be conducted on
sterilization, marking of flies for larvae isolation tests,
fly packaging and transporting, distribution and release
methods, trypanosome detection, fly sampling methodologies,
and preparation of the test site (surveys and basic data
assembly). In 1978 and 1979 it is planned to carry out the
demonstration on the 100 square mile test site and evaluate
the effectiveness of the test.
2. Research Purpose and Expected Products

The purpose of this research project is to develop an effective and economical system for control of the tsetse fly adaptable to an area by area and step by step procedure for application in Africa.

To reach this stage the research objectives will be:

a. To develop the capability to rear tsetse flies in self-perpetuating expandable colonies.

b. To produce enough flies to conduct experiment on viability, competitiveness in breeding, handling, transport, packaging, distribution and release studies as well as to have sufficient flies by 1977 to conduct the demonstration on a 100 square mile test site.

c. To develop procedures and techniques in the total system that will assure competitive released sterile flies.

d. To prepare and test an isolated 100 square mile demonstration area for isolation effectiveness.

e. To test the system developed by releasing sterilized flies and measuring the effectiveness.

In addition to the know how and large scale demonstration developed during the project, there will be at conclusion, a permanent insectory system and radiation sterilization resource for future fly rearing, trained local staff for fly rearing, handling, distribution, release, and evaluation plus a large area controlled and available for maintenance studies.
3. **Significance and Rationale**

**a. Significance**

The growing world population and resulting need for increased food production will call for not only improved productivity of existing lands but also bringing new lands into agricultural production. Large areas of Africa (4 1/2 million square miles) are now scarcely habitable and not tillable with domesticated animals nor available for animal agriculture because of prevalence of trypanosomiasis, a parasite disease affecting animals and man and spread from wild mammalian hosts by various species of the tsetse fly.

Many attempts have been made and are continuing to control the tsetse fly and the significance of the present research on release of sterile males is that in theory if the ratio of sterile to virile males is maintained high enough to reduce the rate of increase to less than one fold per generation a decline in the breedable female population will eventually result in total elimination of the fly. This is in contrast to continuous insecticide use which, besides undesirable environmental consequences is relatively non-selective, destroying beneficial insects as well as predators of the tsetse fly. Insecticides are extremely effective against the tsetse fly because of the highly specific and narrow ecological niche it inhabits in brushy boundaries of savannah, and lower tree trunks.

**b. Rationale**

The rationale for the present project is based on earlier successful control of tsetse fly in an isolated area of Rhodesia using chemo sterilized males that were obtained by collecting and rearing pupae from the wild. Furthermore, earlier successful elimination of the screw worm fly in Florida by the sterilization technique (SIRM) gave reason to hope it can be expanded to large areas in the case of the tsetse.

Because SIRM is most cost effective where population density is low and insecticides are most cost effective where populations are high it is expected that an initial continuation of the latter will be most effective in this project. For maintenance of low population it is expected the continuing introduction of sterile males will prove more cost effective than insecticides.
4. Plans For Research Coordination And Linkage

This research is closely related to other insect control programs supported by AID and other organizations and an attempt was made to enlist support under a UNDP agreement. While this failed to materialize it did stimulate FAO to submit a new Trypanosomiasis/Tsetse fly project to the UNDP and it is anticipated that much of the work will be integrated. There has been a close working relationship with the International Atomic Energy Agency (IAEA) and the University of Bristol under a subcontract with IAEA. The Tanga based researchers have also established close linkages with the Kenya Tsetse Control Division of the Ministry of Agriculture, the International Center for Insect Physiology and Ecology, and the newly established International Laboratory for Research on Animal Disease. Linkages have also been established with French workers at Maison Alfort and Upper Volta who have been doing research on the sterile male technique with another species of tsetse fly and will incorporate the technique in a major Tsetse Trypanosomiasis control program in Upper Volta. The Israel Institute for Biological Research is investigating principals of insect vector control also linked to an AID supported project at CIAT in Colombia which includes studies on biological control systems.
5. Plan To Facilitate Utilization Of Research Results

It is expected that a number of research facilities will be in a position to utilize surplus flies over and above requirements for the sterile male release. (ILRAD, ICIPE, EAVRO).

Both on the job and external training are underway and planned for continuation. Laboratory and field technicians are in training at Tanga and in the field. Selected technician level Tanzanians have been sent to the University of Bristol on rearing techniques and this training will continue under a sub-contract between AID and the International Atomic Energy Agency. Kenya has offered to train field personnel in fly population dynamics and systems for fly releases. One Ph.D entomologist is in training at the University of Florida and another is being selected for training this year and will be available to this project during the demonstration test.

A workshop involving Africans from other countries and participation by French, Israeli, British and Netherland workers as well as scientists from ICIPE, ILRAD, EAVRO and CIAT is being planned to be held in Tanzania in 1976 supported by TA/AGR. A comprehensive quarterly bibliography is maintained and widely distributed as are papers published by the project workers.

FAO has recently proposed a 40 year comprehensive Pan African Trypanosomiasis/Tsetse Control plan which even more recently (Oct. 28-29) was reshaped to a more realistical fifteen year plan costing about $15,000,000 to be funded by UNDP. It is anticipated that the AID research will be near completion when the UNDP funds become available. The FAO plan calls for application of the sterile male technique as one facet of that program.
6. Management Considerations

This project has been beset by difficulties (non-technical) since it was forced out of Rhodesia for political considerations. For a similar reason it failed to become established in Zambia. It was precluded from operation in Kenya because a decision had been made that Kenya had already received a heavy share of AID project support. Eventually the project was located in Tanzania at Morogoro near the Agricultural University. This appeared to be an ideal situation but again a political consideration led the Government of Tanzania to request a relocation. Finally the project was located at Tanga within an accessible area to the field test site.

In October 1973, a new USDA project manager was appointed and supporting staff recruited. The Tanzanian Government in turn appointed responsible officers and the project actually got underway. In less than a year personnel, facilities and equipment were completely in place, the fly colony has become viable, field surveys are operational and planning for field release of sterile male flies has been established. The Tanzanian Government (GOT) has provided the counterpart personnel and suitable logistic support.

Furthermore, GOT will carry out the sheer clearing of the test site in preparation for the demonstration planned for '78 and '79.

The Tanga facility is modeled after the Bristol colony of A. M. Jordan who has been most successful in establishing a successful colony of flies in Bristol, England.

During the period when the insectory is being developed to high capacity production and factors inhibiting viability and release of highly competitive flies are being determined and in the event of a loss at Tanga plans have been made to attain necessary back up supplies of flies contact from the Bristol colony or from Austria by where Tanga flies are being produced.
7. **Technical Review**

It is abundantly clear that the research to establish conditions for fly rearing and exponential colony growth is crucial to any widespread use of the sterile male release approach. Furthermore, it is evident that if control of the tsetse fly is to be achieved in large areas, a well defined technique will be needed to assure that large and costly programs planned to bring about control of the tsetse fly through the use of procedures based on research and that will result in assured success.

The research planned in this project will extend what has already been done in Africa and chemosterilized males obtained from wild sources, to radiation sterilized males from partially closed colony sources. In the earlier study, the sterile males were released on an isolated island having a population of 300 to 600 flies of each sex. Twenty months later, no females were found, indicating that elimination would soon occur.

An assessment of the existing state-of-art of this research indicates that it is extremely essential and that the design is feasible.
8. Research Project Design and Methods

a. Fly rearing

In order for the colony to achieve a satisfactory growth rate it is necessary that the daily mortality rate be reduced from the present 1.26% to 1.00% or less. Research to achieve this will concentrate on maximizing facility and improving feeding methodology. Among the parameters requiring investigation are the type and source of blood used for food, the frequency of feeding and the method of handling. Membrane feeding instead of live animal (goats and rabbits) colony hosts remains an attractive potential alternative; however, this is still in experimental stages and the availability of satisfactory sterile non-diseased blood in Tanga is questionable.

At latest report growth of the colony is accelerating rapidly indicating many of the rearing problems may be resolved.

b. The production of adequate quantities of sterile male flies will require research into the total delivery and release system.

The adult flies produced in the laboratory do not have adequate muscle development to compete with wild flies thus it is preferred to release flies in the late pupal stage. The delivery research, therefore, will concentrate on temperature, humidity, packaging, handling, impact upon release, time of day of release, frequency and rate.

c. From the results of b. procedures will be established for the total systematic release of flies and the competitiveness of the sterile flies will be determined by experimentation in the laboratory comparing them to flies obtained from collected pupae. This involves methods developed previously in the project to measure wing muscle size which can be an index of effective breeding.

d. The test site, a 100 square mile isolated area, will be surveyed and prepared for use.

A barrier to achieve isolation consisting of a totally cleared strip one mile in width is to be prepared. Such sheer clearing is required for 23 miles of the perimeter of the test site. The rest of the perimeter has natural savannah barriers or cultivated plantations. The Mzeri Hill site
selected for testing will require not only a combination of barrier treatments but also insecticide applied in strips next to sheer cleared areas and along water courses and host animals will be eliminated from barrier areas to the maximum extent possible in order to assure isolation. The test site will be surveyed for isolation effectiveness using marked flies (probably florescent dye) released on the adjacent areas. Standard sampling will be employed. This will be completed during the first year.

In January, 1975 the pupal collection team's effort formerly engaged in building up insectary breeding stocks by pupal collection will be reoriented toward conducting fly surveys at the field release site, Mzeri Hill Ranch. It is anticipated that by September, 1975 the survey work will be sufficiently routine that it can be co-ordinated thereafter with the essential research activities of evaluating the vigor of released flies, testing the efficacy of the fly barrier at the perimeter of the release area, determining optimum methods of distribution for ground and aerial release of sterile insects, testing methods of evaluating the effect of released flies, and seeking means of conducting simple, periodic assays of the quality of released flies.

The standard procedure for sampling tsetse population is based upon the fly round. Routes of 5 to 6 miles in length are marked in accordance into type of vegetation representative of the area. The standard round is conducted by two men proceeding at a walking pace, recording exposure hours, one with a standard white patch on his back. Flies are attracted to the patch and are counted every 80-100 yards. Each round is repeated 2-3 days later to check results. The site is then mapped for fly host concentrations, topography, and fly predator concentration. The survey will also include trypanosome counts by sampling and analyzing blood of resident and feral animals before and after sterile fly release. The survey will be conducted during the time the laboratory and distribution studies are carried out.

e. Test the Sterile Insect Release Method (SIRM)

It is expected that by 1978 sufficient knowhow as a result of pilot testing and adequate numbers of flies will be available to launch a major test.
There are a number of experimental designs: full release of one species with a sheer cleared barrier; full release with a barrier of insecticide over part of the area, sheer cleared on the rest; part insecticide treated, part sterile release with part of the barrier insecticide and part sheer cleared. Combinations of the above could perhaps give the most information but does increase the analytical effort, topographic design, and field work. Many of these design problems will need to be resolved as the time draws near, and must await the development and refinement of methodology. When the fly round is questioned as an absolute method for population density determination it is considered the best system available and one that satisfies tsetse fly control programs.

f. Evaluation

 Some of the main points to be determined by evaluation will require re-survey. 1) Density of tsetse flies after release or treatment. 2) Trypanosome prevalence in livestock and 3) cost/effectiveness of the methods tested.

 The concentration of flies must be determined over time and compared to flies released one time with weather and available host monitors taken into account. Documentation and data records are of utmost importance to evaluation and will be provided for at the onset.
9. **Overall Cost Estimates**

Expenditure proposed for the next three years from AID and GOT total about $615,000 per year, about $450,000 provided annually by AID.

A summary of the projected expenditures follows on the next page.
**Summary of Projected Expenditures ($000)**

<table>
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<tr>
<th>Category</th>
<th>Tanzania FY 75</th>
<th>Tanzania FY 76</th>
<th>Tanzania FY 77</th>
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<td><strong>TOTALS</strong></td>
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<td>142.7</td>
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<sup>a/</sup> From Draft Project Agreement between AID and the Treasury of the United Republic of Tanzania, March 28, 1974.

<sup>b/</sup> A detailed budget for FY 75 starts on page 18.
For an operation of this scale the budget is probably minimal, provided objectives can be met. The personnel alone required at the time of the field test will number 158 Tanzanians and 6 full time AID provided project employees.
10. Work Plan and Contract Budget

The following chart of scheduled activities can be related to the objectives as follows:

1. Develop capability to rear flies - a, b, c, d, f, g, and k. All relate to the need for establishing fly husbandry techniques that will assume viable competitive healthy flies. These activities will be heaviest in the second and third year as can be seen from the chart, as well as the 1975 PASA budget and from the previous section 9, where costs are projected for three years. Personnel costs in particular reflect the level of effort of laboratory studies needed to establish self-perpetuating growing colonies of tsetse flies at Tanga.

2. To produce enough flies for the demonstrated test items d., and f. will be especially important since the laboratory host animals will be required unless membrane technology is successful in supplanting live hosts in this relatively short time frame.

3. Procedures for distribution - fly cage construction and release for preliminary study cover a number of subsystem studies that must be carried out to establish the procedures for pupa packaging, sterilizing male flies, measuring viability, distribution techniques, and release technology. These studies must be far enough along by the middle of 1977 so that large scale test facilities, packaging and other necessary equipment and trained personnel are ready for test site activity at the beginning of 1978.

4. To prepare and test and isolated area activities under d., and e. will all be carried out as a part of this objective. Tests of isolation effectiveness, design of experimental area for test will have live surveys of the pre-test population density and trypanosome prevalence. Evaluation methodology will be developed for later application after the full scale release of sterile flies.

5. By 1978 and into 1979 it is projected that the test can be carried out with items 1. and m, predominately. Resurveys for trypanosomes and population density and insecticide suppression effectiveness will of course be necessary in the evaluation. Costs of barrier
maintenance will be kept and cost/effectiveness of
the operation (separate from the research cost) will
be determined for later use in planning for expanded
programs.

11. General Appraisal

A recent review of the present project by American Technical Assistance Corporation (ATAC) has indicated that the principal technical problems at Tanga have been brought under control and that the fly production rate is satisfactory for the planned field test. A draft copy of ATAC's report is included in the supplementary materials. The possibility of obtaining flies from Bristol has been suggested so that the project can proceed with an assurance that adequate numbers of flies will be available.

A one-day review of the tsetse fly research activities in Tanga was made by Mr. Fred Wittnebirt and Mr. C. J. Fredrickson on September 5, 1974. The observations made were favorable with respect to the management of the project, the improved fly breeding progress and the physical and technical improvements which have been over the period of the past 9-month period.

An on-site review of the project was held in Tanga from September 23 thru 27, 1974. The meeting was attended by 12 experts and observers and included inspection of the laboratory and field sites, staff reports on all aspects of the program, and a review of the research plans for obtaining the information necessary to conduct a large-scale release trial. The report of the review team includes general summary statements of the current status and future plans of various aspects of the project as well as specific recommendations on issues that the review team feels should receive the serious consideration of officials responsible for the conduct of the project. The complete report is included in the supplementary material.
<table>
<thead>
<tr>
<th>Activity</th>
<th>FY - 74</th>
<th>FY - 75</th>
<th>FY - 76</th>
<th>FY - 77</th>
<th>FY - 78</th>
<th>FY - 79</th>
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<tbody>
<tr>
<td>a. Construction of Insectory #1</td>
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<td>b. Construction of Insectory #2</td>
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<td>c. Fly cage construction</td>
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<td>d. Pupae collection (field)</td>
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<td>e. Expand &amp; maintain pastures</td>
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<td>f. Develop rabbit colony</td>
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<td>g. Develop goat colony</td>
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<td>h. barrier cleaning &amp; maintenance</td>
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<td>i. Study fly immigration &amp; insecticide suppression</td>
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<td>j. Toxinsomosis survey</td>
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<td>k. Release sterile males for preliminary studies</td>
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<td>l. Large-scale release of sterile males</td>
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<td>m. Evaluate techniques &amp; results</td>
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FY 75 Budget Summary

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<th>Source</th>
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<td>Dr. Gregory PSC</td>
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<td><strong>Total</strong></td>
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## Participating Agency Service Agreement

**With:** USDA, Agricultural Research Service (Tsetse Fly)

**Budget Plan for FY 1975**

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<th>FC Grade</th>
<th>Rate</th>
<th>Plan Days</th>
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<th>8.5% (avg.)</th>
<th>12 Personnel Benefits</th>
<th>21 Int'l. Travel</th>
<th>22 Transportation of Things &amp; Storage HRS</th>
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<td>Doze, David</td>
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<td>8,120</td>
<td>20</td>
<td>624</td>
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<td>57</td>
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</table>

1/ Increase and amendment to IAEA contract subject to only 5% overhead rate.

Prorated portion of overhead remaining on original agreement and amendment:

- $750

5% overhead on $58,000 this fiscal year:

- $2,900

Total IAEA Agreement Overhead

- $3,650

22 Transportation of Things

- 7,000

23 Rent, Communications, Utilities

25 Other Services 1/

- 60,000

26 Supplies and Materials 2/

- 7,100

31 Equipment 3/

- 17,500

Sub-Total

- 166,625

Overhead 25%

- 27,156

IAEA Overhead 1/

- 3,650

Grand Total

- 197,431

Rounded

- 197,500

*Estimated Per Diem: $3,750
## Supplies and Materials:

- **Miscellaneous supplies**
- **Chemicals**
- **Laboratory glassware**
- **Household screening**
- **Vehicle spares**
- **Collars**
- **Regulators (6)**

<table>
<thead>
<tr>
<th>Position</th>
<th>Class. Grade</th>
<th>FC Grade</th>
<th>Rate</th>
<th>Mon. Years</th>
<th>Salary</th>
<th>Differential</th>
<th>TOTAL Personnel Benefits</th>
<th>Int'l. Travel</th>
<th>Transportation of Things</th>
<th>TOTAL</th>
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<tbody>
<tr>
<td>26</td>
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<td></td>
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</tbody>
</table>

## Equipment:

- **Appliances (4)**
- **Air-conditioners**
- **Capacitors, fan motors, compressor parts**
- **Steam jet cleaners (3)**
- **Transformers**
- **Roof fans**
- **Single, side band transceivers (2)**
- **Stainless steel rods**
- **Chain saws (3)**
- **Post hole digger w/motor**
- **Meteorology equipment**
- **Microscope**
- **Refrigerators (3)**
- **Miscellaneous equipment**

<table>
<thead>
<tr>
<th>Position</th>
<th>Class. Grade</th>
<th>FC Grade</th>
<th>Rate</th>
<th>Mon. Years</th>
<th>Salary</th>
<th>Differential</th>
<th>TOTAL Personnel Benefits</th>
<th>Int'l. Travel</th>
<th>Transportation of Things</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
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<td></td>
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<td></td>
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</table>

*Estimated Per Diem:

---

**TOTAL**

- **Rent, Communications, Utilities**
- **Supplies and Materials**
- **Equipment**

**Overhead**

**GRAND TOTAL**
### Participating Agency Service Agreement

<table>
<thead>
<tr>
<th>Position</th>
<th>Class. Grade</th>
<th>FC Grade</th>
<th>Rate</th>
<th>Mon Years</th>
<th>Salary</th>
<th>Differential</th>
<th>Total Personne</th>
<th>Initial Travel</th>
<th>Transportation of Things</th>
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<td>Education Allowances</td>
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<tr>
<td>Local and Regional Travel, vehicle rental and use of private auto on mileage basis</td>
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<td>21,900</td>
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<tr>
<td>Transportation of Things (including $15,000 for transport of prefabs)</td>
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<td>Cooperative Agreement with Tanzanian Government for support of personnel</td>
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<td>Administrative Assistant</td>
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<td>Trainee</td>
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<td></td>
<td></td>
<td>5,000</td>
</tr>
<tr>
<td>Aircraft Rental, Utilities, Vehicle Maintenance, Communications</td>
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<td></td>
<td></td>
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<td>15,200</td>
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<tr>
<td>Country Contractual Services for facilities, project and domestic guards, house maintenance, and domestic utilities</td>
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<td>7,600</td>
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<tr>
<td>Buildings (2 prefabricated homes; 1 prefabricated laboratory)</td>
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*Estimated expenses to be administered by USAID or Ammoniass, Dar-es-Salaam. (Note: Amounts under line items can be shifted at the discretion of the Project Leader.)*

1/ Includes Consultant, 1,000; Gregory to England, 1,500; 2 Trainees to England, 3,300; Review Committee Meeting in Tanga (LeRoux and Jordan), 1,625; Tanzanian Government Officials (2) to Langford and Vienna, 2,600; REA travel for Williamson, 3,450.

2/ Includes items for materials needed for animals, i.e., purchase of feed and drugs. Includes aluminum sheets, woven wire mesh, slotted metal for cages, racks, and shelves. Includes electrical wiring for humidifiers, air-conditioners, etc.

3/ Includes Generator, 8,000; Borehole pump - piping, 3,500; Freezers (3), 1,500; Veterinary instruments, 200; Humidifiers, 2,000; Field equipment, 1,000; Power mowers, 250; Misc. nonexpendables, 1,000; Furniture, 17,000; Estimated Per Diem, 34,450.

**TOTAL**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>Rent, Communications, Utilities</td>
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<tr>
<td>26</td>
<td>Supplies and Materials</td>
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<td>31</td>
<td>Equipment</td>
<td>1,000</td>
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<tr>
<td>Overhead</td>
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<tr>
<td>Grand Total</td>
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<tr>
<td>BUDGET (Increase for Dr. Gregory PSC)</td>
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<tr>
<td>--------------------------------------</td>
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</tr>
<tr>
<td>Transportation of things</td>
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<tr>
<td>Post Differential</td>
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<td><strong>Total</strong></td>
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