PD-AAQ-794

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

1. TRANSACTION CODE: A = Add, C = Change, D = Delete

Amendment Number

DOCUMENT CODE: 3

2. COUNTRY/ENTITY: WORLDWIDE

3. PROJECT NUMBER: 936-5948

4. BUREAU/OFFICE: S&T

5. PROJECT TITLE (maximum 40 characters): Vector Biology and Control

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 09 DD 30 YY 95

7. ESTIMATED DATE OF OBLIGATION (Under 'B.' below, enter 1, 2, 3, or 4)

A. Initial FY 85 B. Quarter XX C. Final FY 94

8. COSTS ($000 OR EQUIVALENT $1 =)

A. FUNDING SOURCE	FIRST FY 85 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total			850			$25,880
~~(XXX)~~ S&T/H	( )	( )	(850)	( )	( )	(19,880)
~~XXXX~~ Buy-ins	( )	( )	( )	( )	( )	(6,000)
Other U.S. 1.						
Other U.S. 2.						
Host Country						
Other Donor(s)						
TOTALS			850			

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
(1) DI	512	590				850		$19,880	
(2)									
(3)									
(4)									
TOTALS						850		$19,880	

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each)

11. SECONDARY PURPOSE COD

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)

A. Code: BP

B. Amount: $19,880

13. PROJECT PURPOSE (maximum 480 characters)

To create or improve effective and cost efficient LDC vector-borne disease control programs.

14. SCHEDULED EVALUATIONS

Interim MM 09 YY 87 MM 09 YY 95 Final MM YY

15. SOURCE/ORIGIN OF GOODS AND SERVICES

☐ 000 ☒ 941 ☐ Local ☐ Other (Specify)

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a ____ page PP Amendment.)

17. APPROVED BY

Signature: Roxann Van Dusen

Title: Roxann Van Dusen, Acting Director, S&T/H

Date Signed: MM 04 DD 01 YY 85

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION

MM DD YY

AID 1330-4 (3-79)

PROJECT AUTHORIZATION

Name of Country: Interregional Project Title: Vector Biology and Control

Project No.: 936-5948

1. Pursuant to Section 104 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the "Vector Biology and Control Project," involving centrally funded planned obligations not to exceed $19.88 million over a ten year period from the date of authorization, subject to the availability of funds in accordance with the A.I.D. OYB/allotment process, to help in financing foreign exchange and local currency costs for the project. The project may also include such additional funding as may be made available for this project by regional bureaus and A.I.D. missions.

2. The project will improve the design, implementation, and evaluation of vector control programs in less developed countries (LDCs); increase LDC expertise in vector control; and improve LDC access to information and new control technologies.

3. The agreement(s) which may be negotiated and executed by the officer(s) to whom such authority is delegated in accordance with A.I.D. regulations and Delegations of Authority shall be subject to the following terms and conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

5. Source and Origin of Commodities, Nationality of Services

a. Commodities financed by A.I.D. under the project shall have their source and origin in the cooperating country* or the United States except as A.I.D. may otherwise agree in writing. Except for ocean shipping, the suppliers of commodities or services shall have the cooperating country or the United States as their place of nationality, except as A.I.D. may otherwise agree in writing.

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* Each country where research, training, technical, or other assistance takes place under the project shall be deemed to be a cooperating country for the purpose of permitting local cost financing of goods or services for the activity being conducted in such country. Such activities may be undertaken in any country included in A.I.D. Geographic Code 935.

b. The aggregate cost of all goods and services procured under each subagreement in a cooperating country may not exceed $750,000.

c. Ocean shipping financed by A.I.D. under the project shall, except as A.I.D. may otherwise agree in writing, be financed only on flag vessels of the United States.

Nyle C. Brady
Senior Assistant Administrator

Date 4/16/85

Clearances:

ST/H/CD, J.Erickson	Date	4/10/85
ST/H, A. Van Dusen	Date	4-11-85
ST/PO, G. Eaton	Date	4/12/85
ST/HP, J. Sarn	Date	4-15-85
GC, S.Tisa DRAFT	Date	4/10/85

ST/H:W.Oglesby:4/4/85:1143t:X5-8926

APR 15 1985

ACTION MEMORANDUM FOR THE SENIOR ASSISTANT ADMINISTRATOR FOR SCIENCE AND TECHNOLOGY

FROM: S&T/HP, James Sarn

SUBJECT: Vector Biology and Control, Project 936-5948

Action: To authorize a new ten-year project, Vector Biology and Control (936-5948).

Discussion: In the past three years S&T/H has been urged to develop a service-oriented, technical assistance project to improve the design, implementation, modification, and evaluation of developing country (LDC) vector control programs. The Vector Biology and Control Project directly responds to perceived LDC needs.

The control of the major endemic vector-borne diseases (malaria, filariasis, schistosomiasis, etc.) has been based on a combined assault involving chemotherapy, chemoprophylaxis, and vector control. These efforts have been compromised respectively by drug resistance, lack of compliance, and insecticide resistance. The potential for new drugs and vaccines has opened new horizons for treatment and disease prevention. Reduction in the transmission of vector-borne diseases still depends, in part, on integrated vector control used in combination with chemotherapy and chemoprophylaxis. However, new operational and technical approaches must be pursued in the future to improve the efficiency and cost-effectiveness of vector-borne disease control.

To date, vector control programs have mainly used residual insecticides to reduce vector populations. High costs and the development of insecticide resistance have compromised the efficacy of these interventions and have significantly reduced the battery of effective chemical control agents. Less than perfect understanding of the biology/ecology of vectors has restricted the implementation of more integrated, and more efficient control strategies. This lack of understanding has been due to a dearth of indigenous skilled manpower, the absence of discrete empirical data on resistance and other factors which influence transmission, and incomplete information on the impact control efforts have had on disease transmission. This project will provide a means for rapid provision of technical assistance to A.I.D.-supported vector control efforts to assist LDCs in the monitoring, evaluation and modification of on-going control programs, and in the design and implementation of new vector control efforts.

The Vector Biology and Control Project will address LDC needs by providing a means by which short-term technical assistance can be obtained rapidly. This assistance, which includes technical, training, and information transfer components will promote more effective and cost-efficient vector control at both the country and regional levels. The Project will utilize the services of a private sector contractor and subcontracted private sector consultants and those of the Centers for Disease Control (CDC).

The project will focus on: 1) improving LDC understanding of the ecology of vectors as it relates to disease transmission and control; 2) assistance to regional training centers; 3) experienced-based training of host country counterparts; 4) applied operational, and entomological research; and, 5) the development of an information center for vector control activities. S&T anticipates funding this project at approximately $19.88 million over 10-years. In addition, Regional Bureau and Mission funding of at least $6 million has been pledged. Additional funding from Missions is anticipated as innovative approaches and new techniques are field tested and become available for wide-scale application.

A Congressional Notification has been prepared and is being cleared. This project was approved by the Health Sector Council on April 4, 1985.

Recommendation: That you sign the attached project authorization.

Attachment: a/s

Clearances:
ST/H/CD, J. Erickson _____ Date 4/11/85
ST/H, W. Uglesby _____ Date 4/11/85
ST/H, A. Van Dusen _____ Date 4-11-85
ST/PO, G. Eaton _____ Date 4/12/85

S&T/H:VBarbier:3/20/85:1143t:235-9649
Revised:4/2/85

PROJECT PAPER

VECTOR BIOLOGY AND CONTROL PROJECT

PROJECT NUMBER (936-5948)

HEALTH SECTOR COUNCIL REVIEW

April 4, 1985

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(Project #936-5948)

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1. SUMMARY

The purpose of the Project is to improve the design, implementation and evaluation of vector control programs in less developed countries (LDCs), to increase LDC expertise in vector control and to improve LDC access to information and new control technologies.

Vector-borne diseases are caused by parasites that require another organism to develop to a stage which is infective to humans. These intermediate organisms can be mosquitoes, flies, other insects, snails or small crustaceans and they can transmit (deliver) the parasite actively or passively. These diseases include malaria, filariasis (including river blindness), trypanosomiasis (sleeping sickness), schistosomiasis and guinea worm. They account for significant mortality and morbidity throughout the developing world, particularly for infants and children. Malaria infects over 225 million people worldwide and is conservatively responsible for 2.5 million deaths annually, one million occuring in Africa. Over 400 million people are infected with filariasis, a set of diseases which cause blindness (onchocerciasis) and swollen, debilitated limbs (elephantiasis).

To date, control of the vector is the most suitable means of limiting these diseases due to the lack of vaccines, safe and effective drugs and, in the case of malaria, drug-resistant parasites. However, vector control efforts have been costly in terms of manpower and commodities and have occasionally promoted the development of insecticide-resistant vectors. Poor quality control and indiscriminate use of chemical insecticides can likewise have other negative environmental impacts, and reduce the overall effectiveness of vector control programs.

This Project will address vector-borne diseases from an ecological perspective and will seek to institutionalize a biologically oriented approach to vector control as a means of improving cost-effectiveness and efficiency. Past control efforts have been primarily based on the large scale use of indoor residual sprays. Although the impact of previous programs has been significant, the efficiency in cost, operational success, measurement of effect, and commodity utilization is debatable. This Project will not ignore established vector control methods, but rather complement them through identification of new tools, testing of innovative operational protocols, evaluation of new technologies which could increase efficiency, and by providing training assistance as necessary.

The Project will be managed by the S&T/Health Office and will utilize the services of a contractor (to be selected by competitive RFP), and the Centers for Disease Control.

2. BACKGROUND

A.I.D. is making significant investments in biomedical research designed to develop new technologies to combat vector-borne diseases. Less attention has been given to the deployment and adaptation of existing technologies to diagnose and combat these diseases in the field. In the past three years Regional Bureaus have urged S&T/Health to develop a service-oriented technical assistance project to improve the design, management, and evaluation of vector control programs. This Project directly responds to Regional Bureau and Mission needs.

There are approximately 44 A.I.D. funded projects which deal with vector-borne diseases--principally malaria. Such assistance includes support to regional training centers in Asia and Latin America, and the CCCD Program, and the Onchocerciasis Control Program in Africa. In addition, A.I.D. and other donors are participating in many irrigation, river basin, and construction projects which have the potential to create environmental changes which exacerbate the transmission of vector-borne diseases. It is anticipated that the Project will provide a valuable resource to Missions, REDSOs, ROCAP, and RBs to modify and evaluate ongoing projects and contribute to the more efficient design, implementation and evaluation of new projects. The availability of skilled manpower in country will also be increased through short-term TA supplied to regional training centers, and through counterpart-consultant, on-the-job, experienced-based training.

One of the major flaws in vector control activities today is the lack of valid field data and applied entomological, epidemiological and operational research to govern the choice of control methods, commodity utilization, mode of operations, and assessment of impact. Much of the neglect for these aspects of vector control activities has been due to an insufficient mechanism for incorporating data collection, monitoring, and evaluation systems into control efforts. Large malaria control programs in India, Sri Lanka, Indonesia and Zanzibar have experienced problems in insecticide resistance, management, increased costs and less than perfect evaluation. Questions concerning the elucidation of the biology of the vectors as it relates to transmission have received cursory attention at best. In each of these, and other programs, issues concerning the development of resistance, quality control, impact on

transmission and disease prevalence, and manpower needs, among others require greater attention. This Project will address these specific needs through centrally-funded TA to Missions upon request. The rationale for this assistance is based on the need for improved vector control programs; the lack of indigenous manpower to accrue information concerning project impact; and the need for empirical evaluation of project success.

The Project is designed to provide TA to LDCs for the design, implementation, evaluation and monitoring of vector-control programs. Field work will include experienced-based-training. The rationale has been derived from a conveyed need through the regional bureaus and Missions which indicates a desire to utilize technical expertise in the field frequently. The Project will provide centrally-funded expertise to assist in the development and implementation of more cost-effective and operationally efficient vector control projects. Rationales for control methodologies will be derived through investigation and monitoring of the "bionomics" (biology, ecology, epidemiology, sociology) of transmission, as an approach to more efficient and effective programs. Through this mechanism, approaches to vector-borne disease control can be specifically tailored to local needs and problems and provide a means of flexible design which will encourage variation in control methodologies based on seasonal change, cultural activities and other "environmental" factors which influence transmission.

In addition to the major component of technical assistance geared to the improvement of vector control programs, the Project will also respond to the need for skilled indigenous manpower which has been expressed by the Regional Bureaus and Missions. The Project will provide: 1) management and technical support to Regional Training Secretariats and Research Institutions; 2) technical assistance to regionally and bilaterally supported training centers; 3) technical assistance for the development of new regional or national training and/or research institutions; and 4) experience-based training for host country counterparts.

Another element of the Project will be the establishment of a Washington-based Vector Control Information Center. This center will be a mechanism by which LDCs can obtain regional and global disease-specific information. It will catalogue A.I.D.-supported vector-control activities to provide a means of comparative analysis for national and regional vector control activities. Regional Centers shall be sent all pertinent informational materials archived in the Information Center. The materials will be updated annually and relevant regional information dispatched as a routine service of the Project. Specific information not routinely supplied to Regional Centers will be dispatched upon request.

3. PROJECT DESCRIPTION

3.1 Goal, Purpose, Outputs, Inputs.

The goal of the Project is the improvement of the health status of LDC populations through a reduction of the incidence of vector-borne diseases. The Project purpose is the improvement of new and/or existing LDC vector-borne disease control programs.

The end of project status would involve positive changes in country strategies for vector control operations and better utilization of commodities, improved patterns of investment for control agents and their application, and an improved ability to determine the need for, and utilization of, new and innovative control techniques and technologies. The Project will invest a high priority in the pursuit of "on the ground" activities to improve and assess vector control programs. Operational techniques will be pursued such as alternating the application of insecticides, and the thorough training of control staff in the application of control agents to maintain quality control. New control agents will be evaluated and the efficacy of these agents determined in relation to local ecologies. Elucidation of the ecology of vector species will be encouraged to identify effective approaches to vector control. Information will be made available at the country level, when appropriate, through the Project's Information Center and/or Regional Centers linked to the Project.Part and parcel of these endpoints would be an increased cadre of skilled manpower, a standardized formula for project monitoring and evaluation, and, a well developed central infrastructure with regional divisions for information cataloguing and dissemination at the regional and inter-regional levels. The Project combines applied field research, field testing of new techniques, innovative operational protocols, experience-based training of local staff in the application of quality control of control agents, and a broad based data collection, analysis and dissemination network.

Outputs would include country programs receiving assistance, general strategies adopted; technologies, new control agents and operational approaches identified and proven effective for LDC use; assistance to regional training centers; improved information on prevalence, incidence and transmission of vector-borne diseases (both qualitative and quantitative); increased numbers of trained LDC personnel; and the establishment of an information transfer center. Inputs would include technical assistance to LDCs through private and university-based consultants, and through a PASA with the CDC; the field testing and evaluation of new and existing control tools; locale-specific, baseline entomological and epidemiological reserach; and training of personnel at, and management assistance to, regional training centers.

3.2 Technical Assistance

Technical assistance will be available for all phases of project design and development, including trouble-shooting, modification, monitoring and evaluation. Quality control assessments, operational assistance and technical training will also be available.

The technical assistance will provide LDCs with an additional means of exploring alternative strategies to vector control. A key factor within this Project is to provide LDC managers and Government Officials with an objective assessment of control options suited to the problems of a particular country. Part of this assessment will include a priority rating of vector-borne disease importance as necessary. Strategic advice and priority assessments would be made available upon request for both new and ongoing projects. The disease potentials, possible control methods and public health cost implications of irrigation, river basin development and other large construction projects could also be assessed through project-supported technical assistance.

The strategy implications for vector control include the choice of control agent(s), how they would be applied, priority areas within a country, methods of monitoring effectiveness (operationally and disease impact), frequency of control agent application and types and duration of applied field research required. By definition, strategy development and adoption is based on experience. This Project will provide the Host Government with a means to evaluate existing strategies and to adopt new strategies as they are proven to be effective in local settings. In some cases, the ongoing strategy may work well and require only fine tuning; in other cases, more significant modificatons may be necessary to enhance program efficacy and improve cost-effectiveness. It is unrealistic to promote a global strategy for vector control as evidenced by the extensive use of DDT in the past and the declining use of residual sprays today. Present approaches recommend an integration of control methods applied in various ways to address specific ecological situations in the field (Gerberg, 1984; Annex II).

It is impossible to state specifically how country strategies towards vector control will be modified because strategies will vary with the vector-borne disease epidemiology/ecology, and the existing operational infrastructure within each country. However, it is reasonable to state that technical assistance will be rapidly available to assess host country strategies and modify these strategies in the context of control programming when and if determined necessary by the Host Government. Such stategic options might inlcude alternating the types of residual sprays used, combining larviciding with residual sprays, reducing breeding habit for vectors, use of biological control agents, etc.

The technical assistance provided by the Project will be innovative in its approach to vector control. Discrete investigation of the functional parameters of transmission will be the benchmark of the assistance provided. Supporting this premise will be the empirical assessment of these parameters and the design of interventions based on accrued field knowledge. Control methods will be recommended only if they are known to be effective and applied when, and where, they can achieve the greatest impact. The efficient utilization of specific interventions will be pursued based on the knowledge of the distribution of incriminated vectors in space and time, and through a combination of interventions (if necessary). Efficacy will be determined through the development of a standardized monitoring system to track the effort on a country-specific basis.

The Project will utilize the data accumulated on vector ecology to improve the efficacy of vector control programs at the country-specific level. The Project will also provide very pragmatic operational assistance. Data collection in the field and operational technical assistance are not seen as separate functions, but rather as complementary by-products of each intervention pursued by the Project. As a part of the technical assistance efforts, data will be collected and analyzed in the following areas: 1) identification and field evaluation of new technologies and new control agents; 2) operational field trials related to quality control, frequency of commodity utilization, recurrent costs, equipment and logistical needs, susceptibility testing of insecticides, and training and manpower needs; 3) baseline data on vector-borne disease transmission and epidemiology (which could be used for, but not limited to, vaccine trials and/or treatment campaigns); and, 4) analysis of needs for furtner research applied to project design, implementation and evaluaton. A further discussion of some of the issues, technologies and control agents to be considered can be found in Annex III.

The Project will also provide assistance to Regional and/or National Research Institutes as a service to strengthen the capability of indigenous institutions to pursue research in vector-borne disease control. TA will be provided to such institutions for defining and refining their research goals and their manpower and technical needs. Management and grant procurement assistance could also be provided as appropriate through the Project. Collaborative links to U.S. institutions and the WHO will be encouraged in order to establish a technical continuun of research assistance to the requesting LDC institutions. TA will also be made available to LDC institutions for the utilization of new technologies and for the empircal evaluation of new contol tools and methods in the field.

3.3 Training

The need for increased skilled manpower to design, implement and evaluate vector control activities is well recognized by developed and developing countries. The Project will support training for LDC personnel through a number of activities. These include: consultant-counterpart experienced-based training; technical management and financial assistance to established and/or developing Regional Training Centers; technical assistance to Regional and National Research Institutes; cooperative organizational and fiscal support to regional workshops and conferences dealing with vector-borne disease issues; and, the establishment of a Washington-based Vector Biology & Control Information Center. The Project will support training activities directly through on-the-job, experienced-based training. Other training will be in the form of technical assistance to regional and/or national organizations and via information dissemination.

Technical support will be available to regional training centers for the development of core curricula, teaching, and administrative assistance through the Project. In Latin America, centers which are anticipated to utilize this TA are the University of Panama Training Center in Panama City and the CAREC in Trinidad. Additional assistance shall be provided upon request to assist in the development of new training centers such as the Sub-Andean Regional Vector-Borne Disease Secretariate. Another major regional center expected to be assisted by the VBC Project is the WHO Inter-Regional Malaria Training Secretariate in Kuala Lumpur.

3.4 Vector Biology and Control Information Center

The dissemination of information is an important factor in the sccessful implementation of vector control activities. The Project will establish a library/information center in the Contractor Office in order to catalogue technical and training literature on vector control methods and make them available to A.I.D.-supported and/or Project-related training/research institutions upon request. The Information Center will also provide a means of tracking vector control activities in order to promote a comparative analysis of inter- and intra-regional vector control efforts. The consultant reports and proceedings of the TAG meetings, workshops and conferences organized through the Project will also be distributed to all Missions and participating institutions as a routine service of the Information Center. The Center's staff shall maintain a reprint file of all published reports on vector control activities

including WHO publications and monographs, and will also maintain subscriptions to relevant scientific journals which focus on tropical disease research. The Information Center will have the capability to make use of computerized technical data bases and be able to search these bases and provide specific information to the field upon request. The provision of this service will enable LDC and Mission planners to obtain a rapid assessment of available information on technical topics, and country- and/or regional-specific data. The Center will also promote the development of guidelines for effective vector control activities based on Project-related information and experience. Regional Training Centers will be automatic receipients of all pertinent information concerning vector biology and control. The Project's Information Center will annually update the informational materials. Adequate stores of materials will be dispatched to all Regional Centers to promote freedom of distribution to participating countries. The informational materials will become the property of those participating Regional Centers at the end of the Project. All documents produced and/or obtained by the Contractor remaining in Washington throughout the LOP shall become the property of A.I.D. at the end of the Contract.

3.5 VBC Relation to the Office of the Science Advisor (OSA)

The Project will complement efforts of the OSA by providing a mechanism to field evaluate new technologies. It is anticipated that the Project will encourage a close working relationship between S&T/H and OSA concerning issues of vector control. The OSA has expressed support for this Project and has indicated it will promote the utilization of vector control TA in the field.

4. IMPLEMENTATION

4.1 AID Management

4.1.1. Project Manager

The Project will be managed by a staff Public Health Advisor/Vector Biologist in the Office of Health/Communicable Diseases Division. The Project Manager will provide general technical guidance, policy and management direction, and assistance in the determination of scope of activities to the contractor and the participating institutions concerning all services performed by them under the Project. The Project Manager will serve as the principal coordination point for interactions among the contractor, U.S.A.I.D. Missions and Regional Bureaus, and the CDC. Field requests will be initially reviewed by the Project Manager. The best source for requested TA will be subsequently determined through discussions with the contractor and RB. If it is determined that CDC personnel are best qualified to fulfill all or part of the TA request, the Project Manager will exercise the PASA accordingly. The Project Manager will serve as the approval point for all requests for services provided under the Project.

4.1.2 Mission Participation

4.1.2a Mission Role in Project Activities

U.S.A.I.D. Mission Directors and their staff will be expected to provide country level management guidance of Project activities carried out in their countries by Project personnel (A.I.D./W, contract, subcontract, PASA). No Project activity will take place in an A.I.D.-assisted country without the approval of the U.S.A.I.D. Mission Director. In the case of Mission-financed, buy-in activities, field operations will conform to requesting Mission procedures. The Project Manager and the Mission will establish vector control priority actions and training interventions jointly. Mission management will include the following:

A. Soliciting, reviewing, approving and submitting to A.I.D./W requests from the host government for technical assistance available under the Project. Obtaining host country contribution or other forms of commitment as appropriate. Programming Mission funds when required.

B. Providing political, economic, and social country-specific guidance to Project personnel.

C. Establishing and maintaining coordination on Project matters with the host government, N.G.Os, and other donors as appropriate.

D. Assisting Project personnel in establishing working relationships with the proper host government officials and selected counterparts.

E. Providing country clearances for Project personnel on official visits to the country.

F Keeping the Chief of Mission informed on Project progress, problems, and accomplishments. Arranging for briefings of the country team by local personnel as appropriate.

G. Assuring maximum coordination at country level between the Project and other A.I.D. and Peace Corps projects in the country.

4.1.2b. Mission and Regional Bureau Financing

Project-funded services are not intended to replace the project design, implementation or evaluation functions of Missions, contractors or host governments. In general, the Project will fully finance assessments and other short-term assistance involving project design, implementation, monitoring and evaluation, and, the evaluation/introduction of new control techniques or control agents. Longer term assistance, and assistance which is partly or completely outside the scope of this Project will be accomodated on a cost-sharing basis.

4.1.3 Technical Advisory Group (TAG)

A Technical Advisory Group (TAG) will be established for the Project in order to provide guidance on what type of assistance should be pursued throughout the LOP. The TAG will provide technical and operational direction on Project activities and recommend priority areas of effort. Members of the TAG will include WHO and PAHO Regional Vector Control Representatives, vector biologists from U.S. and overseas institutions, and the A.I.D. Project Manager. Meetings will be held annually and a report of each meeting will be provided by the Contractor to the A.I.D. Project Manager. Copies of the TAG reports will also be distributed to all TAG members, Regional Training Centers and U.S.A.I.D. Mission Directors through the VBC Information Center.

It will be the task of the TAG to recommend priority technical areas in vector control and applied entomological research, and identify specific regional problems that could be addressed through Project-funded technical assistance. An update of new control tools, technologies and programs will be presented at each meeting. The successes and shortcomings of ongoing A.I.D. and non A.I.D. vector control activities will be discussed and regional strategy issues shall be addressed as they relate to operational questions, training, and the utilization of new control methodologies, tools and agents. The purpose of the TAG is to provide A.I.D., and Contractor Project Managers, and Missions with an up-to-date appreciation of priority needs in vector control and directives based on these needs.

4.2 Contractor

The Primary Contractor will be responsible for the management of its staff, including the identification and management of technical consultants. The contractor must have demonstrable management and technical skills in order to respond to requests from the field rapidly and appropriately. It is estimated that

a staff of three technical personnel will be required. These are: an Administrative Officer; a Technical Officer; and, a Vector Biologist. Any member of the technical staff could provide TA to a requesting Mission providing their skills are commensurate with the request. A brief job description of each is presented below.

- Administrative Officer: Will be required to oversee the activities of the contractor from the administrative standpoint. Will be ultimately responsible for semi-annual, annual, and TA report preparation and distribution. Will be the senior representative for the Contractor in all Project-related activities. Should have five to ten years of management experience in technical programs and be cognizant of the issues associated with the control of vector-borne diseases.

- Technical Officer: Will be the technical liaison between the contractor and the A.I.D. Project Manager. Should be an experienced vector biologist with a strong background in applied malariology. Should be knowledgeable about all aspects of vector control activities and be cognizant of new project and tool development and their potential utilization in the field. Shall be responsible for the technical credibility of the Project in relation to other A.I.D. activities and non A.I.D.-supported vector control projects.

- Vector Biologist: Will be a mid level professional with academic credentials at the doctorate level. Overseas experience in vector biology and/or control is a requisite for this position. Will be the assistant to the Technical Officer and provide technical information throughout the Project. Will assume the responsiblity for organizing all reports and will be in charge of the technical aspects of the Information Center.

4.3 Coordination and Implementation of Project Activities

4.3.1 Overview

Basic short-term services for the design, implementation, modification and evaluation of vector control activities will be available to Missions at no cost to Bureaus and Missions. Where Missions or Bureaus fund specific activities, technical assistance will be provided per request and as necessary. The Project will generally repond to emergency, unanticipated, or

"crisis" needs when the "crisis" threatens to exacerbate vector-borne disease prevalence. However, S&T-funded project services are not intended to replace routine project implementation by U.S.A.I.D.s, their contractors, or host government agencies, rather, they are intended to serve as complementary activities. The Project will not station staff overseas other than on temporary duty except under special circumstances (i.e. staff to Regional Training Centers). At the discretion of S&T/H, some longer-term monitoring activities may be undertaken if co-funded by the requesting A.I.D. Bureau or Mission through a mutually agreed buy-in arrangement.

4.3.2 Procedures for Providing Technical Assistance (TA)

Procedures for providing technical assistance will be as follows:

1. S&T/H will contact each Bureau and each Mission not less than once a year to determine their long-term and short-term needs for technical assistance. S&T/H, in concert with the Contractor, shall develop an "Annual Work Plan" with budgets and with contingency provisions. Each quarter S&T/H, in concert with the contractor, shall systematically update the work plan to accommodate requests which were not included in the annual canvass for anticipated services. In Mission buy-in situations development of the plan will include direct Contractor travel and contact with Missions to define scopes of work.

2. The Contractor shall maintain a roster of technical personnel adequate to insure "quick responses" to LDC/Mission requests relating to vector-borne disease problems. These personnel could also be utilized to respond to crises and emergency needs overseas, particularly for disaster assistance when vector-borne disease epidemics are anticipated. This roster shall be "preapproved" by the A.I.D. Project Manager and the A.I.D. Contracts Officer and shall include key personnel, other contractor and subcontractor staff, CDC personnel, and consultants as required to insure needed competence in technical disciplines and languages. Preapproved personnel shall include vector biologists, medical entomologists, insecticide experts, disease ecologists, parasitologists, epidemiologists, environmental engineers, arbovirologists, medical antnropologists, health educators, logisticians, and public health specialists.

The roster shall be maintained on a current basis and include names, addresses, telephone numbers, qualifications, rates, experience, language capabilities, availabilities, restrictions or constraints on availability, etc. The roster shall be maintained in the operations and information center. The information shall be in a form suitable for search and retrieval by automatic data processing equipment, shall be compatible with A.I.D. Form No. 1420-17, and shall be accessible to the A.I.D. Project Manager. The consultants proposed by the contractor shall be included in the roster and the contractor should anticipate periodic expansion of the roster at a rate of 50 per year in addition to the original cadre.

Consultant agreements shall stipulate due dates, requirements for draft reviews, copies to Missions, translations, and specific details for specific consultancies. The contractor shall be responsible for follow-up evaluations of each consultant task. Evaluations shall be available to the A.I.D. Project Manager.

3. Requests for such technical assistance may be received directly by the contractor or may be generated by A.I.D./W or U.S.A.I.D. Missions. The contractor may also call to the A.I.D. Project Manager's attention needs for technical assistance which emerge during project development, implementation assistance, and evaluation activities. No technical assistance will be authorized without the prior written approval of the A.I.D. Project Manager. In the case of Mission buy-in activities, after A.I.D./W approval, operational approval of in-country activities will rest with the Mission.

4. To accomplish each technical assistance task, the contractor will, in consultation with the A.I.D. Project Manager, Regional Bureau, Mission and requesting organization as appropriate: define the purpose, scope, and scheduling of technical services needed; the type of personnel and special skills required; and any special conditions relative to the task assignment such as briefing/debriefing, in-country logistical support, and, particular working conditions or schedules.

5. The contractor will then: nominate and arrange for the appointment of core staff and/or consultant advisors; obtain Mission and Bureau clearance through the Project Manager; plan and implement orientation and briefing of technical advisors as needed; prepare and monitor travel schedules; arrange debriefings as needed; ensure that reports are prepared and submitted on schedule; negotiate level of effort and pay consultant fees, travel, and other expenses; edit, reproduce, distribute, and catalogue final reports; and evaluate the performance of the technical advisors.

6. Significant changes in the approved workplan must be approved by the S&T/H/VBC Project Manager and coordinated with the requestor.

7. The contractor will not have authority to commit Project resources. Such authority rests solely with the S&T/H/VBC Project Manager or designee.

8. All domestic and international travel supported under this Project must be cleared in advance by the Project Manager. Travel to A.I.D.-assisted countries must be approved in advance by the relevant Bureau and Mission.

4.3.3 Role of S&T/H/VBC

The Project is Agency-wide and is designed to respond to requests for assistance in vector-borne disease control support services coming in from any Bureau and its Missions. S&T/H/VBC will serve as a focal and coordination point for vector control technical assistance services within the Agency. No pre-allocation of S&T/H funds will be made to any one Bureau, Office, or Mission. All Offices, Bureaus, and Missions will have the opportunity to have their requests for services addressed. Although no formal ranking system for requests is proposed, all requests must meet the tests of need, relevance, and cost-effectiveness. The size of the request, source of funds, and equitable distribution between requestors, may be factors in shaping responses.

For each overseas activity (or domestic activity exceeding $1,000 in estimated cost), the contractor will be required to submit a schedule of resources to be used, and to provide curricula vitae for all personnel proposed to the Project Manager. The Project Manager, will in turn verify acceptability of team members to Bureaus and Missions involved and provide recommendations to the M/SER/COM/COD Contract Office as appropriate (an approval list of subcontractors and consultants will be maintained to facilitate rapid response).

Upon approval by the A.I.D. Project Manager of the scope, budget, team composition, and schedule proposed by the contractor, either in the work plan or separately, the contractor will coordinate directly with the relevant Mission(s) or Bureau(s) in working out the myriad of coordination details involved.

S&T/Health will provide at least one full time direct-hire Public Health Advisor/Vector Biologist to coordinate and manage the Project for A.I.D. Other S&T/H/CDD staff will be available, as needed, on a part-time basis to backstop the Project Manager. Experience indicates that such assistance is needed to plan, coordinate, and provide technical input and backstopping for this type of project which must be coordinated with other A.I.D. projects in similar or related fields (e.g., malaria, and diarrhea diseases, and health services).

4.3.4 Estimates of Quantifiable Services

Estimates of quantifiable services through FY 94 are based on projected A.I.D. activities in relevant sectors and subsectors, discussions with other Bureaus and with Missions, and our assessment of unmet needs. Approximately 100 person-months per year of vector-borne disease control-related technical assistance is anticipated. Experience in similar A.I.D. projects (WASH II, PRITECH) indicates that approximately 70 percent is for "general" technical assistance, 15 to 20 percent for training assistance, 10 to 15 percent for technology transfer assistance, and 10 to 15 percent for information services. Obviously many of the activities to be undertaken are relevant to more than one category. However, person-months is the primary measure of level of effort. Estimate of person-months and other services are as follows.

1. Thirty-six person-months per year of technical-professional contractor core manpower for management and coordination of A.I.D./W and U.S.A.I.D. consultancies, direct services, and operation of the operations and information center are anticipated.

2. It is estimated that 60 person-months per year will be utilized for non-technical support staff in the contractor office.

3. Approximately 12 person-months (one full time librarian) per year for information services, including special studies, information gathering, literature research to support subject syntheses and bibliographies, and for dissemination of information

materials on vector biology and control to Missions, Bureaus, et. al. is anticipated. Estimated demand is 500 information requests per year and approximately 1000 documents dispatched per year.

4. Approximately 100 person-months per year will be utilized for technical services overseas including assistance for design, implementation, evaluation, product testing, and training.

5. Approximately $25,000 per year of commodities and equipment for field activities, training, and a new product evaluation is expected to be spent.

6. It is also anticipated that the Project would support, through the contractor, a few longitudinal applied entomological field trials to provide baseline information on vector biology and disease as a precursor to national vector control efforts if requested.

4.3.5 Development, Management and Implementation of Project Activities

4.3.5a General Approach

Overviews will be prepared through TA in the requesting country to summarize available knowledge and identify priority issues. The contractor shall draw upon published literature and information obtained from technical consultations to derive a needs assessment for a particular country. The Project will provide technical assistance to: 1) assist in project design; 2) identify indigenous technical personnel and institutions capable of assuming responsibility for long-term control, research and training activities; 3) monitor and evaluate control programs and applied research efforts; and, 4) prepare technical reports and disseminate results of intervention activities.

The steps involved in developing, managing and implementing Project activities will follow the same general pattern whether these are for project design and strategy development, applied field research and/or training. These steps include: assessing current knowledge and needs; identifying capable collaborators, institutions, and consultants; obtaining necessary clearances and approvals; designing, funding, monitoring and evaluating projects; and analyzing, writing up and disseminating results. A more detailed explanation of these steps is provided below.

4.3.5b Project Design and Strategy Development

Effective project design depends on an indepth understanding of the problem. The Project will provide TA to assess the availability and validity of information concerning a specific vector borne disease problem as appropriate. Questions concerning cost, manpower needs, behavioral factors which influence disease and the ecology of transmissions will be addressed as a pre-design activity. In cases where sufficient information exists, project design assistance will be provided as needed. Strategy determinants are a complex group of factors which influence how, when, what and where interventions should be implemented. The utilization of new control tools can be realized if found to increase project efficacy and efficiency. Once proven in the field, the options for promoting new tool use and operational modifications can be submitted for approval to the host country. However, the decision to adopt new strategies in vector control activities will rest with the host governments. The Project will provide TA only to examine the opportunity for modifications of strategic approaches to vector-borne disease control, and assist LDCs in implementing strategy decisions as appropriate.

4.3.5c Applied Field Research

The Project will provide TA to identify research needs as they relate to ongoing projects and/or the development of new projects. Available scientific information will be reviewed and gaps in knowledge will be explored as requested by the host government. The Project will promote the need for comprehensive field data in order to achieve more efficient and effective vector-borne disease control. The pursuit of applied field research activities will be contingent upon host country requests. The Project will provide TA to meet practical research needs as requested and assist in the modification of existing projects and/or the design of new projects as appropriate. The Project will also provide a mechanism to support workshops to define applied research and training needs at the regional levels.

4.3.5d Training

Training needs will be assessed through invitation of Project technical consultants. Visits to regional training centers and national vector control units will provide indices of regional and country training needs. The degree to which a lack of skilled personnel has impeded vector control efforts on a country-specific basis will be determined and appropriate

training assistance will be made available through the Project as per requests. The magnitude of training assistance will be contingent upon the availability of LOP funds and the status of Regional Bureau and Mission buy-ins.

5. Timetable

Proposed Project Implementation Plan
Project Period 60 months
(FY '85 - FY '89)

Action	Date
1. Approval of PP and Authorization	4 April 1985
2. Approval of PIO/T for 1985 funds	5 April 1985
3. S&T Notifies Missions of New PP	5 April 1985
4. Congressional Notification	5 April 1985
5. PIO/T to SER/CM	5 April 1985
6. RFP Announced in CBD	5 April 1985
7. Receipt of Proposals	21 May 1985
8. Completion of Technical Review	15 June 1985
9. Selection of Competitive Range By SER/CM	21 June 1985
10. Initiation of Negotiation by SER/CM	21 June 1985
11. Selection of Contractor	28 June 1985
12. Signing of Contract	1 July 1985
13. Initiation of Contractor Services	8 July 1985
14. S&T/H Advise Missions of Project Award and disseminates information on types of technical assistance available	8 July 1985
15. Operations of VBC begin: Contractor establishes Office-Preliminary Development of Annual Work Plan	19 July 1985
16. Approved of PIO/T Funds 1986	30 July 1985
17. First Meeting of TAG	29 August 1985
18. Finalization of Annual Work Plan	September 1985
19. Receipt of Mission Requests	October 1985
20. Semi-annual Contractor Report	19 January 1986
21. Update of Annual Work Plan	1 February 1986
22. Annual Contractor Report	30 March 1986
23. Approval for PIO/T Funds 1987	30 July 1986
24. Second TAG Meeting	25 August 1986

25.	Regional Workshop Latin America	10 October 1986
26.	Regional Workshop Asia	10 January 1987
27.	Semi-annual Contractor Report	19 January 1987
28.	Annual Contractor Report	30 March 1987
29.	Project Evaluation	25 July 1987
30.	Approval for PIO/T Funds for 1988	30 July 1987
31.	Third TAG Meeting	25 August 1987
32.	Semi-annual Contractor Report	20 December 1987
33.	Regional Workshop Africa	10 January 1988
34.	Fourth TAG Meeting	25 August 1988
35.	Semi-annual Contractor Report	30 July 1988
36.	Approval for PIO/T Funds for 1989	30 July 1988
37.	Project Evaluation	10 December 1988
38.	End of First 5-Year Funding Period	30 March 1989
40.	Fifth TAG Meeting	25 April 1989

6. Budget

The Project will operate over a 10 year period with $19.88 million from S&T funds and a minimum of $6 million from Mission/Regional Bureau funds for a total of approximately $26 million. Additional Mission funds are anticipated as new techniques are field-tested and become available for wide-scale application.The project will provide approximately 100 person-months of field technical services per year from three sources: 1) contractor staff; 2) consultants secured by the contractor; and, 3) CDC staff. Contractor staff will include three technical professionals and a small logistics and support unit.

The limited commodity budget of the Project is intended for the purchase of small quantities of new control agents and tools for field testing purposes. The project will not finance commodities on an operational scale, except on a buy-in basis utilizing Mission or Regional Bureau funds.

Contractor technical services costs incorporate an inflation factor of approximately 4.5%. Contingency costs are included at approximately 7.5% over the life of the Project.

7 Reports

The contractor shall submit reports as follows:

a) interim activity reports (submitted six months after contract signing and then at twelve month intervals)
shall briefly indicate ongoing activities and progress and serve as updates to the Annual Report.

b) annual reports (submitted twelve months after contract signing and then at twelve month intervals)
shall include, but not be limited to, a description of activities, summary of results, accomplishments, problems and anticipated activities for the following year.

Both interim and annual reports shall be submitted to the A.I.D. Project Manager in six copies.

c) all financial reporting, vouchers for payment and reporting of expenditures shall conform to standard A.I.D. regulations and procedures.

8 Evaluation

The project will be closely monitored by the A.I.D. Project Manager and the staff of the Office of Health. There will be annual management reviews. Interim evaluations are planned in the third and seventh years. Major evaluations are planned at the mid-point and conclusion of the Project. The mid-point evaluation

ESTIMATED BUDGET

VECTOR BIOLOGY AND CONTROL PROJECT

(Fiscal Years '85 - '94)

	85	86	87	88	89	90	91	92	93	94	Total
1. Contract Technical Services (of which Information Center)	700 (35)	1,200 (50)	1,600 (50)	1,650 (50)	1,700 (50)	1,825 (50)	1,925 (50)	2,025 (50)	2,100 (50)	2,100 (50)	16,500 (385)
2. CDC PASA	100	100	100	100	100	100	100	100	100	100	1,000
SUBTOTAL Technical Services	800	1,300	1,700	1,750	1,800	1,850	1,925	2,025	2,125	2,200	17,500
3. Evaluation			25		50		35			50	160
4. Commodities	25	25	40	40	40	25	25	25	0	0	245
5. Regional Meetings/ Conferences		25	100	100	100	30	30	30	30	30	475
6. Contingency	25	150	150	150	160	160	160	170	180	195	1,500
TOTAL	850	1,500	2,015	2,040	2,150	2,065	2,175	2,250	2,335	2,475	19,880

shall be utilized as a basis for deciding project continuation. The interim and major evaluation will use A.I.D. staff and outside experts to assess project organization and development; project management; project output; research; information transfer; training activities; technical assistance activities; and recommendations for project improvements and future activites.

9. Conditions and Covenants

Agreements which may be negotiated under this Project and executed by the officer(s) to whom such authority is delegated, in accordance with A.I.D. regulations and Delegations of Authority, shall be subject to the following terms and conditions together with such other terms and conditions as A.I.D. may deem appropriate:

Source and Origin of Goods and Services

Each country where research, training, technical or other assistance takes place under this project shall be deemed to be a cooperating country for the purpose of permitting local cost financing. The aggregate cost of all goods and services under each subagreement in a cooperating country may be procured in the special free world category (Code 935) up to $750,000 for the purpose of permitting local cost financing.

10. Recommended Environmental Threshold Decision

Vector control activities do not present a threat to the environment of any country when the application of insecticides and habitat modification are properly managed. The VBC project will use only small amount of test commodities. However, when recommending interventions for large scale, long term efforts which include residual sprays, larvicides, source reduction, etc; the project shall stress the need for quality control monitoring of insecticide application and pre-implementation consideration of the effects of any environmental modification activities.

Since the project will adhere to quality control procedures, it will not directly threaten the environment of LDCs. The development of detailed training plans for the use of chemical agents will be part of the responsibility of any technical assistance team that recommends the use of such agents. Training will protect host country vector control workers and minimize the potential for adverse environmental impacts. We recommend a negative environmental threshhold decision.

Annex I: Logical Framework

AID 1020-28 (1-72)

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number: Vector Biology & Control (936-5948)

Life of Project: From FY 85 to FY 94
Total U.S. Funding 26 M
Date Prepared: 4/1/85

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal The broader objective to which this project contributes: To improve the health status of LDC populations exposed to vector-borne diseases	**Measures of Goal Achievement:** Reduction of acute and chronic vector-borne disease prevalence, decreased morbidity and mortality, improvement in health status	Vital statistics compiled by host countries, entomologic/epidemiologic data compiled through initiated vector control programs, end of project reports by USAIDs	**Assumptions for achieving goal targets:** That effective vector-borne disease control technologies are instrumental in reducing parasite burden and improving health status
Project Purpose: To create or improve effective and cost-efficient LDC vector-borne disease control programs	**Conditions that will indicate purpose has been achieved: End of project status.** a. positive change in LDC strategic approaches to vector control b. cost-effective/environmentally sound use of commodities c. LDC personned in key positions d. comparability of vector control programs e. new tools tested and adopted	AID/W, Mission and contractor reports and evaluations	**Assumptions for achieving purpose:** 1. MOHs.USAIDs encourage selective vector control programs 2. technical project management available 3. new techniques and stratigies increase program efficacy 4. indigenous personnel utilize skills effectively
Outputs: a. development of new design strategies b. increased skills of LDC vector control staff c. utilization of new control tools d. growth or regional training centers and research institutes e. dissemination of state-of-the-art information on control activities	**Magnitude of Outputs:** a. 40-50 recipient of technical assistance b. 100-200 LDC staff recipient of assistance c. 10-15 new control tools field tested d. expansion of 4-6 existing and/or new training centers, TA to 10-15 research institutes e. information to 30-40 institutions	1. Contractor records and reports 2. AID/W and Mission reports and evaluations	**Assumptions for achieving outputs:** 1. TA skills required will be available in U.S. and other countries 2. counterpart manpower available in LDCs
Inputs: a. contractor management services b. provision of a broad spectrum of assistance c. development of information center d. participant-training in assistance e. publication/distribution of reports, meetings, workshops, scientific publications f. standardized protocol for tracking control activities	**Implementation Target (Type and Quantity) ($000s)** 1. Contractor Tech Service 16500 2. CDC PASA 1000 3. Evaluation 160 4. Commodities 245 5. Meetings/Workshops 475 6. Contingency 1500 TOTAL 19880	1. Contractor accounting records 2. Annual Project Manager reviews	**Assumptions for providing inputs:**

NARRATIVE PRESENTATION

LOGICAL FRAMEWORK FOR VECTOR BIOLOGY AND CONTROL PROJECT

A. Narrative Summary

1. Goal: To improve the health status of LDC populations exposed to vector-borne diseases.

2. Purpose: To create or improve effective and cost-efficient LDC vector-borne disease control programs.

3. Outputs:

a. development of new design strategies and methodologies

b. increased levels of skills of LDC professionals and staff involved in vector-borne disease control

c. utilization of new and/or improved control technologies, methods, and tools

d. growth of regional training centers and research institutes

e. dissemination of state-of-the-art information and recent data on vector control activities worldwide

f. reduced incidence of vector-borne diseases

4. Inputs:

a. contractor management services

b. provision of a broad spectrum of technical assistance

c. development of a vector control information center

d. participant-training in all categories of technical assistance

e. publication and/or distribution of all consultant reports; proceedings of meetings and workshops; and recent scientific publications on tropical disease research to all project participants.

f. development of standardized protocol for designing, monitoring and evaluating vector control activities

B. Objectively Verifiable Indicators

1. Measures of Achievement: reduction of acute and chronic vector-borne disease prevalence, decreased morbidity and mortality, improvement in health status

2. End of Project Status

   a. positive change in LDC strategic approaches to vector control
   b. cost-effective and environmentally sound use of commodities
   c. LDC personnel skilled in state-of-the-art techniques in key positions managing vector control activities
   d. regional and global comparability of vector control programs through the use of standardized protocols in AID-assisted activities
   e. new techniques, technologies, and/or control agents field tested and adopted in LDC programs

3. Magnitude of Outputs

   a. 40-50 LDC programs recipient of technical assistance and implementing improved strategies for vector control
   b. 100-200 LDC professionals and staff recipient of project technical training assistance
   c. 10-15 new control tools, agents, and/or methods field tested
   d. expansion of 2-3 existing regional training centers, assistance in the development of 2-3 new training centers, technical assistance to 10-15 research institutes
   e. periodic distribution of state-of-the-art vector control information to 30-40 LDC health institutions

4. Implementation Target:

		($000's U.S.)
1.	Contractor Technical Services	16,500
2.	CDC PASA	1,000
3.	Evaluation	160
4.	Commodities	245
5.	Regional Meetings/Conferences	475
6.	Contingency	1,500
TOTAL		19,880

C. MEANS OF VERIFICATION

1. Program Goal

Vital statistics compiled by host countries, entomologic/epidemiologic data compiled by initiated vector control programs, end of project reports by USAIDs.

2. Project Purpose

AID/W, Mission, and contractor reports and evaluations

3. Outputs

1. Contractor records and reports

2. AID/W and Mission reports and evaluations

4. Inputs

1. Contractor accounting records

2. Annual project manager reviews

D. IMPORTANT ASSUMPTIONS

1. Assumptions for Achieving Goal Targets

1. That effective vector-borne disease control technologies are instrumental in reducing parasite burden and improving health status.

2. Assumptions for Achieving Purposes

1. MOHs/USAIDs encourage initiaing/enhancing selective vector control programs via field requests
2. Technical project management available and effective
3. New techniques and strategies can increase the efficacy of vector control programs
4. Indigenous personnel will utilize their new skills effectively

3. Assumptions for Achieving Outputs

1. Skills required will be available in the U.S. and/or other countries
2. Counterpart manpower available in LDCs.

Annex II: Technical Citations

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3. Service, M.W., 1984. Problems of vector-borne diseases and irrigation projects. Insect Science and Its Applications, 5(3):227-231.

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THE UNITED STATES INVOLVEMENT IN OVERSEAS MALARIA PROGRAMS

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Historically speaking, the United States' interest in malaria overseas could be said to have begun with the building of the Panama Canal. Then in the late 1930's came the first foreign assistance to malaria programs through the Institute for Inter-American Affairs which earmarked some several million dollars, specifically for the control of malaria. In the 1940's the Rockefeller Foundation was extremely active and successful in demonstrations of malaria control in various places, but notably in Brazil, where they eradicated the introduced vector of malaria, *Anopheles gambiae*. Later they attempted to eradicate the vector in Sardinia. Although this attempt was not successful in eradicating the mosquito, it certainly led the way for eradication of malaria in many places with methods which have been used ever since. By the late 1940's and the early 1950's the United

[1] Formerly, Office of Health, Agency for International Development, Washington, DC 20523.

[2] Presented at World-Wide Medical Entomology and Vector Control Seminar, 38th annual AMCA meeting, Sacramento, CA, April 19, 1982.

States Government through its foreign aid program was giving direct bilateral assistance to a number of countries for their malaria programs.

This world-wide program peaked in the mid-1960's with U.S. foreign aid programs providing some 70 malaria advisors overseas and an average of about 50 million dollars a year to 37 countries. From 1950 to the present, AID (Agency for International Development) and its predecessor agencies contributed close to one billion dollars in the support of overseas malaria programs. Nearly 700 million of it went to some 36 countries in direct bilateral agreements and to the multilateral agencies, such as World Health Organization, Pan American Health Organization, United Nations International Childrens' Emergency Fund, and the United Nations Development Program. These agencies then distributed funds to some 90 countries, including nearly all of the countries of the world with malaria programs. By the late 1960's assistance by AID was substantially reduced. This was in part, because of the highly successful malaria programs which had drastically reduced malaria throughout a large part of the country to where it was no longer considered a serious public health problem, but also because of AID budget reductions which resulted in money going to other priority programs. In a number of countries where AID assistance was terminated, the countries themselves then diverted their funds to other programs. Consequently, within a period of 3 to 5 years, malaria had returned to the point where again a crash program was required and AID assistance was resumed in order to protect other development programs. The current status of U.S. assistance to overseas malaria programs can be summed up rather briefly. The Agency for International Development is currently involved in assistance to malaria programs in Indonesia, Thailand, Nepal, India, and Sri Lanka. In Africa a demonstration project is just being completed in Zaire and a new control project is starting in Zanzibar. In the Americas, AID is assisting the program in Haiti, and also in Honduras where malaria control is a part of the health sector assistance program.

OTHER U.S. AGENCIES

The CDC (Centers for Disease Control) have personnel involved in malaria research and training in Guatemala, in Haiti, in Kenya, in Zaire, and in Malaysia. Personnel from The National Institutes of Health are monitoring malaria research in Egypt.

The U.S. Army has personnel conducting malaria research in Thailand with the Armed Forces Research Institute of Medical Sciences and also in Brazil.

The U.S. Navy has personnel involved in research on malaria in the Philippines and Indonesia.

THE NEED FOR CONTINUED U.S. EXPERTISE

In view of the current situation in which control of malaria, through the use of residual insecticides and antimalarial drugs, is becoming more difficult every year with additional species of mosquitoes becoming resistant to insecticides and with drug resistant malaria spreading, comprehensive vector control using all available methods in an integrated approach is becoming more important. In some countries, vector control is the only hope for reducing the amount of malaria. Although the need to make use of all available methods of malaria control has been recognized for a number of years, still very few countries are actually conducting programs in which they are making proper use of a variety of vector-control methods, such as source reduction, larviciding, space spraying and biological control. Although some countries have committed themselves to such a program, many of them are still not using these methods or are using them improperly. The reason is easy to see. Most of the senior personnel directing malaria pro-

grams throughout the world were trained in one or another of the malaria eradication training centers, where they learned residual spraying and drug treatment. Although they were exposed to the fact that there are other methods, they really did not learn how to use them. It is for this reason that WHO, PAHO, and AID have concerned themselves in recent years with the need for training in the field of malaria that would emphasize the use of all available methods. As a result of this concern, there has now been established in Kuala Lumpur, Malaysia a WHO training secretariat on malaria and other vector-borne diseases, which is attempting to coordinate and assist national training programs with this conversion to the use of all available methods of malaria control. Also, the Pan American Health Organization has already sent fact-finding teams to the Latin American countries to determine the training needs in the field of malaria and vector-borne diseases and survey the resources available for meeting those needs. A seminar will be conducted by PAHO during September 1982 directed towards developing a training plan for the Americas in this field of malaria and vector-borne diseases.

Through the local mosquito control programs the state health departments, the universities, and through federal agencies, the U.S. has a favored position in this matter of expertise on various methods of vector control. There are many experts who are in a good position to provide the developing countries with the kind of information they need to make better use of the available methods of vector control that are already in use throughout the U.S. Fortunately at the present time, there is considerable interest in this field. The Agency for International Development has recently (April 13–16, 1982) sponsored a workshop on Comprehensive Vector Control through the U.S. Department of Agriculture's laboratory in Gainesville, Florida in which priorities were established for research to improve current methods or develop new methods of vector control. The National Academy of Sciences, also with AID funding, is planning a workshop on training requirements and career opportunities in vector biology and control.

However, in spite of the obvious need and the apparent interest in doing something about improving vector control activities, there appears to be no plan, no mechanism, by which the U.S. expertise can be put to work on behalf of developing countries. The AID for some years now has been in the position of being asked to do more with less. At the peak of the antimalaria effort in the mid-1960's, AID provided 70 malaria experts in the field and annually expended between 50 and 100 million dollars in support of antimalaria programs. This agency is now reduced to the level of exactly 2 malaria advisors (one in Washington and one in the field) plus 5 country malaria project-monitors in the field on contract. The World Health Organization also, due in part to budget constraints, but also as a matter of policy, has reduced its malaria advisors from the peak number of several hundred down to less than 100. Theoretically, this should not make any difference. After all, over the past thirty years, both AID and WHO have sponsored hundreds of training fellowships for senior personnel in national malaria programs. Unfortunately, these people are not necessarily still available. Many of them have moved on to senior positions of responsibility in their Ministries of Health and have been replaced by junior individuals, who have not had adequate training. An adequate senior malariologist professional course has not been available on a regular basis since 1973 when the National Eradication Training Center in Manila was closed.

There are 3 priority areas of need in the worldwide malaria program today. First, and most important, is the job-oriented training of the senior personnel from malaria and other vector-borne disease programs. Good progress is being made in meeting this need through the training secretariat in Kuala Lumpur,

Malaysia established by WHO with assistance from AID and CDC, through the integrated control course in Turkey referred to by Mr. Rafatjah in another presentation, through the malariology course organized by WHO in Rome, Palermo and Turkey and through the plans underway by PAHO for development of a training program in malaria and other vector-borne diseases for the Americas.

There is considerable scope for a contribution of U.S. expertise to this program. Individual specialists will be needed for preparation of training aids and for actual teaching. Another way in which U.S. expertise can serve this training program, is through individual or traveling seminar types of observation tours, usually sponsored by WHO or AID. I am sure that many of you have had foreign visitors or groups of visitors come to see your programs. This has all too often been on an ad hoc, last minute, hit or miss basis. The American Mosquito Control Association is in an excellent position to assist this effort by surveying its members for their interest in hosting such visits and coordinating such observation tours of vector control and research activities in the field of an organized basis.

The second area of need is for the provision of specialists to work overseas with malaria or vector-borne disease programs on a regular basis, 2 or more years, or for short term assignments of 2 weeks to 2 months, to evaluate on-going programs or to assist in developing plans for new programs. The supply of malariologists, medical entomologists, or engineers with actual field experience in malaria or vector control programs has dwindled to the vanishing point. World War II, MCWA (Malaria Control in War Areas), or even AID "retreads" are just no longer available in reliable numbers. For those fresh out of school who are interested, we are back in the situation where you cannot obtain a job because you do not have experience and you cannot get experience because you cannot get a job. The administrator of AID, Mr. Peter McPherson, has recently made an imaginative and innovative proposal, which if implemented, could go a long way towards solving this problem. In an address to the National Association of State Universities and Land Grant Colleges on November 10, 1981, he proposed that AID and Universities work together to establish a core of jointly utilized AID/University, career professionals, who would remain employees of the University, but AID would reimburse the University for costs associated with their assignment with AID. On completing an overseas tour for AID, they would then be in a reserve status and would be available and on call for short-term assignments at AID expense. When and if this proposal is acted upon, it could make a start towards a solution of this problem. Similar proposals have been made in the past but have never gone beyond the talking stage. In the meantime, AID and WHO find that in order to field teams with knowledge and experience, they must drag "old duffers" like myself out of retirement. The average age of a 5 person malaria team, that followed the road to Zanzibar for AID 2 years ago, was 65.

The third area of need is in the field of research. In order to convert malaria eradication programs to malaria control programs, utilizing all available methods in an integrated approach, the individual countries are finding that they must organize and conduct applied field research projects in which they test each of the supplementary or alternative methods against each of their vector species. Many of the developing countries need advice, training, and assistance in developing such a research program. In general, the trend in recent years has been for the funding agencies to provide the money directly to the developing country institutions. It is then up to them to make their own arrangements for external technical assistance and/or collaboration. Here again is an area where U.S. experience could be used to good advantage on behalf of the developing countries. However, there is a need for a central clearing house of information as to the availability

of specialized expertise in the field of vector-borne disease research. Again the American Mosquito Control Association could serve a very useful purpose by organizing and coordinaging such an effort, which would be a logical outgrowth of the Directory of Vector Control Specialists recently developed (1982) by Eugene Gerberg and the AMCA World Wide Committee.

PROSPECTS FOR THE FUTURE

The prospect for any expansion of U.S. involvement in malaria programs in the future does not appear very bright at the present time. The trend for some years in AID financing of malaria programs has been towards multi-donor funding, with 2 or more donor countries sharing costs of funding of malaria as a part of a primary health care program. I would predict that these trends will continue.

During the past several years, malaria programs have been funded by the World Bank, by UNDP, by the United Kingdom, by The Netherlands, by Japan, and by the Scandinavian countries.

There is some prospect of renewed interest by AID which might lead to a greater involvement in malaria programs. The GAO (General Accounting Office) has recently issued (1982) an audit report on world-wide malaria programs in which they call attention to the increasing seriousness of the malaria problem worldwide, and recommend to the AID that they reexamine their strategy for control of malaria. I am sure we will all follow the results of that recommendation with a great deal of interest.

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GLOBAL MALARIA CONTROL STRATEGY FOR THE FUTURE[1]

Eugene J. Gerberg[2]

ABSTRACT: Malaria is the leading deterrent to development of human and natural resources. Malaria eradication programs have given way to malaria control programs. Maximum use should be made of existing and potential primary health care systems in the operation of malaria control programs, based on any of the four tactical variants. Malaria control programs must have the full commitment of the country, must be financially, administratively, and technically feasible, and should have long-term planning. Complete baseline data should be acquired in order to evaluate the effectiveness of the program. Adequate training and expanded research activities are required.

Malaria continues to be the leading deterrent to development of human and natural resources in vast areas of the world. It is the leading disease in terms of mortality of morbidity. The number of reported cases (not including Africa) reached 7.8 million in 1980. This may be a small proportion of the actual total number of cases. As a direct result of the adverse impact of the disease, countries with serious malaria problems cannot become economically viable.

Since the early 1950's the United States has provided over $1,000,000,000 in bilateral assistance to support anti-malaria programs, in contributions to the malaria efforts of the World Health Organization, and in support of research, including the development of mosquito control methodology, epidemiological research, improved insecticides and application equipment, malaria vaccines, and anti-malaria drugs.

The initial results of these programs were dramatically successful, resulting in eradication of the disease in many countries, and striking reductions in malaria-related mortality and morbidity in virtually every country where programs were initiated. Unfortunately, the successes of the early years of the programs could not be maintained everywhere. In some countries malaria resurged with alarming rapidity when anti-malaria efforts slackened. By 1969, WHO reluctantly concluded that however desirable the eradication of malaria might be as an ultimate goal, it was not feasible in many countries, due to financial and technical constraints. The alternative was malaria control.

Malaria eradication programs were designed with a limited duration. Malaria control programs have no predictable end. The objective of the eradication program was the ending of transmission and elimination of infective cases, all to be done within a given time frame. The objectives of a control program is to reduce the prevalence of malaria to a level where it is no longer a major public health problem. Thus, there is no time limit, as the problem is diminished but not eliminated.

Perhaps there were additional reasons for the failure of the eradication programs. The financial expenditures were undoubtedly high and were provided, at least initially, by the developed countries. The lesser developed countries were in no position to bear the costs. In those countries where success seemed to have been attained, the reaction was to reduce the program (and its costs) and maintain surveillance. The vertical malaria organization was dispersed within the basic health service and, as a result, the technical expertise to maintain the surveillance was diverted. Poor surveillance allowed an explosive increase of malaria morbidity. Another important factor was the rapid rise of insecticide and drug resistance, the increasing costs of insecticides, plus the pressure of environmental groups to curtail the use of effective insecticides. Inadequate planning, poor administration and poor training contributed to the downfall of the malaria eradication program. Thus, eradication is out—control is in.

In 1976, the 30th World Health Assembly declared that the world's social goal should be "health for all by the year 2000," In 1978, a joint WHO/UNICEF meeting in Alma-Atta endorsed the view that the provision of primary health care (PHC) to the mass of the world's people should be seen as the highest international priority in the health sector and agreed that the PHC approach is the key to attaining the goal of health for all. These meetings have had and will continue to have a profound effect upon malaria programs. Primary Health Care is defined as essential health care based on practical, scientifically acceptable methods, and made accessible to individuals and families in the community through their full participation. It is a health delivery system to the periphery. It is the first level of contact of individuals, the family, and community with the national health system.

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In 1979, the 17th report of the WHO Expert Committee on Malaria defined a malaria control program as an organized effort to institute, carry out, and evaluate such anti-malaria measures as are appropriate to the prevailing epidemiological and socioeconomic conditions in order to achieve the greatest possible improvement in the health situation of a population subjected to the burden of this disease or exposed to the risk of its resurgence.

The purpose of such a program is to reduce the impact of malaria on the population to the lowest possible level. The control measures should be economical and the methods of operation and evaluation must be chosen in relation to the set objectives. The committee then described four tactical variants encompassing the major possibilities of malaria control.

Tactical variant 1: The goal is reduction and prevention of mortality due to malaria. The program consists of the administration of curative doses of an effective schizonticidal drug. Basically this method is "death control."

Tactical variant 2: The goal is reduction of prevention of mortality and morbidity. The program consists of providing anti-malaria drugs not only to acute cases, but also chemoprophylaxis to certain selected groups (e.g., infants and young children, nursing and expectant mothers, high-priority members of a labor force, etc.).

Tactical variant 3: The goal is reduction of prevalence and endemicity of malaria. In contrast to tactical variants 1 and 2, which are "holding operations," this program is designed to reduce malaria prevalence and endemicity. Measures to be taken would be selected on the basis of the epidemiological and vector ecological situation, availability of funds, and technical administrative capabilities. It would include, in addition to chemotherapy and chemoprophylaxis, all available and useful methods of vector control. These measures, of course, may vary from country to country and would be carried out, not necessarily nationwide, but in areas where technical feasibility exists. Other variants may be used in other parts of the country while technical variant 3 is being conducted in defined areas of the country.

Tactical variant 4: The goal is countrywide malaria control, aiming at the ultimate objective of eradication. This variant requires a long-term malaria control program with specific time targets for attaining the interim objectives described under variants 1, 2, and 3 and leading ultimately to malaria eradication.

Based on these WHO mandates, malaria control programs will use one of the four tactical variants; and, if possible, the malaria program will be incorporated into the primary health care system.

The determination of a strategy for a malaria control program may reflect the viewpoint of whether the strategist is a donor country or is the donee. The following strategy would be that of a donor country:

1. The country requesting assistance must recognize and commit itself to the long-term control of its malaria problem. Without such a commitment, no amount of external support and no plan of operation, however well conceived, can assure long-term success in controlling malaria.

2. A plan for malaria control must be appraised on the basis of its technical feasibility and the country's administrative capacity and long-term financial responsibility. The scope of the program should not exceed the capabilities of the country to sustain the activity if external assistance were to be terminated.

3. Maximum use should be made of existing and potential PHC systems consistent with the capacity of such systems to carry out their assigned roles. In some countries, the PHC system, supported by a mandatory core of malaria expertise within the Ministry of Health, may be the only vehicle for malaria control.

The plan should describe the malaria problem, the proposed course or courses of action and the anticipated results. The plan should provide:

1. Data on the geographical area in which the program will be conducted, the population affected, and the specific population and age groups targeted for attention.

2. A baseline of epidemiological data which describes the existing problem in quantitative terms to enable subsequent evaluation of accomplishment under the program.

3. A baseline of entomological data which identifies the mosquito vector or vectors, breeding sites, feeding habits, and related biological data. Resistance to insecticides should be determined and field test comparison of usage under local conditions should be undertaken to determine the most cost-effective insecticide.

4. Description of plans for supervising, monitoring, evaluating, and providing essential specialized support to workers at the periphery.

5. A life-of-project projection of requirements in terms of manpower, money, equipment and supplies, defining in terms of quantity and quality the resources to be provided by the host government and those expected from external sources.

6. Logistic and transportation requirements of the project, including descriptions of equipment needed, methods of procurement, warehousing, distribution, stock control, reorder levels, etc., and as appropriate, provision for equipment and vehicle maintenance.

7. Training requirements and a plan defining who requires training, where, when, and by whom.

8. The relationship of the malaria control program to other activities of the Ministry of Health. Methods of assuring coordination with and the full support of other elements in the Ministry of Health and with other ministries and agencies (including the private sector) concerned with activities affecting malaria in the country.

9. The social and economic impact of the proposed program.

Strategies as well as the tactics of anti-malaria programs have to be flexible and changed as necessary to take advantage of technological advances, or changes in the habits, or susceptibility of the vectors of parasites to control agents or practices. Research and training are essential for any successful vector control program. Future strategies are going to have to include the use of malaria vaccines, new immunological techniques, satellite mapping techniques, new approaches to residual house spraying, personal protection methods, the use of biorational pesticides, and hopefully a host of other new improved methods. The shortage of trained personnel with malaria expertise will require extensive training, both academically as well as in the field. As Dr. Paul Russell stated in 1968, "There does not appear to have been a logical or practical ratio between the $500,000,000 spent trying to eradicate malaria and the $25,000,000 spent to find out how to do this most effectively and economically."

In summary, the future global strategy for malaria control will require:

1. A definite commitment, political as well as financial.

2. Complete prior planning, including monitoring and evaluation.

3. The maximum efficient use of drugs, pesticides, and other vector control methodology.

4. Adequate training.

5. Continued and expanded research activities on immunological techniques, diagnostic methods, and vector control.

Malaria programs in the past have not always had the necessary leadership, dedication, technical capabilities, and financial resources. If we are to be successful in the future, malaria programs will have to become efficient operations, taking advantage of all new technological advances.

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PROBLEMS OF VECTOR-BORNE DISEASES AND IRRIGATION PROJECTS

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Abstract—In many tropical countries, increasing use is being made of irrigation to grow more food for the world's expanding population, but as well as bringing benefits irrigation also causes problems. The proliferation of standing water provides numerous habitats for snail intermediate hosts of schistosomiasis and mosquito vectors of diseases such as malaria and filariasis. Thus, while irrigation schemes can be successful in providing more food they may be accompanied by increases in vector-borne diseases. In some schemes resettlement of people creates overcrowding and slum conditions which can result in a deterioration in general health and hygiene, facilitating the spread of water related diseases such as cholera, typhoid and various dysenteries. Efficient vector control, supported by the people, is needed to reduce the undesirable effects of irrigation.

Key Words: Filariasis, insecticides, irrigation, malaria, mosquitoes, schistosomiasis, snails

INTRODUCTION

This paper was presented in June 1982 at the international meeting on "Perception and Management of Pests and Pesticides" in Nairobi, Kenya and briefly reviews some of the health problems so often encountered with irrigation projects.

PEOPLE AND FOOD

Agriculture probably began some 12,000 years ago when man began collecting a few seeds and growing plants around where he lived and sheltered, and it was not long before man started changing his environment to suit his immediate needs. Within recent decades man's effect on the environment has been much greater and his activities in one place may have worldwide repercussions. For example, there is considerable concern that the destruction of vast areas of rain forest in South America, Malaysia and Central Africa not only destroys valuable habitats and resources, but may even affect world climate. It has been estimated that at present 30 ha of tropical rain forest are destroyed every minute and this rate is accelerating. Another worldwide problem concerns pesticides. These are produced and used mainly in the northern areas of the world, but pesticide residues occur almost worldwide.

What concerns ecologists and thinking people is the exponential rate of the changes that man is making to his environment, and this is due to one phenomenon—the logarithmic growth rate of the human population: 12,000 years ago there were probably about 10 million people, but by 1980 world population was about 4140 million, and conservative estimates forecast that it will be about 7000 million by the year 2000. Now the important point is that more than 90% of this increase will be taking place in the developing countries. More people means more food, and although at present the world produces sufficient food for everyone, the problem is that it is not evenly distributed. In developed countries large sections of the community are overfed and people are trying to lose weight, while in the developing countries large numbers of people have insufficient food. In 1974 the World Food Conference pledged that by 1980 "no child should go to bed hungry" which was clearly ridiculously overoptimistic. In 1979, the International Year of the Child, an estimated 17 million children under 4 years died of hunger. A similar over ambitious and unrealistic claim of the World Health Organization, is that there will be "health for all by the year 2000". Returning to the problem of feeding the world, redistribution of food on a large scale is unlikely to happen, so there must be increased food productivity, and this mainly in the developing world. One way of increasing food production is irrigation. We will now focus attention on this strategy and some of the problems it can create.

IRRIGATION: SOME GENERAL CONSIDERATIONS

About 30% of the world's land surface is classified as arid and about 14% of the world's present population, i.e. some 600 million people strive to make a living in this inhospitable environment. Irrigation provides a means of growing crops in such harsh environments. Israel, by necessity, has very efficient irrigation policies which allow agriculture to be extended to large arid and semi-arid lands where formerly it did not exist. Irrigation, however, can also improve productivity in areas where agriculture is not already practised. In 1975 about 223 million ha of land were under irrigation, comprising about 13% of available arable land, but this is expected to rise to 273 million ha by 1990. Although the last few decades have seen a proliferation of irrigation

schemes. Irrigation is not new, it was practiced by the Egyptians in the Nile delta some 4000 years ago, enabling Egypt to become the cereal bowl of much of Europe.

A variety of crops can be irrigated such as cotton, sugar, vegetables, cereals, groundnuts, citrus and dates, but the most commonly irrigated crop is rice. Irrigation brings many problems. It is expensive in terms of energy and other inputs (e.g. fertilizers, pesticides) and requires considerable expertise and management to prevent soil degradation such as increased salinity and alkalinity. Lake Nubia in Egypt for instance has an annual evaporation loss of 2500 mm which results in concentrating salts in the soil. More than 70% of the 30 million ha of irrigated land in Egypt, Iran and Pakistan are affected by salinization and water-logging. In Madhya Pradesh in northern India, the Tawa irrigation project has created a "wet desert". The soil is water-logged. Instead of getting a 10-fold increase in crop production as was expected, production is in fact smaller than prior to irrigation. Many irrigation schemes are operating at less than 50% efficiency, partly because of poor management and deterioration of maintenance.

Medium to large-scale irrigation schemes drastically alter the environment. For example, there is usually a large influx of people and this may lead to overcrowding and slum settlements and associated health problems. The combination of poor housing, lack of hygiene and large numbers of crops in the fields and in storage can substantially increase rodents, which apart from being pests *per se* can harbour plague, leptospirosis and various rickettsial infections (Smith, 1972). The creation of large expanses of perennial water provide ideal habitats for aquatic and semiaquatic birds, some of which may be important in the cycle of transmission of zoonotic arboviral diseases (Beran, 1981; Simpson, 1972). More importantly, permanent water leads to greatly increased numbers of snail intermediate hosts of schistosomiasis (Jordan, 1972; Smith, 1972), and mosquito vectors of malaria, filariasis and arboviruses. Sometimes simuliid blackfly vectors of onchocerciasis become established in irrigation canals, which as well as constituting a health risk in some areas of Africa and Latin America, can cause a severe biting nuisance. Some of the vector-borne disease problems that can commonly arise on irrigation projects are discussed below.

IRRIGATION AND VECTOR-BORNE DISEASES

Schistosomiasis

The major disease associated with irrigation, especially rice and cotton, is schistosomiasis. Nobody knows how many people have schistosomiasis, but an estimate in 1979 was that probably 200 million have the disease, while some 500–600 million people are exposed to the risk of infection (Chernin, 1978). The snail intermediate hosts breed in irrigated fields and more importantly in the irrigation ditches and canals supplying them with water. Thirty years ago the prevalence rate of schistosomiasis in Gezira, Sudan, was only about 20%, but despite greatly improved housing and hygiene the prevalence of schistosomiasis in the massive Gezira irrigation scheme is now over 50%, and more than 80% in men and school children—some 600,000 people are infected. Why? A. Fenwick (personal communication, 1982) believes that intensification of cropping is an important factor. This is because greater productivity hinges on keeping the irrigation canals filled with water for long periods, which in turn has resulted in more weeds and large increases in snail populations. On the Mwea-Tebere irrigation scheme in Kenya, 60% of the children are now infected, whereas in 1956 before the scheme started no cases of schistosomiasis were recorded (Hignton, 1974; Teesdale, 1962). In contrast, good collaboration between the National Irrigation Board of Kenya and the Ministry of Health has managed to keep snails out of the Ahero rice project in western Kenya. In Tanzania a survey in 1972 revealed that 84% of sugar-cane cutters and irrigation workers had schistosomiasis. In Egypt, farming in and areas previously relied on annual flooding of the Nile valley and this temporary inundation did not permit the permanent establishements of aquatic snails. Now, however, perennial irrigation has resulted in the schistosomiasis rate rising from 5 to 80% in these areas; about half the people of Egypt now have schistomiasis (Chernin, 1978; Malek, 1975). In Tanzania, Sturrock (1965) found that effective, but not particularly modern, husbandry as practiced by the Baluchis prevented snails becoming established in their rice fields, whereas they invaded more grandiose nearby irrigation projects developed with international and national funds for settlement farmers growing a variety of crops.

Theoretically, schistosomiasis can be prevented simply by people avoiding contact with water likely to contain infective snails. In practice it is very difficult, as well as unreasonable, to stop people washing or swimming in infected waters. Moreover, because of high temperatures and other difficulties it is impossible to persuade people who habitually come into contact with infected water, such as farmers and labourers, to wear protective clothing. The transmission cycle could also be broken by improving hygiene education and persuading people to use latrines and not to urinate or defecate in water (Jenkins, 1979). But, in many irrigation settlements latrines are broken and there is little privacy, so people continue to defecate in the fields. I have seen numerous notice boards sited along canals telling people to use latrines, but these serve little purpose if, as is often the case, the intended audience of farmers and labourers cannot read. Clearly, measuring human contact with water is critical to the epidemiology of schistosomiasis, but there have been very few worthwhile investigations into this.

Host snails have a restricted tolerance to water speed and can survive and breed only if the water flow is less than 0.3 m sec, so an obvious control method is to ensure a relatively fast flow of water through irrigation canals. This usually requires them to be lined with concrete and maintained free of vegetation and silt. But we all know that these objectives are rarely achieved on irrigation schemes, and because of high costs many, if not most, irrigation canals are mud-lined and these very rapidly silt

up and support large populations of snails. During the last few years molluscicides and chemotherapy have formed the basis of control, and there is currently a trend to place greater emphasis on new one-dose drugs such as Praziquantel.

Mosquito-borne diseases

In some parts of Africa extension or rice cultivation has led to greatly increased local populations of malaria vectors of the *Anopheles gambiae* complex. About 65% of the man-biting mosquitoes in a village on the Ahero irrigation project in western Kenya were of the *An. gambiae* complex, and some 68 times more were biting man than in a nearby village not affected by irrigation (Surtees, 1970; Surtees *et al.*, 1970). In Venezuela, populations of the important malaria vector *An. albimanus* increase yearly when the rice-fields are flooded. In many situations the worst period for the production of mosquitoes is from when young seedlings are being transplanted into the main fields until they grow to 60–75, or even 100 cm (Chandler and Highton, 1975, 1976; Womeldorf and Whitesell, 1972). When plants become taller the ricefields become less favourable for mosquito oviposition. In many areas, ranging from South America to southeast Asia, irrigation has provided prolific sources of mosquitoes which not only transmit malaria, but filariasis and a variety of arboviruses.

In both Tanzania and Uganda, large populations of *An. gambiae* breeding in rice fields have resulted in people living near irrigation fields having much higher infection rates with bancroftian filariasis than those living in villages further away.

In the Indian subcontinent through to southeast Asia and Japan, larvae of *Culex tritaeniorhynchus*, an important vector of Japanese encephalitis, are found extensively in ricefields. Not surprisingly, therefore, there have been marked increases in many areas in the transmission of this viral disease. In Sarawak, for instance, vector populations in the paddy fields reach a peak at the end of each year and this is accompanied by increased infections of Japanese encephalitis in pigs which are important amplifying hosts (Macdonald *et al.*, 1967; Simpson *et al.*, 1970). Up to about 1960 the only important malaria vector in the semi-arid area of the Kunduz valley in Afghanistan was *An. superpictus*, which bred in small seepages of clean water in the foothills. Irrigation has now changed the ecology of the area. Not only were large-scale agricultural schemes implemented, such as the planting of rice, cotton and melons, but there were increased populations of both man and cattle and, in addition to the water in the ricefields, standing water accumulated in seepages, irrigation ditches and numerous pools. These new habitats favoured the increase of two important malaria vectors, *An. pulcherrimus* and *An. hyrcanus*, and as a consequence malaria transmission quadrupled in some villages. There have been similar increases in the breeding of malaria vectors in many other countries such as *An. sinensis* in China, *An. aconitus* in Indonesia, *An. culicifacies* in the Indian subcontinent and *An. philippinensis* in much of southeast Asia. Increased vector production can result in higher prevalence rates of malaria and extension of the transmission season, but in areas where malaria is stable and holoendemic then there may be little obvious change in malaria morbidity or mortality.

Irrigation often results in substantial increases in aquatic and other birds, such as herons, storks, ibises and egrets, several of which may be important reservoirs of arboviruses such as Western-, and St Louis equine encephalitis in the U.S.A. Japanese encephalitis, West Nile and possible Sindbis virus, as well as several other zoonotic viral infections. Not only can birds act as reservoirs of infection, they can also play an important part in spreading viruses from one area to another.

Accumulation of food crops such as rice, sugar, maize and other cereals on irrigation schemes, and pockets of high human population densities encourage the build-up of rodent[illegible]nd this makes the risks of transmission of zoo[illegible] infections greater, such as leptospir[illegible]ever, plague and various rickettsial diseases (Smith, 1972). Following irrigation at Hola on the Tana River, Kenya, rodents such as *Acomys* species have been replaced by *Praomys* (=*Mastomys*) *natalensis* and *Rattus rattus*, species much more closely associated with man and disease than the original rodents. The presence of numerous gerbils in the Uzbekistan region of the Soviet Socialist Republic north of Afghanistan provided a reservoir of dermal leishmaniasis, with the result that construction workers building irrigation projects were exposed to high risk of contracting the disease. However, irrigation has now raised the water table with the result that the gerbil population has greatly decreased, but at the same time this has allowed more breeding by *Phlebotomus papatasi*, a vector of leishmaniasis (Lysenko and Beliaev, 1977; Safyanova, 1977).

Resettlement problems

There have undoubtedly been mistakes in planning and execution of health and development programmes. For example, land needed for agricultural purposes has sometimes been obtained by compulsory purchase from local farmers. As a result peasant farmers suddenly acquire new wealth, but since they no longer own land or cattle, their standing in the community may decline. Many become tenant farmers and are accommodated in standard-sized houses with generally little regard to their family size (van Luijk, 1974). This sometimes leads to overcrowding and because the people do not own their houses there is little incentive to maintain them. As a consequence they fall into disrepair and slum conditions begin to develop with the usual profusion of scattered refuse, broken latrines and accumulation of polluted waters. This is accompanied by a deterioration in general health and hygiene standards, so facilitating the spread of water-related diseases such as cholera, typhoid and amoebiasis, while unhygienic disposal of excreta can lead to spread of intestinal heiminths, bacterial and viral dysenteries, and increase in diseases spread by filth flies. The mosquito *Culex quinquefasciatus* is an important vector in the tropics of bancroftian filariasis, a disease that can give rise to the grotesque symptoms referred to as elephantiasis, and this vector breeds almost exclusively in water polluted with human and animal excreta and other

decaying organic matter. Pit latrines are an important breeding source. Delapidated latrines and defective soak-way pits on the "housing estates" of irrigation projects will therefore result in an increase in this vector.

Resettlement may also entail bringing together people from different areas and having dissimilar social structures and customs. Because of the diversity of backgrounds there is often little community spirit and morale may be low; conditions which can be conducive to poor health. Another problem is that some of the immigrants coming into the area will already be infected with parasites of schistosomiasis, malaria and filariasis, and because of the mosquitoes and snails breeding on the irrigation schemes these diseases will soon spread through the whole community. Now, some of these people will have come from areas where there is little malaria and will therefore have acquired little protective immunity, with the consequence they are likely to suffer considerably when they become infected.

In summary, rice cultivation and irrigation schemes do not necessarily imply an increased health risk, but in tropical countries the ecological changes accompanying such projects create extensive habitats particularly suited to the intermediate hosts of schistosomiasis and mosquito vectors of several diseases. Clearly irrigation projects will become increasingly important in producing more food to feed an ever expanding human population, but great care is needed at the planning stage to minimise adverse effects on health.

INSECTICIDES AND PEST MANAGEMENT

It will be clear from the preceding account that while crop irrigation increases food supply and hopefully improves living standards, there is unfortunately at the same time a rise in the transmission of a number of diseases. Moreover, problems may be aggravated by the frequent application of insecticides to combat agriculatural pests. In El Salvador for example the principal malaria vector, *An. albimanus*, has developed resistance to DDT, HCH, dieldrin, the organophosphates and carbamates, not due to any anti-mosquito activities, but because of massive cotton spraying; as many as 30–50 sprayings over a 90-day season resulting in 80 g/ha of insecticides. Similarly, insecticide resistance arising from crop spraying has occurred in *An. aconitus* in Java, *An. sacharovi* in Greece and Turkey, *An. sinensis* in parts of China, *An. stephensi* in Iran and Iraq and possibly in the *An. gambiae* complex in Sudan and Upper Volta (Georghiou, 1976). In the Ahero irrigation scheme in Kenya applications of Dimecron, an organophosphate insecticide, to kill ricestem-borers, resulted in killing almost all aquatic life in the ricefields. One of the first recolonizers was *An. arabiensis*, the principal malaria vector in the area, which in the absence of predators reached populations considerably greater than encountered before spraying (Service, 1977).

There is clearly an urgent need for closer collaboration between different disciplines, such as agriculturalists, economists, engineers, sociologists and hygienists to minimise the spread of vector-borne diseases associated with irrigation projects. A comprehensive integrated pest and vector management programme is required. In China, where there are 36 million ha under rice cultivation the importance of developing pest management strategies which rely, whenever possible, on cultural and biological methods and minimise the use of pesticides has been realised and put into practice (Pao Ling Luh, 1981). Insecticides for example are not used as routine measures against possible losses (i.e. insurance spraying) but only when pest population densities approach levels likely to cause economic loss. The efforts of 20 million labourers armed with shovels have largely succeeded in digging new irrigation canals, while at the same time filling in old ones and burying the snail intermediate hosts of schistosomiasis. This labour intensive, but attractively simple approach, has apparently greatly reduced schistosomiasis transmission in some areas (Chernin, 1978). There are not many places, however, where such devoted community participation and discipline can be found. Also, the snails (*Oncomelania* spp.) have separate sexes, whereas snail hosts (*Bulinus* and *Biomphalaria* spp.) of schistosomiasis in Africa and the tropical Americas are hermaphrodite, thus making them much more difficult to control.

PEOPLE'S PERCEPTION AND ATTITUDES IN DISEASE CONTROL

A peasant farmer readily appreciates that the arrival of pests on his crops is going to threaten an economic loss, he can actually see pests eating away his profits. But, he is less likely to understand that mosquitoes in his house may cause the death of his child from malaria. First, he is unlikely to know that mosquitoes spread malaria and secondly, even if he is told this he may find it a difficult concept to accept, because he cannot see the insects causing any harm to his child. The same type of difficulty occurs in getting him to accept that careless handling of insecticides can be hazardous, because there may be no immediate effect after initial contact. This failure to realise potential dangers is one of the reasons why there are so many accidental pesticide poisonings in the developing world. In the Neuva Ecija province in the Philippines there were 33–44 insecticidal deaths a year from 1973 to 1976 in agricultural workers; surveys showed that not a single farmer was aware that insecticides could enter the body through the skin (Saxena, 1983). According to the World Health Organization about 500,000 people may be poisoned accidentally each year by insecticides, the fatality rate being about 1% (WHO, 1973). Others dispute this and estimate around 20,000–30,000 deaths a year (Bull, 1982). In Sri Lanka, for instance, an average of 13,327 patients a year were admitted to hospitals during 1975–1980 suffering from pesticide poisoning. Analysis of a sample of the 13,372 poisoning cases admitted in 1979 showed that surprisingly, poisoning was due to suicidal intentions in 66% of the male and 91% of the female patients.

To return to the farmer whose child is threatened with malaria, even if he wants to protect his family against mosquitoes there may be little he can, or will, do. For although mosquito nets would offer protec-

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tion against night-biting species, good quality nets may be too costly or unobtainable. Moreover, in many houses there is simply just not sufficient room for nets to be placed over occupants, and of course they make the night hotter, and thus may be unacceptable. House-spraying with residual insecticides can certainly reduce the risks of malaria transmission, but preparing a house for spraying causes the owner some inconvenience and the operation becomes tedious to the spraymen, so after a few spraying-cycles there is the tendency for inefficient house-spraying. Incentives may be needed to ensure that simple control measures which are socially acceptable are implemented (Rosenfield and Bower, 1979; Rosenfield *et al.*, 1983). Introducing control measures which may rely on changing peoples' behaviour and attitudes should operate through a careful and culturally sensitive educational and propaganda programme. Long lasting control is much more likely to succeed if the community becomes involved and convinced of the immediate benefits control can provide.

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CRITERIA AND MEANING OF TESTS FOR DETERMINING THE SUSCEPTIBILITY OR RESISTANCE OF INSECTS TO INSECTICIDES[1]

The detection and measurement of insecticide resistance in any insect by standardized methods depends upon comparison with a strain of normal susceptibility, tested under similar conditions. Preferably the susceptible strain should be one collected prior to the use of insecticides and reared in their absence. If this is not available, it may be necessary to compare results obtained with specimens from treated and untreated areas; or even merely to note serial changes in time after insecticide use for a number of years.

To obtain baseline data for the susceptible strain, the soundest methods are those in which batches of insects are individually dosed with known quantities of poison (as in techniques of topical application). However, individual dosing involves technical difficulties with small insects such as mosquitos. Therefore, in most test methods the insects are made to dose themselves by forced contact with treated paper for a standard time.

It has sometimes been found necessary to use different durations of exposure to a constant concentration as the basis of dosing rather than exposure to papers with different concentrations for a standard time. If it is assumed that the dose acquired by the arthropod is proportional to exposure time, the use of time as a measure of dosage is quite justified and all results in the following paragraphs are relevant, except that "time" should be regarded as interchangeable with "concentration" and "LT_{50}" with "LC_{50}". There is evidence that this assumption is justified for organochlorine, organophosphorus, and carbamate insecticides, with several species of mosquitos. Therefore, it appears justified to rely on time as a method of dosage, at least for the detection of resistance, provided that excessively long (e.g., over 8 hours) or extremely short (e.g., less than 15 minutes) exposures are avoided.

The following cautionary remarks apply to all types of resistance test:

(a) No species under natural conditions is invariable in its response; the baseline varies with many factors, such as season of the year, condition of nutrition, period since a blood meal, stage of egg development, and age. The conditions prevailing during a test, e.g. temperature light intensity, or any other factor influencing the activity of the test insects will also affect the results.

(b) Populations subject to control measures, or any other selection process, often give response lines differing not only in position but also in shape from the characteristic straight regression line relating dose and kill given by a susceptible population when plotted on logarithmic-probability paper. Frequently the curve shows marked bending towards higher doses above a certain mortality (see Fig. 1). This effect is due to the presence of a proportion of resistant individuals in the population of insects tested. If the proportion continues to increase the resulting line becomes horizontal and remains so up to

[1] Annex of Twenty-second Report of the WHO Expert Committee on Insecticides-Resistance of Vectors and Reservoirs of disease to Pesticides, Tech.Rep.Ser. 585 (1976)

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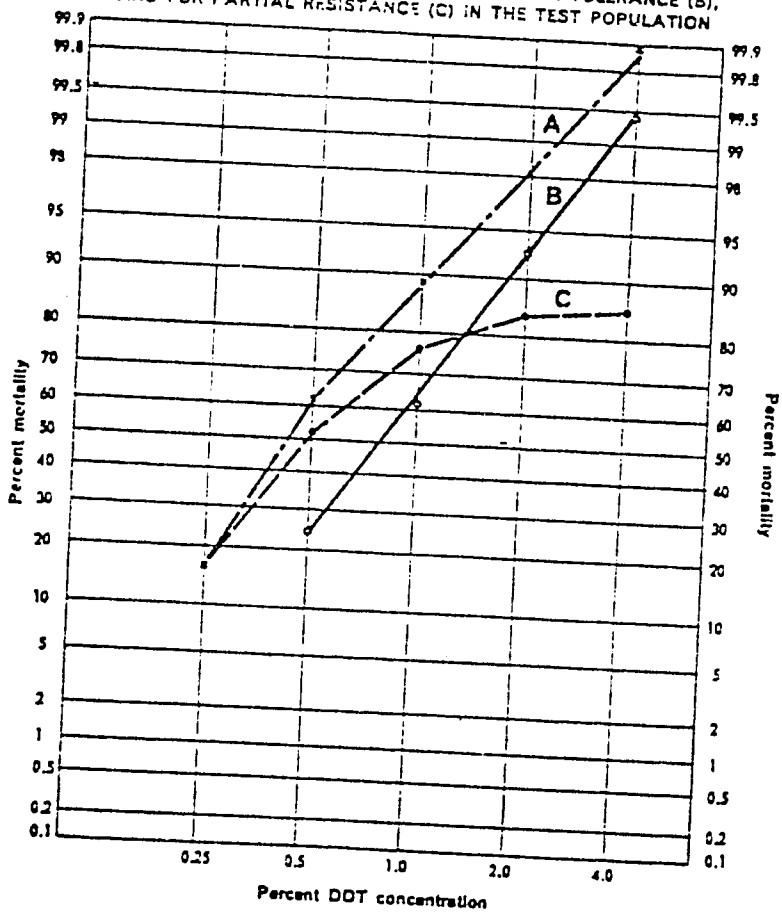
FIG. 1. SAMPLE REGRESSION LINES FOR SUSCEPTIBILITY (A), FOR SEASONAL FLUCTUATION OR FOR VIGOUR TOLERANCE (B), AND FOR PARTIAL RESISTANCE (C) IN THE TEST POPULATION



the highest dose used, it is obvious that only a portion of the total population can be killed by the procedure and the survivors are resistant.

Changes in the regression line due to incipient resistance are thus most likely to be evident at high dose levels, as will be evident from an inspection of the figure. Consequently, it is in this range that evidence of incipient resistance should be sought, rather than in a change in the LC_{50}. Accordingly, it is recommended that regular monitoring tests for early detection of resistance, should make use of a diagnostic dose (or concentration) that has a very high probability of killing all susceptible insects. On this basis, the percentage of survivors in such a test is a measure of the proportion of resistant individuals in the population sampled. It is therefore unsound to grade results according to percentage survival as "susceptible", "intermediate", or "resistant". The category "intermediate" seems to have no logical definition and attempts to rationalize it lead to ambiguities. Thus it can be interpreted as indicating either the existence of a small proportion of resistant individuals or the existence of a resistance mechanism giving only a low degree of protection. In fact, an "intermediate" result may often occur because of the survival of some susceptible individuals as a result of abnormal environmental conditions or an abnormal physiological state (e.g., impending hibernation); alternatively, or in addition, it could be due to the choice of too low a monitoring dose. Accordingly if the result has not been confirmed by further investigation, a low percentage of survival could be categorized as "indeterminate".

Prinicples underlying diagnostic dosages and their confirmation

The first problem is to decide on the dose level "expected" to kill all susceptible insects. The original baseline tests on the susceptible strain can be plotted on

logarithmic-probability paper (or statistically calculated) so that the doses expected to produce various levels of kill can be estimated. Unfortunately, on theoretical grounds, it is impossible to estimate an "LC_{100}". As a working approximation, the WHO Expert Committee on Insecticides in 1975 adopted as a criterion, double the lowest concentration that had killed all insects in the experiments used to delineate the baseline for a susceptible strain. This criterion is likely to work well with a test that gives a steep regression line for susceptible populations. It is evident, however, that no indication of the probability of chance inclusion of a normal type can be estimated from any dose level, without information on the slope of the regression line. Therefore, it is sounder to choose the discriminating level by a mortality probability.

If the discriminating dose is chosen on the basis of the dose corresponding to 99.9% kill, there is 0.001% probability of a normal insect surviving, so that in a batch of 100, there is 0.1% chance. One would expect one survivor in each 10 tests, but for a single survivor in repeated tests, the chance markedly declines, 0.1%, 0.01%, 0.001%, etc. Therefore, persistent survivors in successive tests are fairly good proof of true resistance.

There may not of course be sufficient numbers of insects to carry out such repeated tests with adequate numbers. Other equally valid methods of verification are, however, available. If it is possible to retain the survivors from a diagnostic exposure, breed from them and test their progeny, the presence of true heritable resistance will be indicated by an increased percentage survival at the diagnostic level.

Diagnostic doses and concentrations for mosquitos

Where carefully measured baseline data on known susceptible colonies of important species have been obtained in collaborating laboratories, the field worker may be spared the trouble of determining these for himself (in addition to the time and expense necessary for preparing the range of different concentrations required for this purpose). Furthermore, it is often difficult for the field worker to be certain of obtaining a normally susceptible strain in the field, since insecticide use (often in agriculture) has induced more or less resistance in many species.

A number of useful data for adult and larval mosquitos, body lice, bedbugs and fleas have been determined and are set out in Tables 1, 2, and 3.

Further remarks on the interpretation of results of resistance tests

(a) In cases where the genetic basis of inheritance has been determined and where it has been shown to depend on a single major factor, certain higher diagnostic doses (known as discriminating doses or concentrations) may be used to distinguish certain genotypes. This type of test is usually most applicable to dieldrin resistance, which is usually inherited by a partially dominant factor, as it facilitates the separation of heterozygous individuals from homozygous resistant or susceptible ones. Thus, in partially dominant dieldrin resistance in adult anopheline mosquitos, a discriminating concentration of 4% dieldrin for 2 hours will kill heterozygous but not homozygous individuals.

(b) When resistance has been detected with certainty, it is highly desirable to determine its degree and also the cross-resistance spectrum. It is really possible to do this only with a strain that is virtually homozygous for resistance, so that field specimens usually need to be maintained in the laboratory and further selected. As this may present difficulties and is certainly time consuming, some investigators have made preliminary assessments on the basis of field samples. This is often done on the basis of estimated LC_{50} levels; but this is really justified only if the strains concerned are homogeneous as regards resistance (which is seldom the case). To determine an LC_{50} for a mixture of susceptible and resistant insects is as unsound as estimating an LC_{50} for a mixture of houseflies and mosquitos. Nevertheless, it is often useful for gaining an approximate idea of cross-resistance from field specimens, and this should be done on the basis of a high level of kill (e.g., LC_{95}) rather than the LC_{50}.

Table 1. Tentative diagnostic dosages for adult mosquitos

Insecticide	Anophelines		*Culex quinquefasciatus*	
	Concentration	Exposure time	Concentration	Exposure time
DDT	4%	1 h	4%	4 h
Dieldrin	0.4%	1 h[a]	4%	1 h
Malathion	5%	1 h	5%	1 h
Fenitrothion	1%	2 h	1%	2 h
Propoxur	0.1%	1 h	0.1%	2 h
Chlorphoxim	4%	1 h	—	—
Permethrin	0.25%	1 h	0.25%	3 h[b]
Decamethrin	0.025%	1 h	0.025%	1 h[b]

[a] Except for *A. sacharovi*.
[b] Exposure tubes held flat so that mosquitos which are knocked down remain in contact with the paper during the entire time specified.

Table 2. Tentative diagnostic dosages for larval mosquitos (mg/l)

Insecticide	Anophelines	*Culex quinquefasciatus*	*Aedes aegypti*
DDT	2.5	—	0.05
Dieldrin	0.1	—	0.1
Malathion	3.125	1.0	1.0
Fenitrothion	0.125	0.125	0.06
Fenthion	0.05	0.05	0.05
Temephos	0.25	0.02	0.02
Chlorpyrifos	0.025	0.01	0.01

Table 3. Tentative diagnostic dosages for lice, bedbugs and fleas

Insecticide	Body lice		Bedbugs		Fleas (*Xenopsylla cheopis*)	
	Concentration	Exposure time	Concentration	Exposure time	Concentration	Exposure time
DDT	4%	1 d	4%	5 d	1%	1 d
Dieldrin	0.1%	1 d	0.8%	2 d	0.2%	1 d
Propoxur	0.8%	10 h	0.8%[a]	1 d	0.1%	5 h
Fenchlorphos	4%	10 h	4%[a]	5 h	4%	5 h
Malathion	Under revision		5%[a]	16 h	Under revision	
Fenitrothion	1%	5 h	1%	5 h	1%	2.5 h
Trichlorphon	1%	2.5 h	1%	5 h	1%	1.25 h

[a] Provisional.

Annex III: Technical Review of Project Activities

1. Field Data Collection

2. Analysis of Research Needs

3. Identification and Field Evaluation of Insecticide Resistance, New Control Agents and New Technologies

   3a. Insecticide Resistance Studies/Evaluation of New Chemical Control Agents
   3.b. Monomolecular Surface films (MSF) (Mosquito Larvicide)
   3.c. Biological Control Agents
   3.d. Biochemical Techniques
   3.e. Genetic Probes

4. Operational Research (OR)

5. Baseline Field Research

1. Field Data Collection

Field data collection represents a significant component of the Project which can be divided into four major categories: 1) analysis of research needs as they apply to project design, implementation and evaluation; 2) identification and field evaluation of new technologies and new control agents; 3) operational research as it relates to quality control, training and manpower needs, frequency of commodity utilization and recurrent costs, equipment/logistical needs, and, suseptibility testing of insecticides; 4) baseline information on vector-borne disease transmission and epidemiology which could be utilized for vaccine trials and/or treatment campaigns (examples would include efficacy trials for a malaria vaccine or a treatment program for schistosomiasis).

It is anticipated that some of the work will involve longitudinal efforts directly linked to a control program in order to establish a data base by which program activities can be monitored and modified as necessary. A small number of proposals will be considered providing they have: demonstrable LDC significance; host country support at the Ministerial level; strong in-country institutional links; and a significanton-the-job training component. All studies supported by the Project must have applied value in terms of improving the efficiency of vector control activities.

2. Analysis of Research Needs

A prudent approach to vector control activities includes an understanding of the parameters which support vector-borne disease transmission. It is critically important to know whether vectors are susceptible to various insecticides, where vectors bite and rest, where and when they breed, what people within a community are most heavily infected and at greatest risk, which vectors are responsible for transmission, where the most severe problems exist within a country, and what impacts can be expected from specific interventions. Ideally, each of these questions should be answered prior to the design phase of a control program. However, these investigations are time consuming, cost money and require relatively sophisticated technical and operational protocols. Too often they are disregarded as being too costly, redundant and esoteric. Unfortunately, the lack of these data has compromised the efficacy of past control efforts. The VBC Project will provide TA to address the above-mentioned issues upon request in order to contribute to the better design of new programs and enhance the efficacy of existing ones.

Research needs will vary within and between countries and diseases. Data on diseases of interest may exist and be highly valid, information may exist and not be valid, and very little knowledge may exist at all. The purpose of an analysis of needs is to determine what reliable information is available in a country on the target disease and what information needs to be obtained to achieve a sound design and implementation for control.

For example, malaria data is abundant in Latin America due to national malaria control units (SNEMS), however, in Africa, less is known about the vector and disease due to the vast distribution of the parasite and genetically distinct subpopulations of the vector. In Asia much is known about malaria, but insecticide and drug resistance is common and inadequate perceptions of the scope of these problems have seriously compromised control efforts particularly in the consolidation and maintenance phases. The presumption that data are valid and research has been adequate is ill-afforded today given the high cost of insecticides and treatment. It is critically important that we understand which methods will work and proceed with confidence in the validity of measurement of impact throughout the life of a project. To assume we know all we need to know and "get on with the job" is a premis that could have grave consequences in the next decade. We must be sure we know what to do and how to do it.

Today our defenses against malaria and other vector-borne diseases are waning. Twenty-five years ago we spoke of eradication with confidence, today we modestly and more humbly pursue control. Integrated approaches to vector-borne disease control need to be realized, however, the ecological aspects of disease transmission must be identified and characterized in order to determine which approaches will be used, how they will be integrated, and how their impact will be evaluated in relation to disease prevalence. Such an approach will be more costly in the short-term, but more cost-effective over the longer-term.

This Project will provide TA to examine the availability and status of in-country information and assist LDCs in determining what new information (if any) needs to be obtained prior to project design and/or implementation. The Project will also provide TA to develop a surveillance system for a proposed project in order to monitor inputs and measure outputs. Such a system could be linked to established control units such as the SNEMs or be an independent, program-specific system which would require more frequent technical guidance. In either case, the Project would provide a mechanism to provide technical personnel to the field to assess research needs, recommend feasible approaches, monitor program impact and assist in the development of a data collection system.

3. Identification and Field Evaluation of Insecticide Resistance, New Control Agents and New Technologies

The state-of-the-art techniques in chemistry, biochemistry and molecular biology have opened up new horizons for many aspects of applied science. Naturally occuring chemicals can be synthetically produced, exquisitely specific and highly sensitive diagnostic probes can be developed, and effective vaccines can be extracted from cellular material through genetic engineering. Much of the technology available today can be applied to vector-borne diseases to elucidate the factors that influence transmission, promote more efficient and safe control, allay the development of resistance, and facilitate the field work required to assess program efficacy. The Project will promote the field testing and evaluation of new control agents and technologies as a means of improving the efficacy and efficiency of control programs. A number of new tools exist today, and in the future, these will be refined and new ones will be developed. New techniques and technologies will not solve the problems of vector-borne disease alone, rather, they will be utilized to complement classical approaches and enhance program efficacy. The Project will provide TA to assess how new tools can be incorporated into new or existing control programs and to train personnel in their utility and application if they are proven to be effective and contribute to project success.

3a. Insecticide Resistance Studies/Evaluation of New Chemical Control Agents

Probably the most pressing problem facing the control of vector-borne diseases is the development of resistance to insecticides and the lack of highly effective, yet inexpensive chemical control agents. The Project will provide TA via a CDC PASA and through contractor-identified consultants to evaluate target vector resistance in the field and monitor the profile of insecticide resistance throughout program LOPs. Insecticides of choice will be evaluated in terms of environmental safety, efficacy and cost. All resistance trials will be conducted in concurrence with WHO guidelines. Laboratory studies in country and on site trials will be conducted as necessary. Throughout the tenure of TA, local personnel will be trained to maintain resistance tests in adherance to a pre-determined operational protocol. Backup compounds will be evaluated concurrently with the insecticide(s) of choice as deemed appropriate. The field evaluations will be conducted for residual indoor sprays, larvicides (applied to water sources), and outdoor, ultra low volume (ULV) sprays. Safety testing and operational management questions will also be addressed.

New chemical agents are becoming available, and, despite their often high cost, they may possess some selective utility. TheProject will provide a mechanism to test new chemicals in the field for potential utilization at the country and regional levels. It will provide a testing package comprised of TA and a limited amount of the control agent at no cost to LDC or Mission. The testing of new agents will necessarily be a longer-term endeavor and would most likely tap technical personnel from the private sector which could be linked to an indigenous research institution. CDC personnel would also be tasked to consult longitudinal trials of new agents. The advantage of this component of the Project is that it will provide LDCs with information on the potential use of new chemical agents in their countries and will enable local personnel to obtain training in the empirical and practical evaluation of these new agents.

3b. Monomolecular Surface Films (MSF) (Mosquito Larvicide)

Monomolecular films have been used in the U.S. for many years and in some LDCs. MSFs float on the water surface and deprive mosquito larvae of oxygen. Their efficacy is high under controlled conditions and promising results have been obtained in the field. Disadvantages include relatively high cost and a need for frequent application. However, new slow release techniques are being developed and a reasonable potential for selective utilization as an additional control tool exists. Since the mechanism of killing is more mechanical than biological, the probability for the development ofresistance is reduced. Such a tool could augment a control program if the local ecology is appropriate in terms of mosquito breeding sites (household containers, small ponds, etc.). The Project will provide TA to evaluate the utility of MSFs upon request.

3c. Biological Control Agents

Biological control agents can also play a role in vector control programs. Like MSFs, the local environment will dictate their potential utilization. Bacteria, fungi, protozoa, viruses, worms, fish and invertebrate predators represent biocontrol agents. Genetic manipulation represents another facet of biological control. The most promising biological control agent today is a bacterium, which when injested by a mosquito or balck fly larvae produces a toxin which kills the organism. Bacillus thuringengiensis, variant israelensis (Bti) is presently being evaluated under laboratory and field conditions. The use of this agent and other agents could be assessed on a program-specific basis through the Project.

3d. Biochemical Techniques

New breakthroughs in bio- and immunochemistry have revolutionized the prospects for diagnosis and treatment of disease. The methods utilized in medicine are also being applied to other areas of science, including medicalentomology. There are two prominent technologies which may have direct application in vector control programs in the next five years, these are: enzyme-linked immunosorbent assays (ELISAs); and polyacrylamide gel electrophoresis (PAGE). ELISAs show great promise for the diagnosis of a parasite within a vector, or infection in a human host. They have the potential to be extremely sensitive (able to pick up low infections) and exquisitely specific. Kits are being developed which could be used in the field by local workers. Such a tool would enable us to track the success of a vector control program through prospective estimates of transmission rates in the vector and prevalence rates in the human host. PAGE technology can be utilized to separate vectors at the species complex (i.e. biochemical/genetic, re: enzyme) level. This type of knowledge can provide an understanding of what vectors are transmitting the disease, where, and when they are transmitting. Genetically different vectors, even of the same species, may exhibit different behaviors or have different ecological niches (i.e. indoor biting, outdoor biting, large pool breeding, home container breeding). If these nuances of their biology are known, control strategies can be modified to attack the most important members of a species complex and thus promote more efficient control. The potential contribution of these (and other biochemical techniques) remains conjecture, however, when appropriate, the Project would provide a mechanism to evalutate existing biochemical tools under field conditions.

3e. Genetic Probes

Genetic probes rely on cleaving the genetic material (DNA, RNA) of an organism, and binding it to a marker. This process enables us to identify organisms, whether they be parasites or vectors with the highest specificity. As with the PAGE and ELISA techniques, genetic probes can greatly improve our ability to separate vector species and diagnose infectivity. Although still in the development stage, probes have the potential to be used in the field as stable colorometric tests. When available these probes could be evaluated through the Project.

4. Operational Research (OR)

The Project will provide technical assistance for operational research (OR) as required. OR represents a functional assessment of program activities and can provide information in manpower and

training needs, quality control of commodity use, equipment and transportation requirements, and socio-behavioral factors which influence program efficiency in the field. Operational research will also contribute to the prioritization of needs within a country in relation to disease importance (epidemiology) and logistical requirements. The OR provided by the Project will provide a mechanism to evaluate the operating costs of a program and modify procedures when necessary. Well designed OR can provide important practical information for all aspects of vector control. The OR provided by the Project will have the option to be longitudinal in nature in that TA could be provided to track operational success throughout the LOP of programs and recommend specific modifications in operational protocols as neccessary. The responsibility for promoting and implementing operational research activities will be that of Technical Officer for the Contractor. Published material on OR shall be maintained in the Information Center and be available for distribution upon request.

5. Baseline Field Research

The VBC Project will provide a small opportunity for the support of longitudinal research activitites in applied medical entomology. It is anticipated that baseline entomological research will be required within the next five years to define the parameters of vector-borne disease transmission as they relate to control programs and/or vaccine interventions. The Project will also respond actively to proposals which promote strong collaboration between LDC and US-based institutions. Although the baseline field research component is a small activity within the Project, it is felt that some longitudinal efforts should be supported to strengthen indigenous institutions and LDC scientists, and provide a possible contribution to A.I.D.'s effort in the development of a malaria vaccine.

Annex IV: Partial List of A.I.D. Funded Health Projects which would be eligible for TA from the Vector Biology and Control Project

AFRICA

COUNTRY	PROJ#	TITLE	BEG	END
Benin	6980399	Onchocerciasis Control Phase II	74	85
Burundi	6980421	Combatting Childhood Communicable Diseases	85	88
C.African Repub.	6980421	Combatting Childhood Communicable Diseases	84	88
Cameroon	6980408	Health Constraints to Rural Production	83	87
Congo	6980421	Combatting Childhood Communicable Disease	84	88
Gambia	9311918	Mass Media and Health Practices	78	85
Ghana	6410098	Community Health Team Support.	79	86
Ghana	6980399	Onchocerciasis Control Phase II	74	85
Guinea	6980421	Combatting Childhood Communicable Diseases	85	88
Ivory Coast	6980399	Onchocerciasis Control Phase II	74	85
Lesotho	6980421	Combatting Childhood Communicable Disease	84	86
Liberia	6980421	Combatting Childhood Communicable Disease	83	87
Malawi	6980421	Combatting Childhood Communicable Disease	84	88
Mali	6980399	Onchocerciasis Control Phase II	74	85
Mauritania	6820230	RHS:River Valley Hlth.Control	85	88
Niger	6980399	Onchocerciasis Control Phase II	74	85
Regional	6980408	Health Constraints to Rural Production	81	87
Regional	6980421	Combatting Childhood Communicable disease	78	87
Regional	6980460	Health Training Centers in Africa	86	90
Rwanda	6980421	Combatting Childhood Communicable Diseases	84	88
SAHEL REG	6250966	Onchocerciasis Control	86	90
Sudan	6980408	Health Constraints to Rural Production	81	87
Swaziland	6450087	Rural Water-Borne Disease Control	79	83
Swaziland	6450220	Rural Health Development	85	88
Swaziland	6980421	Combatting Childhood Communicable Disease	84	88
Tanzania	6210163	Zanzibar Malaria Control	81	81
Togo	6980399	Onchocerciasis Control Phase II	74	85
Togo	6980421	Combatting Childhood Communicable Disease	83	87
UV(Burkina Faso)	6980399	Onchocerciasis Control Phase II	74	85
Zaire	6600058	Endemic and Communicable Disease Control	76	78
Zaire	6980421	Combatting Childhood Communicable Disease	82	87

NEAR EAST

COUNTRY	PROJ#	TITLE	BEG	END
Egypt	2630015	Strengthening Rural Health Delivery System	76	84
Regional	2980165	Epid.& Control of Arthrop.-Borne Diseases	81	83

ASIA

COUNTRY	PROJ#	TITLE	BEG	END
Burma	4820013	Strgthng.Primary Hlth.Care SVC DE	86	88
India	3860492	Biomedical Support for Health Services	85	87
Indonesia	4970237	Malaria Control	75	75
Indonesia	4970273	Health Training Research and Development	78	85
Indonesia	4970325	Comprehensive Health Improvement Program	81	82
Indonesia	4970326	Timor Malaria Control	81	80
Nepal	3670115	Malaria Control	75	80
Nepal	3670135	Integrated Rural Health/FP Services	80	87
Pakistan	3910472	Malaria Control II	82	86
Philippines	4920386	Biomedical Research	86	87
Regional	4980249	Interreg.Malaria Training Secret.(PD&S)	81	
Sri Lanka	3830043	Malaria Control	84	86
Sri Lanka	3830088	Water Supply and Sanitation Sector	84	89
Thailand	4930305	Malaria and Vector Control	79	79

LATIN AMERICA

COUNTRY	PROJ#	TITLE	BEG	END
Belize	5050018	Increased Product.Through Better Health	85	88
Dom.Republic	5170153	Health Systems Management	84	85
E.Carib.Reg.	5380027	Epidemiological Surveillance & Training	79	83
Ecuador	5180049	Malaria Prevention and Control	85	87
Haiti	5210091	Rural Health Delivery System	79	85
Haiti	5210143	Management of Malaria	82	86
Haiti	5210188	Expanded Malaria Control	86	90
Honduras	5220153	Health Sector I	80	87
Regional	5980632	Technology Devlp.and Transfer in Health	84	88