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9. ABSTRACT

Failure to respond to the challenge of resurgent malaria in many countries will have a serious adverse impact on almost all other A.I.D. efforts. Assistance to antimalaria efforts should now be directed to soundly conceive programs of malaria control. The essence of malaria control is that all operations must be specifically designed, area by area, to maintain the incidence of malaria below the level of public health importance, rather than to create and maintain a complete interruption in the transmission of all malaria. Five components to A.I.D.'s malaria strategy are recommended: properly planned and evaluated malaria control programs; a mechanism to bring these programs to the attention of potential donors; establishment of an international training center for control of malaria and other vectorborne diseases for training of professionals; expanded support of a research effort; and continued participation in regularly recurring international expert appraisal of malaria control programs. The report also examines anti-malaria strategies and their results, justification and criteria for A.I.D. support, mobilization of financial assistance, organization for maleria control; malaria control techniques, training requirements, and research needs and priorities.

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ASIA BUREAU MALARIA STRATEGY STUDY

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ASIA BUREAU MALARIA STRATEGY STUDY

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FOREWORD

Somewhat more than a year ago, AID's Auditor General issued Audit Report No. 76-348, Malaria Eradication Programs. While the report was nominally concerned with AID's role in global eradication efforts during the period from January 1, 1973 to December 31, 1975, its scope was in fact far broader it covered AID's assistance to malaria programs from the early 1950's through 1975; it examined the total anti-malaria effort; and it reached a number of conclusions of major significance:

1. "Endemic malaria has recrudesced in many places where the disease was either controlled or virtually eradicated. The malaria situation continues to deteriorate ... and will worsen unless firm action is taken by governments to halt the resurgence of the disease."

2. "...The program machinery to combat malaria on a global basis has largely been disassembled. ...The AID policy of relying on WHO rather than AID for providing technical assistance resulted in a net decrease in needed technical advisory assistance to affected countries. While most countries continue anti-malaria activities at some level, the overall attack on malaria has dropped to a very low level. As a result, the potential for re-emergence of malaria as a major hindrance to development is again a significant possibility."

3. "Failure of most countries to integrate the malaria service into the rest of the health system left technicians and workers alike without job security or career potential. As a result, many thousands of trained and experienced malaria specialists left the malaria service to seek other jobs and careers. In addition, the closing of the International Malaria Eradication Training Center in Manila, Philippines, has further contributed to an already critical shortage of replacements for senior technical and administrative personnel who had left the program."

4. "Major donor assistance by AID to malaria eradication programs has steadily declined over the past seven years. These reductions were due to increasingly tight overall AID budgets, assumptions that the downward trends of malaria would continue, and new program priorities..."

5. "In the past, economic gains have been derived from antimalaria programs. Further economic gains are dependent on reversal of the downward trend of assistance to malaria eradication programs..."

6. "AID's most dramatic malaria research project is the search for a malaria vaccine, the need for which is becoming more urgent every year... AID should continue to give this worthwhile project a high priority."

7. "...We believe that our review brings out a world-wide need having a great impact on almost all other Agency world-wide efforts and management may wish to weigh the effect of this need on other programs..."

8. "We have, therefore, posed three recommendations ...that suggest consideration of (a) assembling a task force to review the world-wide problem and make recommendations, (b) coordinating with other organizations regarding establishment and administration of a revolving loan fund for world-wide (anti-malaria) programs and (c) the feasibility of establishing an international training center for training of professional malaria specialists and program managers."

The Asia Bureau Malaria Strategy Study Group was assembled in partial fulfillment of the first of these recommendations. While the Study Group does not support the concept of a revolving malaria loan fund, in the main the Study Group finds the Audit Report to have been a document of tremendous significance, sound in its identification of a world-wide need. Failure to respond to the challenge of resurgent malaria in many countries will have a serious adverse impact on almost all other Agency efforts. Management should indeed weigh the effect of this impact.

SUMMARY AND RECOMMENDATIONS

A. Malaria Control vs. Malaria Eradication

The Study Group supports AID's judgment that its assistance to antimalaria efforts should now be directed to soundly conceived programs of malaria control -- programs which may in appropriate cases have eradication of the disease as an ultimate goal, but which, unlike the malaria eradication programs of the past, are not time-limited and which have as their immediate goal the reduction of malaria incidence to a tolerable level, at which malaria no longer constitutes a major public health problem. Malaria control operations are concentrated in those parts of the country where endemicity is highest and where its impact on the health or economy of the population is greatest.

The very essence of malaria control is that all operations must be specifically designed, area by area, to maintain the incidence of malaria below the level of public health importance, rather than to create and maintain a complete interruption in the transmission of all malaria.

To the extent that earlier AID-supported malaria eradication programs in Asia did not bring about a complete interruption in the transmission of malaria, they cannot be considered to have achieved their goal. To the extent that they demonstrated the possibility of reducing to manageable proportions the incidence of a disease which had been the major cause of morbidity and mortality in Asia, and made possible many of the major developmental projects of the decade of the 1960's, they represented an effective use of AID financing. (Section II, Results to Date, provides an assessment of the Asian programs which AID is now supporting or has supported in the past).

B. AID's Malaria Strategy

AID's malaria strategy should have five distinct components:

1. Support of properly planned and evaluated malaria control programs, preferably but not necessarily multidonor-supported, consistent with the criteria outlined in the subsection C, Malaria Policy, below, and more fully examined in Section IV Criteria

for AID Support for Malaria Control.* The strategy should also include the installation within the host government structure of a cost-effective system for continued control beyond the period of external assistance.

2. A major effort to stimulate the creation of a mechanism to bring well-planned malaria programs to the attention of potential donors and to elicit support for those programs which cannot be carried out without external assistance (as outlined in subsection D, External Support, below, and more fully examined in Section V, Mobilization of Financial Assistance).

3. Support of establishment of an international training center for control of malaria and other vector-borne diseases for training of professionals in advanced and intermediate practice of control of these communicable diseases, and, within approved country programs and where important to their success, technical and/or financial assistance to national training institutions (as outlined in subsection G, Training, below, and more fully examined in Section VIII, Training Requirements).

4. Continued and in fact expanded support of a research effort sufficiently high to enable a long-term commitment to research as an integral part of long-term strategy (as outlined in subsection H, Research, below, and more fully examined in Section IX, Research Needs and Priorities).

5. Continued AID participation in regularly recurring, international expert appraisal of malaria control programs (as outlined in subsection I, Evaluation, below, and more fully examined in Section X, Evaluation).

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* The tactics for achieving the goals of this point in strategy of malaria control may and will differ from country to country, and even within different areas of the same country. They should be determined locally, if possible, after a review of the epidemiological factors affecting transmission of malaria in each area, and as close to the locus of action as possible. See Section VII, Malaria Control Techniques.

C. Malaria Policy

AID's current policy on malaria is set forth in AIDTO Circular A-733, July 3, 1973, a document which also establishes the criteria for considering assistance to country malaria programs. The policy and related criteria (which appear in Annex 3, AID Policy on Malaria Programs) are in most respects sound; yet the Study Group believes that the developments of the four years since the issuance of AIDTO Circular A-733, both within AID itself and in the severity of malaria resurgence, warrant a reexamination of the policy statement and criteria for considering assistance.

The Study Group recognizes that its terms of reference do not extend beyond advising the Asia Bureau; it nevertheless recommends AID consideration of certain clarifications of its present policy, believing that the policy (and/or the implementing criteria) should deal specifically and explicitly with eight major points. (These points are more fully examined in Section IV, Criteria for AID Support for Malaria Control).

1. AID should be prepared to consider assistance to country malaria programs in those instances where there is a critical need to protect a substantial U.S. investment in terms of gains already made or a need to prevent malaria from becoming a deterrent to other country development programs.

2. AID should be prepared to provide selective assistance to national anti-malaria efforts on a case-by-case basis. As a precondition for consideration of such assistance, AID should insist that the country demonstate its own interest in and concern about malaria through the development of an appropriate plan to control malaria and the provision of an adequate budget and staff to carry out the country program. The malaria plan should be technically, administratively and financially sound--as determined by AID after review of the recommendations of a joint WHO/LDC evaluation team. (For details of essential plan content, see Section IV, Criteria for AID Support for Malaria Control).

3. AID should insist that the country demonstrate its own interest in and concern about malaria through the provision of an adequate budget and staff to carry out the country program.

4. AID should also insist that, in addition to the mobilization of available internal resources,

there must also be a systematic exploration of external sources of assistance. (This topic is more extensively developed in Section V, Mobilization of Financial Assistance).

5. AID should be prepared to provide those kinds of support which, taken together with inputs of other donors and of the recipient country, will make possible the successful implementation of the plan. Such inputs will include commodity support, funding of training and research when essential to the success of the program, funding of a portion of local costs in special cases where appropriate, and cooperation with WHO on evaluation of malaria programs. In some cases, it may be desirable to provide direct technical assistance. (See item 6 below).

6. For the most part, AID should rely on WHO to meet the primary needs of the individual country malaria programs for specific scientific advisory services, including the assignment of advisors as required in such specialities as malariology, epidemiology, parasitology, entomology, sanitation, engineering and health education. However, general reliance on WHO to provide technical expertise should not constitute a strait-jacket under which AID would be precluded from providing a technical advisor or advisors whose skills might be imperative to program success.

7. AID should provide a technically qualified and experienced AID officer in each malaria program receiving AID support, to assist in the technical project monitoring aspects of the program and in the management of the pesticides used in this project.

8. AID should itself support and actively encourage the support of other concerned bilateral and international agencies for the development of a center for regional and/or interregional advanced and intermediate training and research in the control of malaria and other vector-borne diseases. While major AID support to country malaria programs should (even for multidonor-supported programs) constitute an element in bilateral AID assistance to the countries concerned, AID support of the regional training center (or centers) should stem from regional funds, making it possible to provide essential training and improve both planning and execution of malaria programs in countries which are not receiving bilateral AID assistance.

D. External Support

Although WHO has a long-standing responsibility for coordination of resources to implement malaria control programs, no systematic approach to elicit and coordinate the support of bilateral donors has been developed beyond the moribund Special Malaria Funds, to which the U.S. was the only major contributor. (This subject, and the following three recommendations, are more fully examined in Section V, Mobilization of Financial Assistance.)

At the WHO/AID/USPHS Malaria Coordination Meeting, to be held in Geneva on December 8 and 9, 1977, the subject of mobilization of external financial assistance to soundly planned and internally supported malaria control should be placed high in priority on the agenda.

Subsequently, there should be a second meeting, to which should be invited, in addition to the membership of the existing Malaria Coordinating Group, such potential donors as Australia, Canada, Germany, Great Britain, Japan, the Netherlands, New Zealand, Switzerland and the Scandinavian nations, together with UNICEF, UNDP and PAHO. Further, there is no readily apparent reason to exclude potential Eastern European donors or the petroleum exporting nations, and a number of the foundations would, at a minimum, be expected to take an interest in operational research and pilot projects.

Whether or not it proves possible to elicit support of malaria control programs from other donors on a continuing basis, the prerequisites for further AID assistance to malaria programs should be those outlined in subsection C, Malaria Policy, above.

E. Organization for Malaria Control

It is readily apparent that, entirely apart from the technical and financial difficulties which have beset malaria programs throughout Asia, a key problem is the organizational structure selected to conduct a program which is not time-limited, which is not necessarily applied throughout the entire country, and which may vary in its application from one area of the country to another.

There is no single organizational structure which would prove universally applicable to all countries in which AID is (or may be) supporting national programs of malaria control.

The change in objective from eradication to control should not be interpreted to mean that malaria in Asia is any less important now than it was during the era of the so-called eradication programs. The very intractability of the disease has brought about the discontinuance of the eradication effort. The relative success of the eradication effort has allowed shifts in populations to previously highly malarious areas and has increased expectations of the populace for protection against malaria. In many areas, control is far more important now than was the case prior to the eradication effort.

In almost all of the Asian countries of concern in this report, malaria is not now under control; the situation is such that intensive efforts must be undertaken quickly, aimed at major reduction in malaria incidence.

The complexity of operations required for an effective malaria control program is equal to or greater than that characteristic of an eradication program.

With the above considerations in mind, the Study Group has reached the following conclusions. (These conclusions, and their rationalization, are more fully examined in Section VI, Organization for Malaria Control).

1. Malaria control should be an integral part of National health planning in Asian countries.

2. Malaria control programs should be organized at as high an administrative level as is required to assure cost-effective achievement of program goals.

3. Malaria control programs integrated with other communicable disease control activities should have organizational identity and designated allocations of funds. Organizational identity means that there must be room for professional recognition of specialists and provision for their promotion in responsibility, pay and status.

4. Malaria control operations aimed at the mosquito vector (e.g., residual spraying, larviciding, and large-scale source reduction measures) should be organized vertically until the incidence of the disease has been reduced to a level sufficiently low that effective control can be maintained with a minimum of central direction.

5. Where (and when) general basic health services are adequately developed and effectively functioning, malaria control operations related to epidemiological investigations, distribution of drugs, health education and, ultimately, vector control can be devolved to the local health infrastructures.

6. Community participation should be promoted in source reduction measures, passive case detection, drug distribution, some spraying operations, and health education activities.

Inevitably, some broad decisions will have to be made at higher levels, particularly in the choice of equipment, commodities, etc., and central procurement offers the potential of economies of scale. Until the incidence of malaria is brought down to and maintained at a tolerable level, some elements of vertical control must be retained.

F. Tactics

(The tactics, as against the strategy of malaria control, and the Study Group's recommendations on this topic, are more fully examined in Section VII, Malaria Control Techniques).

In addition to insecticides, a considerable range of tactics is available for use in the control of malaria vectors. For some, utility and effectiveness are well-established (source reduction; the use of larvivorous fish); others are more limited in usefulness (larviciding); still others are in early stages of evolution and evaluation (pathogens, predators other than fish). All are useful or potentially useful tools which can supplement the principal existing techniques of malaria control: residual insecticide spray and antimalarial drugs. It is the view of the Study Group that there is in the near future no alternative to the use of insecticides in the strategy of controlling malaria vectors. The Study Group anticipates the gradual emergence of an integrated approach to malaria control (and, indeed, to the control of other vector-borne diseases), using a variety of control tactics as appropriate to the epidemiology of the disease, the behavior of the vector, the terrain and the environment. To the extent possible, choice of tactics should be based on cost-effectiveness and maximum benefit. The goal should be reduction and containment of malaria, carried to the point of eradication where feasible, but without the time limits which characterized the earlier eradication programs.

Implementation of control plans which rely upon a selection of the most beneficial and cost-effective among alternative methods will increase the need for applied research efforts; the Study Group recommends continued and expanded support of operational research.

G. Training

Many countries where malaria continues to be an important public health problem are now and will for the indefinite future be in need of experienced staff for their antimalaria programs. With the change of strategy from malaria eradication to a broader concept of malaria control, increased training of specialist and intermediate staff in the practice of control of malaria and other vector-borne diseases has become imperative. This broader training, including both theoretical and practical knowledge, will increase the possibility of a long-term career in public health. (Training and the Study Group's recommendations on the subject, are more fully examined in Section VIII, Training Requirements).

Regional training centers are required for personnel who will plan, organize and direct national malaria control programs, or who will provide training to personnel within their country who will execute programs in the field. No existing training center is properly staffed and orientated to undertake the broad training required on a regional basis.

Within (or available to) 1/ each country undertaking malaria control programs, there is need for a strong training program to provide competent technical personnel for the various administrative levels and operational areas. Existing national training centers need to be strengthened and curricula reorientated to the needs of malaria control. There is need for a range of skills, appropriate for the local situations. Among the subjects to be taught should be entomology, including anti-larval measures and source reduction, serology, immunology, detection of drug resistance and ecology. In no country in Asia did the Study Group find national training which covered these elements.

1/ E.g., Nepal lacks a center to provide training but has access to India's National Institute of Communicable Diseases.

Country-level training is still keyed to the unidirectional techniques of malaria eradication through the use of residual spray.

The key requirements are technical and financial. Where possible, WHO should provide resident foreign expertise; local colleges and universities should be drawn upon where they possess the essential skills; but the training should be pragmatic rather than theoretical, stressing the management of resources and the decision process.

The success of malaria control efforts depends largely on the availability of trained technical personnel of all grades; AID's investment in support of national malaria control programs is endangered to the extent that technical personnel are improperly or inadequately trained to carry out programs, however well planned.

In view of this the Study Group recommends:

(a) That an International Training Center for control of malaria and other vector-borne disease for training of professionals in advanced and intermediate practice of control of these communicable diseases be set up with AID initiative and with its substantial financial contribution and technical assistance. Participation of other agencies and governments should be sought and encouraged.

(b) That speedy action be taken with regard to the implementation of this recommendation and decision on the best site for it, taking into account the views of WHO.

(c) That national training institutions in control of malaria and vector-borne diseases, already functioning in most countries where malaria control programs are supported by AID, should receive technical and financial assistance from AID whenever this is regarded as important to the success of the relevant programs.

H. Research

The Study Group emphasizes the fact that the intrinsic nature of present malaria control programs is such that research in support of an operational program is an absolute necessity for long term success. The investment in control-related research should be commensurate with the investment in the overall program. Not less than 10% of funds allocated to malaria control should be devoted to research. (Research,

and the Study Group's recommendations on the subject, are more fully examined in Section IX, Research Needs and Priorities).

Field assessment of new or improved control techniques is often needed for short-term improvement of program effectiveness. Examples of such projects are trials of improved insecticides or application techniques, field trials of available drugs, evaluation of improved serologic tests for surveillance. The Asia Bureau should include area-specific field assessment projects in the malaria strategy.

Present control methods are imperfect at best and the expectancy for long-term usefulness of any given method is limited because of biologic adaptation of vectors and parasites. Effective long-term solutions to the problem of malaria will therefore depend on successful research efforts in one or more of three areas; vaccine research, drug research, vector control research. Of these, the most important area for long-term support by AID is in research aimed at development of an antimalaria vaccine. AID should plan for long-term (5-10 year) support for basic and applied vaccine research at the present level, with expectation of increased funding when research results indicate the feasibility of vaccination for preventing malaria.

Biological control methods range from practical alternatives to long-term opportunities; from distribution of larvivorous fish to genetic control of mosquitoes. AID should concentrate its support of biologic research on those methods which show early promise. AID should support field trials for assessment of biologic control methods where feasibility appears established.

Insecticides will for the foreseeable future continue to be required for malaria control. The need for a safe, effective insecticide for public health as well as for agricultural use is apparent. There is no assurance that the basic research now being conducted by industry and the Department of Agriculture will meet public health needs. Support for field assessment of new insecticides is appropriate for AID funding. Additionally, the Study Group recommends an in-depth evaluation of the Department of Agriculture's developmental research program as it relates to AID requirements and a reevaluation of the judgment that USDA research will to a satisfactory degree focus on the need for a safe, effective insecticide for malaria control.

Development of new antimalaria drugs must continue, both to provide effective prophylactic curative drugs for malaria control and to treat individual cases. At present the U.S. Army is the principal agency in the U.S. Government for this research. AID should encourage continued DOD support of drug development research. Support for field assessment of developed prophylactic drugs is appropriate for AID funding.

I. Evaluation

On-site recurring progress appraisals of malaria control programs are conducted by combined teams of senior officials of the national programs and internationally recognized experts in malaria, supplied by WHO, AID, USPHS/CDC and others. These appraisals form a vital part of the evaluation system which AID has made a precondition of assistance to country efforts. There is no comparable system of dispassionate, international expert appraisal of results achieved, problems faced and improvements required for any programs other than malaria control. AID's input into these appraisals is a major contribution to national efforts to control malaria; in addition, such participation provides AID a breadth and depth of knowledge obtainable in no other way, and an influence over the content and conduct of malaria programs which continues beyond direct AID support. Such participation imposes on AID's small central malaria staff a staggering burden of travel time and time away from the central office. Yet the participation is vital, and should continue. (This topic, and the following recommendation, are more fully examined in Section X, Evaluation.

The Study Group recommends the expansion of the Malaria Staff, including the possible establishmentof a position for an Asia-based malaria specialist, to carry at least the Asian portion of the world-wide evaluation effort, to assure the sharing of experience and information among participants in AID's largest effort in support of malaria control, and to serve as coordinator and technical backstop for country-based AID malaria officers in Asia. Being based in Asia, he would help conserve the Agency's increasingly limited operational travel funds.

I. ANTI-MALARIA STRATEGIES

A. Malaria Eradication vs. Malaria Control

The two strategies of antimalaria campaigns must be clearly distinguished. Malaria control implies the reduction of the disease to a level at which it is no longer considered a serious public health problem, with continued maintenance of activity to contain the disease within such a level. Where feasible, the ultimate goal may continue to be the terminal interruption of transmission of malaria, but without the time limits which characterized programs of malaria eradication. The essential characteristics of malaria control are that the program is not time-limited, must be specifically tailored to the epidemiological situation in each country, is not applied uniformly throughout the country (concentrating on areas of highest population density or greatest economic importance), and may vary in its techniques of application from one area of the country to another. It requires a range of skills broader than those employed in eradication programs.

Malaria eradication, however, is designed to interrupt any further transmission of malaria, to eliminate any reservoir of infection, and to prevent any resumption of transmission, within a specific time frame.

Annex 1 of this report details the methodology of malaria eradication, which relies on the deceptively simple-sounding technique of DDT domiciliary spraying of all infected areas; intensive case detection and treatment (surveillance) to identify remaining disease pockets and enable focal remedial measures to be taken; and a permanent vigilance system integrated into the general health services, to prevent the reestablishment of transmission after eradication is achieved.

B. Terms of Reference of Study Group

A generation ago, malaria was the leading cause of morbidity and mortality throughout the countries

of South and Southeast Asia[1]-- and, indeed, throughout much of the world. Some areas were providentially free of the disease -- few of its vectors transmit the disease above the 4,000 foot level, although in the Western Himalayas transmission persists far higher --but throughout the region, malaria has been the major impediment to agricultural production, development of new areas, resettlement and industrial growth.

Twenty years ago, with the urging of the World Health Assembly and the World Health Organization, and with the vigorous (and generous) support of AID, the countries of the region (and of the balance of the developing world, with the conspicuous exception of sub-Saharan Africa) had embarked on a bold new program, not to control malaria but to eradicate it. World-wide, AID invested over a billion dollars in malaria eradication programs. Including inputs into current malaria control programs, AID's investment in the antimalaria effort in Asia totals over $540 million.[2] Case reduction of malaria was, throughout the region, brilliantly successful -- generally in the order of 90% reduction or better. Yet within a decade the trends of malaria were on the rise, to catastrophic proportions in some countries; the very concept of malaria eradication came under challenge; and slowly, reluctantly, malaria programs have been (or are being) restructured to deal with what is now recognized as a continuing problem. Section II, Results to Date, lists the major causes of resurgence

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1/ For purposes of this report, the countries of South and Southeast Asia are considered to include Pakistan, India, Sri Lanka, Nepal, Bangladesh, Thailand, Burma, Malaysia, Indonesia, Laos, Cambodia, Vietnam and the Philippines. AID's regional definitions do not coincide with those employed by WHO; the countries listed above fall within three WHO regions: Eastern Mediterranean, South East Asia, and Western Pacific.

2/ In the countries of the Asia region, a considerable proportion of AID assistance to malaria programs, over 44%, took the form of U.S. owned local currencies generated under various types of commodity import programs. The attribution of these local currencies to malaria eradication provided the country a claim on existing resources but did not provide additional resources. Since the local currencies had been generated by the sale of imported commodities contributed by the U.S., to consider them also as a U.S. contribution to the malaria program is a form of doublecounting.

and describes the nature and degree of past and present AID participation in antimalaria programs and the current situation in the countries of South and Southeast Asia.

The Study Group does not propose to assess blame for "losing the battle of malaria eradication". Its functions are, by the terms of its charter of existence, constructive. The Group's tasks were defined by the Asia Bureau:

1. Assess the results to date of malaria control/ eradication programs in Asia, with particular attention to past and present U.S. participation. Country by country study will give the information necessary to understand what has happened in the past and provide the basis for making a current assessment.

2. Review the technical problems interfering with the progress of the on-going malaria programs in Asia and identify research and training needs of the Asia Region to overcome these technical problems.

3. Review and analyze organizational and operational aspects of planning, implementing and evaluating AID-assisted Asian malaria programs and provide specific comments on the implications of various approaches.

Beyond these three charges, the Study Group has sought to assess the appropriate priority of malaria control programs in Asian and AID development assistance programming; to examine and comment on the structure and content of AID support; and to consider and recommend modifications of the present preconditions for AID support of malaria programs. The Study Group is unable to estimate the total cost of malaria control program requirements, since the Study Group cannot know in advance the kinds or the magnitude of programs which host countries and their technical advisors will themselves be able to mount and support, the control methods to be adopted, or even the areas to be protected.

The very essence of malaria control (as opposed to the standardized approach which characterized malaria eradication) is that each country program must be specifically designed to meet the problems of that country.

C. Study Group Methodology

The nine Study Group members were selected for expertise in their specialties, with experience and backgrounds suitable to carry out the terms of reference. Specialties required for the Study included administration, research, malaria operations, public health, logistics, health delivery systems, education and training, economics and international development planning. The Group was supported by a TA/H research officer who served as Executive Secretary to the Group and whose responsibility it was to locate, abstract and compile background information and prepare country profiles in advance of the first meeting of the group, and to obtain additional information as required. Other members of the TA/H malaria staff assisted as required.

The first group colloquium took place from May 16 to May 20; it included a review of all background information available, the establishment of rules of procedure, and the allocation of specific assignments. It also identified areas where further information (to be secured by a field team) was required to reach conclusions.

Between May 22 and June 28, a three-man field team interviewed officials in WHO/Geneva, WHO/New Delhi (South East Asia Regional Office), and WHO/Manila (Western Pacific Regional Offices; they also interviewed officials of country malaria programs from Sri Lanka, India, Nepal, Thailand, Indonesia and the Philippines, and met with AID officials in these countries. In all, the field group consulted with some 71 officials and other experts in assessing current Asia malaria program operations, in addition to the 15 AID and other U.S. experts consulted in Washington by the entire Study Group. Without the generosity of these men and women, in terms of time, expert knowledge and documentation prepared for the field group, this report would have required far more than the alloted time, and have covered less ground.

The Study group takes this opportunity to express its gratitude to the many officials and other experts whose advice was so freely given; but responsibility for conclusions reached and recommendations advanced in this report lies exclusively with the Study Group.

II. RESULTS TO DATE: ASSESSMENT OF PROGRAMS WITH AID INVESTMENT

AID is engaged in active assistance to malaria control efforts in three Asian countries -- Pakistan, Nepal, and Indonesia - and has recently agreed to support a program in Sri Lanka. In the past, AID has provided varying levels of assistance to malaria programs in India, Bangladesh, Burma, Thailand, Laos, Cambodia, South Vietnam, the Philippines and Taiwan, but, at present, no AID contributions are being made to malaria programs in these countries.

AID has had experience with Asian malaria programs since the early 1950's and has played a major role in the enormous gains made against this important disease in the last twenty years, not only in Asia, but world-wide. Over two billion people -- 50% of the world's population -- live in areas currently or formerly affected by malaria; the magnitude of the disease in relationship to health, economic and social development is easily apparent. Roughly, 83% of the world's population considered to be at malaria risk at the inception of the world-wide malaria eradication effort is residing either in areas where malaria eradication has been achieved (824 million) or in areas where antimalaria measures are being carried out (848 million). This highly effective program has improved the health of hundreds of millions of people; its principal impact has been on the "poorest of the poor" at the village level; it must be considered one of the major public health achievements of all time. In cooperation with the efforts of other countries, the World Health Organization and other multilateral agencies, AID has played a significant role in this major achievement. The Agency is recognized throughout the world for its sustained interest, technical expertise, financial assistance and support of research. in the field of malaria.

AID involvement in antimalaria programs in Asia over the years has been of importance to their progress; the programs, in turn, have been an inseparable element in resource development in a number of countries. Even in the face of the resurgence of malaria which has taken place in many countries, AID assistance has provided positive and useful help in the way of institution building, improved management practices, training of public health workers, and in every instance, major reduction in the incidence of disease. It has allowed lands to be settled and utilized, provided a positive influence on ministries of health in seeking goals

which are preventive in orientation and, perhaps more important, demonstrated to the people of Asia that disease is not inherent in life and that it is possible to control or modify conditions which affect people adversely. This has had the result of producing pressures on governments to maintain a status of relative freedom from the danger of malaria.

Current AID assistance to antimalaria efforts in Nepal, Pakistan, Indonesia and (recently approved) Sri Lanka has a goal quite different from that of the programs of the 1960's: malaria control, which throughout this report is defined to mean significant reduction in malaria incidence to a predetermined level which the recipient country has established as technically and economically feasible and politically supportable, at which point the disease no longer constitutes a major public health problem; and, thereafter, containment of malaria at or below that level. Such a program is not time-limited; it has no predictable date of termination, so far as the containment phase is concerned, although the need for external subvention is finite. Such a program contrasts sharply with earlier AID-supported eradication programs, which had as their goal the permanent interruption of the transmission of all malaria in the country in question within a finite time-frame -- after which the problem remained one of detecting and curing imported cases of malaria and preventing reinfection of the population at large. This meant, in effect, the reduction to the zero point of any in-country reservoir of the malaria parasite, and of the need for a special budgetary provision for the antimalaria effort.

Earlier programs were dramatically effective in reducing the incidence of detected malaria (as revealed by malaria-positive blood slides). India, Nepal, Pakistan and Ceylon showed rates of detected incidence which were a minute fraction of pre-program estimated case incidence; moreover, the extent of blood examination was sufficiently high to bring detected incidence reasonably close to total incidence. In each case, however, the task of continued surveillance and elimination of residual foci of potential infection proved to be beyond the capacity of the public health services of the country. It must be noted, however, that while the malarious countries of Asia have indeed failed to carry out appropriate surveillance, there is no evidence that they are incapable of surveillance. During the 1960's, many countries had excellent surveillance programs. Decreasing government priority was the principal precipitating factor in organizational deterioration. Those responsible for the

allocation of scarce resources judged the costs of such continued surveillance to be unsupportable, when assumed for a disease which had, in comparison to other illnesses, dropped to a level of virtual insignificance; malaria resurgence followed.

Two key factors were belated recognition by Asian governments that total eradication of malaria within the original time frame would not take place, and the failure of these governments to develop health delivery systems (as against malaria eradication systems) which could take measures required to prevent increases in malaria incidence above the requisite low level. Integration of malaria efforts into basic health services had been emphasized by WHO for a number of years -- but governments had not, and have not, emphasized the extension of health delivery systems to the point where they were established and ready when malaria incidence was reduced to a low level. In countries where control is now the long-term objective, it becomes increasingly essential that delivery systems be developed with some degree of urgency. The countries of Asia cannot afford indefinitely to maintain parallel systems within the Ministry of Health, primarily because the costs are too high. (For exposition of this point, see Section VI, Organization for Malaria Control).

Other reasons for resurgence were many; they included carelessness as to spray coverage, in time (the period of intense emergence of the vector and consequent high rates ofinfection) and in space (remote areas left untreated, or areas imperfectly covered); population movement (involving both reintroduction of malaria into areas which had been free of the disease, and also intrusion into malarious areas of population bodies from malaria-free areas, where their lack of any degree of immunity made them subject to very high rates of infection). The vectors themselves changed or modified their habits; many kinds of anopheline mosquitoes developed partial or virtually total resistance to the insecticide of universal choice, DDT, used as a residual spray (and have continued, in some cases, to develop resistance to the ever-more-toxic and ever-more-costly insecticide sprays which have succeeded DDT--malathion, BHC, lindane, propoxur, fenitrothion and others). Some vectors which had tended to rest on interior house surfaces, where they were overcome by the effects of residual spray, developed new habits of resting and biting outside houses; outside-biting mosquitoes became more significant (especially in areas where new agricultural lands were created in previously forested areas). The ecology of many areas changed significantly with land reclamation and population pressure; that of the

vectors changed accordingly. This list of causes is representative, not exhaustive; the combined effect was the resumption of transmission of malaria throughout South and Southeast Asia. The degree of resurgence has varied, from relatively minor (Philippines), to serious (Nepal, Indonesia, Thailand), to catastrophic (India, Pakistan, Sri Lanka).

With the resurgence of malaria, AID resumed assistance to four Asian countries -- most recently to Sri Lanka, and earlier to Pakistan, Nepal and Indonesia. Significantly, malaria is again on the decline in each of the countries where AID has an active role in program support.

The four current control programs receiving major AID support are more modest in their goals than the earlier programs of malaria eradication, but are not for that reason less expensive. This is especially true since they are, for the countries themselves, not time-limited. Neither are they simpler to conduct; while they do not require the total spray coverage and the massive centrally controlled detection apparatus of the eradication programs, they require a greater technical capacity at levels below the top of the vertical structure which universally characterized the national malaria eradication programs and as much decentralization of operational decision-making as is consonant with effective and efficient operations. Moreover, universal dependence on residual insecticide spray (in most cases, still the most cost-effective single tool against malaria) is being supplemented wherever feasible by such additional measures as larviciding, source reduction through better water control and elimination of such vector breeding foci as borrow pits, and biological controls, such as the introduction of larvivorous fish. The need for more and better training is apparent.

The following section summarizes the present situation in, first, the four malaria control programs to which AID is providing current support; (Nepal, Pakistan, Indonesia and Sri Lanka); and second, programs which AID has supported in the past (India, Bangladesh, Burma, Thailand, The Philippines, South Vietnam, Cambodia, Laos and Taiwan). Afghanistan, although not considered part of the region, is also dealt with because of its proximity to Pakistan and the enormous border traffic between the two countries.

A. CURRENTLY AID-ASSISTED PROGRAMS

1. Nepal

The Nepal malaria eradication effort began in 1959 when the estimated incidence of malaria was approximately two million cases annually; upwards of 10,000-20,000 deaths occurred annually due directly or indirectly to malaria; and an important area of the country, the fertile inner Terai, was largely unoccupied and grossly underproductive because of hyperendemic malaria. After pilot control projects in the mid-fifties, the decision was made to mount a national malaria eradication effort. AID provided the majority of the costs of the program, both imported commodities and local currency; a team of technical advisors; and training. WHO also provided technical assistance, limited commodities and training. The program was phased over time to cover the entire country and by 1972 the incidence of malaria had been reduced to approximately 2,500 cases. The AID Mission terminated the project in June, 1972, contrary to the warning of the technical staff that the basic health structure of the country was not ready to take on the important and, indeed, vital task of control of malaria by responding to local outbreaks and providing adequate epidemiological surveillance. There followed a rising case load of malaria, peaking at approximately 15,000 cases by 1974. The Nepal Government recognized that the rising trends of malaria were due to an inadequate malaria control response by the National Malaria Eradication Organization, which had been greatly reduced in manpower and budget. A new program of antimalaria activities was drawn up; AID again responded to a request to provide assistance. The Government of Nepal was particularly concerned that protection from malaria be given to the approximately 2 million settlers, primarily from non-malarious areas of the country, who had come into the formerly malarious areas in the inner Terai and forest fringe. A massive epidemic was avoided by Government of Nepal action and AID assistance.

Nepal's present malaria program appears to be soundly conceived and reasonably well executed; the case-load had been reduced to approximately 10,000 by 1976, and it is expected that further reductions in incidence and improvements in execution will take place in the next two years. The impact of imported cases of malaria from India is

highly significant; some 35% of all reported malaria incidence is of Indian origin.

Integration of malaria control and general health services is moving slowly; significantly, malaria control is less effective in areas where control responsibility has been assigned to the health service, in part because of inadequate preparation for the change. It is improbable that the integrated services will be able to provide adequate control of malaria by 1980, when the present assistance program will be concluded. There are some areas of Nepal where integration may be feasible (e.g., Siraha, Saptari), but epidemiological reviews must precede the integration effort. In other districts (e.g., Kaski) the malaria structure has been used to assume many of the responsibilities of the general health services (e.g., to provide immunizations); this has in general proved to be more successful.

AID's current assistance to Nepal, provided in coordination with the UNDP, WHO, and to a lesser extent, the U.K., will provide more planning and implementation time to develop a basic health infrastructure which can contain malaria at an acceptably low level, carry out a wide range of malaria control techniques for long-term program development, and prevent a serious increase in malaria in the future. As noted above, however, it is improbable that general health services will by 1980 be capable, unassisted, of containing malaria and successfully carrying out all its other tasks. AID should consider continued support pending a technically sound expectation of maintenance of an acceptable level of performance by the Nepalese health services.

2. Pakistan

The malaria efforts in Pakistan have not met with continued success, basically for one reason -- lack of government commitment to support and carry out the work. The earlier malaria program supported by AID did lower the incidence of malaria to a level of approximately 3,000 reported cases in 1966 from a pre-program total of an estimated 15 million cases in the 1950's. For lack of adequate GOP support of the malaria program, AID decided to withdraw its support for malaria activities in Pakistan; AID assistance was terminated in 1972, when the reported caseload was roughly 600,000.

By 1975, the caseload was up to "several million cases"; some malaria workers considered the actual incidence to have been at the pre-program level of 15 million. There were many reasons for this massive resurgence: a government which was not fully committed to funding what had become a low-priority program after AID withdrawal; a premature and inadequately planned attempt to integrate the malaria program into the basic health services as a temporary unit, resulting in a loss of operational efficiency; vector resistance to DDT and BHC; changes in the ecology of Karachi and its emergence as an area of high malaria incidence; inadequate provision for urban operations; and decentralization of the malaria program (in line with a general overall policy of increased provincial autonomy) from a nationally directed to a province-directed effort--a major cause for the rapid return of malaria, especially in the Sind.

Despite the foregoing, Pakistan's AID-assisted current efforts to control malaria are showing rapid results; Pakistan, along with Nepal and Indonesia, is a member of very select group of Asian countries which have shown themselves able to bring about a reduction in the incidence of resurgent malaria. In the case of Pakistan, the reduction has been dramatic -- from an officially reported 240,000 cases (unofficially estimated 5-10 million) in 1975 to about 120,000 reported cases in 1976 and an anticipated further drop in 1977. Official, detected cases are far below the actual incidence, but the gap is shrinking; so is malaria incidence. While some share in this success is attributable to higher morale among malaria workers who now see improved career possibilities within a permanent health service, the principal reason for declining malaria incidence was the replacement of DDT and BHC -- to which the major vector had developed almost total resistance -- by malathion. While the use of malathion was accompanied by unfortunate results in the form of illness and even a few deaths on the part of spraymen accustomed to the carelessness which virtually non-toxic DDT had made possible, the morbidity and mortality prevented by the use of malathion demonstrate beyond question that malathion was the proper insecticide of choice and should continue to be employed during its period of effectiveness--which will unfortunately be shorter than was the useful life of DDT.

The present malaria control program has halted the epidemic of 1974-75, and by the end of 1980, the incidence may be stabilized at the level of perhaps 35,000 cases annually. However, the continued control of malaria in Pakistan through the decentralized programs of the four provinces (Punjab, Sind, North West Frontier Province and Baluchistan) is not likely to occur without strong committed leadership. A national operational structure with its own designated budget would permit economies of scale in administrative leadership as well as other resources, but would still need timely and adequate support from the provinces.

The problem areas will continue to be in the Northern Sind and Southern Punjab districts, with local problems in the North West Frontier Province. Integration of malaria control into basic health services in these areas is questionable for a long period of time. Pakistan will continue to require external assistance, particularly technical assistance, for some time beyond the 1979 termination of the present support agreement. The area of most critical need is the development of health delivery infrastructure.

3. Indonesia

The Indonesia malaria program on Java and Bali has reduced the malaria case load to approximately 12 125,000 cases from what was estimated at 20-25 million cases in the pre-malaria program stage; incidence on Java and Bali is declining. Present AID assistance to this malaria effort has been largely limited to Development Loan financing of commodities, although some research support and limited technical assistance are also provided. The Indonesian Government meets all local costs and a portion of the foreign exchange costs of this program. The major malaria effort in Indonesia needs now to be focused on antimalaria activities in the Outer Islands; outside assistance is being requested for this purpose. If transmigration plans (calling for massive movement from over-populated Java and Bali to the Outer Islands) are to be successful, malaria control is an essential service which must be provided.

Beyond the planned movement under the transmigration program, however, there is large-scale self-generated population interchange among the islands, no small part of which is made up of transmigrants returning to their original homes. Reinfection of

"clean" areas is very possible.

The Study Group is informed that the World Bank, now considering a loan to Indonesia to cover the transmigration of about 5,000 families, is already discussing with AID the need for malaria control in the areas to be settled. The Study Group is also informed that the Government of Indonesia envisions the movement of some 500,000 families. Clearly, the program of malaria control requires geographical expansion, with more emphasis in the malarious areas to be settled. Support for the effort is necessary, in conjunction with other sources of assistance (such as IBRD). Without control of malaria, the opening of new areas for settlement and agricultural development will be unsuccessful. Foreign technical assistance may have to be augmented, given the shortage of trained personnel in Indonesia.

4. Sri Lanka

Sri Lanka's earlier malaria eradication program, to which AID made a relatively small contribution in insecticide (DDT) and local currency, was one of the most successful in Asia. At one point (1963), Sri Lanka reported only 17 cases of malaria.

For the same reasons which caused the failure of the Indian malaria eradication effort--poor surveillance as the malaria program was integrated into basic health services; concentration by health workers on family planning to the virtual exclusion of other interests; inadequate budgets; and, in addition, rapidly developing mosquito resistance to DDT, the disease recrudesced to epidemic proportions, with over 550,000 reported cases at the peak of the epidemic in 1969 (and actual incidence estimated up to 2.5 million).

Sri Lanka has initiated an intensive five-year malaria control effort, calling for wide-spread residual spraying of malathion for the first two to three years of the program to lower the incidence to more tolerable levels. Over the balance of the planned program, there will be limited focal spraying. The prospects for success in this program are good if the present expected support levels continue.

The newly approved malaria control project for Sri Lanka appears well conceived and operationally sound. Some of the lessons learned in providing

assistance for malaria work in other countries are being used in Sri Lanka. The country itself has indicated its interest in malaria by making malaria control its Number One priority for external assistance. The country has approved in principle a five-year budget for the project. The leaders of the malaria program asked for international assistance in holding an in-depth review of current performance and future plans. A comprehensive plan of operations has been carefully prepared and approved by the Government; AID has responded to the assistance request along with other donors and in coordination with the World Health Organization. The project has clear objectives and an evaluation mechanism is in place. AID will provide direct technical and managerial monitoring of the project, including careful monitoring of the use of malathion, the insecticide of choice. It is planned to encourage a broad spectrum of malaria control pilot studies using alternative methods of control.

The project appears well designed to meet its objective: to halt the present epidemic, and to allow malaria control to be integrated into the general health service in a planned and orderly way.

Sri Lanka's continued poverty and limited foreign exchange resources, however, suggest foreign assistance; financing of imported commodities and support of applied research may be necessary for two or three years beyond the present five-year program. Given the U.S. comparative advantage in these areas, AID should examine the advisability of providing some of this needed help.

B. PREVIOUSLY AID-ASSISTED PROGRAMS

1. India

Resurgence of malaria in India has been fully as dramatic as that in Pakistan. After a period of unbroken success during which malaria incidence dropped from an estimated 75 million cases in the pre-program period to less than 150,000 cases in 1965, the incidence has risen inexorably to 5.8 million reported cases in 1976, and unofficial estimates put the actual case-load as high as 15-25 million. India is now spending 70% of the national health budget, plus large amounts of state health budgets, to bring the disease back

under control; to restate, annual expenditures for malaria control are now as high as they were for entire five-year plans for malaria eradication a decade ago.

AID support of India's antimalaria effort was initiated in the mid-fifties and terminated in 1972. It totaled almost $110 million in grants and loans, plus $182 million in United States-owned local currency -- nearly a third of AID's total support of all malaria programs, world-wide, and well over half of such support in Asia. As noted above, dramatic success in reducing malaria almost to the vanishing point was followed by equally dramatic resurgence. Where India was once concerned about importation of malaria from its neighbors, India itself is now the source of over a third of malaria cases in Nepal.

India's resurgent malaria traces to all of the causes previously cited; in recent years, there was an additional factor: premature decentralization of antimalaria efforts which gave responsibility to block leaders who lacked the essential skills.

The program of control of malaria is being revitalized by the National and State Governments. The disease is now at epidemic levels in several parts of India, with Gujarat, Orissa, Madhya Pradesh, and Punjab-Haryana being especially affected. The new malaria control effort will take several years to reduce malaria to levels which India considers tolerable. Indian officials believe that a vertical operational structure is necessary to supervise block and state plans for spraying, larviciding and coordination with other agencies in regard to source reduction and water management.

The program, still termed the National Malaria Eradication Program (since the term "control" is considered pejorative and unlikely to elicit essential financial support)has in fact been converted to an apparently thorough-going control program. Since the conversion took place only in April, 1977, and since the training program at the National Institute of Communicable Diseases remains (to date) essentially unchanged from that considered appropriate for eradication, it is too early to evaluate its success. At last report, malaria incidence was still rising, although reportedly at a rate less rapid than a

year ago.

The National Institute of Communicable Diseases (NICD), once the bell-wether of malaria training centers, no longer enjoys preeminence in the field, and would require extensive reorientation and technical support in order to serve as a regional malaria control training center.

India's determined self-reliance and go-it-alone posture have been slightly modified, to the extent that India has recently requested WHO advice in modifying the structure and content of courses at its training center. India has already taken action to increase its own budgetary provision for antimalaria programs; and is moving towards (but will not soon achieve) self-sufficiency in insecticide production capacity. Beyond this point, it is not a simple matter to project future developments. A crash program for India, speeding up the current incidence-reduction effort, would be very costly, and even a continuation of India's existing and projected effort may require outside help until malaria is reduced to a level which is acceptable to India and thereafter containable without major external assistance. Simple allocation of U.S.-owned, PL 480-generated rupees is not adequate; these represent a claim on existing resources, not new resources. One commodity requirement that external assistance could easily help meet is that for antimalarial drugs, primarily chloroquine. India now uses a third of all chloroquine produced in the world, and can produce only one-eighth of its requirements.

2. Burma

Although Burma was at one time a recipient of small-scale AID assistance to its antimalaria efforts, AID has had no program activity in Burma for more than 20 years.

The modest efforts against malaria being made by Burma at this time are not sufficient to do much more than contain the disease in limited focal areas. Outside assistance seems required if a larger program is to be launched.

3. Bangladesh

In Bangladesh, AID assistance provided support to one of the better malaria structures in Asia; this malaria program is now integrated into the health services of the country.

In those parts of the country where malaria is not a problem, the former malaria personnel are doing multi-purpose health work. In areas where malaria is a serious problem, the personnel are primarily engaged in malaria control activities.

Malaria is mainly concentrated in the hyperendemic Chittagong Hill Tracts, Sylet, and along the Assam and Tripura border areas.

AID assistance, which was terminated in 1972, provided support to an effort which reduced to 6-7 million (out of the estimated 75 million in Bangladesh) the number of people now at serious risk of malaria.

AID's past assistance to research on the serological diagnosis of malaria has proven very useful in Bangladesh and an on-going applied research effort, funded by the Center for Disease Control of the U.S. Public Health Service, is continuing in that country to increase the usefulness of these serological tools. AID is presently considering modest support to malaria control research (larviciding studies in the Chaklapungee area).

There is need for a long-term effective malaria control effort in Bangladesh; otherwise malaria will begin to return to the central lowlands, which are now virtually free of malaria. The present malaria strategy in Bangladesh will not prove successful unless additional commodities, training and research support can be provided. Given Bangladesh's extreme poverty, which has prompted AID and other foreign donors to designate it as one of the nations which must receive assistance on the softest possible terms, it seems certain that the needed added resources can only come from foreign assistance. The need is vital and immediate. AID is presently considering its future role in supporting malaria control efforts in Bangladesh, and has projected an assistance role in its present program plans, but is awaiting definitive decisions by other bilateral donors.

The Study Group was informed that the Netherlands is considering assistance to Bangladesh; to the extent that such assistance is forthcoming, the need for AID participation may be reduced or eliminated. An assistance package coordinated like the Sri Lanka model may be possible.

4. Thailand

As was the case in Pakistan, malaria efforts in Thailand have had limited success and incidence of malaria has increased markedly since the termination of AID support for the malaria program. The principal reason for malaria resurgence is the lack of a government commitment to support and carry out the work which the Malaria Division and its parent organization, the Office of Communicable Disease Control, fully recognize to be necessary. The Malaria Division's budget, about two tenths of one percent of the national budget, has remained fixed for several years, while all costs have risen; as a result, both spray and surveillance coverage are now sharply limited. The program which had lowered malaria incidence from 8-10 million per year in the mid-50's to approximately 128,000 by 1966, is now facing upwards of 300,000 reported cases in 1976, (with every possibility that the actual number was over three times this level). Further, the trend for 1977 is up.

AID withdrew support for the malaria program in 1971 and for the Thailand Malaria Operational Research Unit (TMORU) in 1972. In retrospect, the AID decision to withdraw program support at that time was short-sighted; the Thai Government was unable or at least failed to provide budgetary resources to meet insecticide requirements for the following year and AID withdrawal was not preceded by realistic forward planning which could have enabled the program to carry on successfully. The decision to withdraw support from the TMORU project appears at this point to have been better justified; a good deal of its work is being done by either Thai institutions or other assisting groups such as the SEATO laboratory and WHO.

The current malaria situation in Thailand is considered serious and is expected to worsen. The impact of the disease is especially severe in the newly developed areas in Eastern Thailand, the gem-mining areas and in the forest and forest-fringe areas of the Northeast and Northwest.

The Malaria Division has developed a new plan of operations to deal with rising incidence, but the Finance and Economic Development Ministries have not approved financing.

In parallel with increased support from the Thai budget, AID should consider assistance to support of malaria control in Thailand.

5. The Philippines

The Philippines have continued a relatively stable malaria effort without gains or major losses since the withdrawal of AID assistance in 1972. The process of integration is slowly being organized by the Ministry of Health and the Provinces to provide a multi-faceted basic health service including malaria control. AID assistance to malaria control in the Philippines was directly instrumental in establishing an institution and reducing the disease in large parts of the country. AID support of the International Malaria Training Center in Manila was the principal reason for the center's existence and success. This institution played an extremely important training role for health and malaria professionals not only for Asia, but for the entire world. The closing of this institution because of lack of support was a major setback to the world-wide program of anti-malaria work. An institution of this quality is needed now and should be developed. However, it will be several years before an institution can be developed to match the caliber of the former METC in Manila.

The hard-core malaria areas of the Philippines are gradually expanding and a slow rise in case rates is predictable over the next few years. The Sulu area and Palawan already have serious problems of infection.

The present malaria control effort limits but does not contain the disease. WHO experts predict a focal epidemic within a five year period, followed by a general increase in incidence.

Philippine malaria control officials were primarily concerned over the problem of transportation.

The present program in the Philippines suffers from limited budgetary support, but in particular from the government-wide shortage of foreign exchange for imported commodities. The Western Pacific Regional Office of WHO, located in Manila, has agreed to act as agent in procuring the

imported insecticides used for residual spraying; the local currency equivalent of the foreign exchange costs for such procurement, provided from the budget of the Ministry of Health, is used to defray WPRO expenses in Manila. The problem of transportation has proved less tractable; no vehicle imports have been authorized for many years, and the newest of the vehicles used by the malaria staff are reportedly ten years old. U.S. military excess stocks may provide a partial answer; officials of the Philippine Malaria Control Program appear to have been unaware of this source of potential assistance.

6. Indochina

The malaria programs in Cambodia and Laos, at one time assisted by AID, were never conducted in a manner which was conducive to ultimate success, because of such outside factors as wide-spread insurgency. The Viet Nam malaria program prior to the war was considered excellent, and might well have led to expected success if it had been possible to carry out plans. Even during the war period, the malaria program was effective in maintaining a satisfactory level of malaria control in certain areas of South Viet Nam. Reportedly, malaria is again resurgent in South Viet Nam; WHO reports relatively successful malaria control in the North.

AID assistance to Laos and Cambodia was limited to small commodity grants, and no country-wide effort was mounted in either country. Both countries at present are experiencing wide-spread malaria epidemics; WHO reports several hundred thousand cases in Cambodia, and in Laos, the entire population outside of Vientiane province is considered at risk.

7. Taiwan

With AID assistance, Taiwan mounted a program which resulted in the eradication of malaria. The country is free of the disease.

8. Afghanistan

Afghanistan maintains a national malaria control program, aimed primarily at prevention of epidemics in the more important agricultural areas: the Kandahar area; areas around Jalalabad; and areas along the Kunduz River to the Oxus River, and along its southern banks.

Most recent official reports (1975) indicate more than 77,000 cases of malaria, with major epidemics in Laghman, Kunar, Ghaziabad and Jalalabad, (where the annual parasite index was an incredible 101.60). Conditions in 1976 reportedly worsened -- more generally epidemic and higher case rates.

Afghanistan requested AID assistance in May 1976; AID did not agree to supply assistance.

The impact of the Afghan malaria problem extends beyond Afghanistan; an estimated one million people cross the border with Pakistan each year, and malaria can move in both directions. Laboratory examination of malaria blood-slides at Ghazni, Afghanistan, showed about 10% malaria-positive results in 1975; half of these positives were labeled "imported".

It is apparent that without external assistance, Afghanistan, one of the countries designated by the U.N. as "least developed", will be unable to do more than contain the disease in focal areas, will be subject to periodic epidemics, and will adversely affect the malaria control efforts of Pakistan and Iran.

STATUS OF ASIAN MALARIA PROGRAMS

	Total Population In originally malarious area Presently at risk (all figures in 1000's)	Malaria Incidence 1975 1/ 1976 1/	AID Assistance At Present	Status of Integration with General Health Services	Type of Program	Process Used in Development of AID Support: Strategy Review	Revised Plan of Operations	Start of AID Assistance	End of AID Assistance	Prospects of Success
PAKISTAN	64,330 49,799 49,799	238,315 120,145	YES $35.0 million loan $25.0 million grant	Partially integrated; (Baluchistan). Headquarters part of MOH	CONTROL (Residual Spray)	YES - conducted annually	YES - FY 1976-80	FY 76	FY 80	Prospect mixed; additional inputs required
INDIA	627,000 595,000 237,000	5,266,142 5,821,734	NO Assistance in past, loan, grant technical assistance	Headquarters vertical. Operations conducted by states, mostly integrated	CONTROL (Residual Spray; limited urban malaria control program)	In-depth review-latest in 1970	NO	—	—	Internal costs very high. May have adequate foreign exchange to cover imported commodities
NEPAL	12,834 7,560 7,560	11,670 10,137	YES $4.0 million grant	Headquarters integrated into MOH. Integration in process at district level (6 districts)	CONTROL (Residual Spray; limited larvicide)	YES - conducted annually latest, Feb. 1977	YES - FY 1975-79	FY 75	FY 79	Good. Integration process proceeding slowly. Requires commodity support beyond FY 79
SRI LANKA	14,266 10,554 10,554	400,727 302,946	NO (New project approved $12.0 loan)	Vertical, but moving toward integration at top levels	CONTROL (Residual Spray; some water management)	Situation analysis; annual evaluation planned	YES - FY 77-81	FY 77	FY 81	Very good. Will require limited assistance beyond FY 81
THAILAND	43,239 39,569 39,568	267,534 285,342	NO Assistance in past	Integrated into MOH	CONTROL (Residual Spray)	Latest program review-1974	In Draft	—	—	Program in serious trouble; requires assistance
BANGLADESH	75,155 75,155 38,110	31,247 44,645	NO Assistance in past; project under consideration	Integrated	CONTROL (Residual Spray)	Latest program review - 1976	In Draft	(Included in FY 1978 presentation.		Program in trouble. Special attention and assistance needed in Chittagong Hill tracts, Assam border
INDONESIA (Java-Bali)	134,900 130,375 130,375 (of which 86,251 on Java and Bali)	125,146 71,936	YES $24.8 million loan	Integrated into MOH	CONTROL (Residual Spray)	YES - conducted annually. Latest, July 1976. In depth review now in process	YES - FY 1975-79	FY 75 (New plan for Outer Islands under consideration for FY 80-84)	FY 79	Good on Java-Bali. Needs revision to meet needs of Outer Islands
PHILIPPINES	43,699 13,957 13,957	72,675 72,711	NO Assistance in past	Partial Integration	MIXED (Eradication-7.1 million Control -6.9 million) (Residual Spray)	Latest program review May 1973	YES	—	—	Hard-core malaria areas expanding. Requires assistance
N. VIETNAM	23,700 23,630 23,630	N/A N/A	NO No assistance in past	Integrated	CONTROL	—	—	—	—	Program reported effective. Setting up DDT plant
S. VIETNAM	21,486 17,400 17,400	N/A N/A	NO Assistance in past	N/A	N/A	—	—	—	—	
LAOS	3,365 3,121 3,121	N/A N/A	NO Assistance in past	N/A	N/A	—	—	—	—	Epidemic malaria reported. Apparently no program outside Vientiane province
CAMBODIA	8,237 2,677 2,677	N/A N/A	NO Assistance in past	N/A	Emergency relief-mass drug treatment	—	—	—	—	Epidemic malaria reported
BURMA	30,920 26,720 22,676	11,971 N/A	NO Assistance in past	Integrated	CONTROL (Residual Spray)	—	—	—	—	Program limited to containment in focal areas. Requires assistance if larger area is to be covered.

1/ All figures on malaria incidence are detected cases. Actual caseloads are in most instances far higher.

III. JUSTIFICATION FOR AID SUPPORT

Should there be continued AID involvement in Malaria Control? AID's mission is to help the people of the developing nations correct the growing disparity in real incomes between the "rich" and the "poor" countries. Through both bilateral and multilateral assistance AID is trying to respond to the problems poor people, in the world's poorest nations, face every day. But AID's resources are limited, and so to get maximum results AID focuses its efforts:

1. On priority sectors (agriculture, population, health and education),

2. On the poorer countries (three fourths of U.S. assistance is to countries with per capita incomes of $300 or less);

3. On projects and activities that reach the poor majority directly;

4. On activities that utilize those technological, scientific and material resources the U.S. has a comparative advantage in providing;

5. On projects and activities where the ratio between the overall costs and the benefits to the target group are relatively best (in any case, above a conventionally accepted minimum).

Poor health is one of the most important of these problems faced by the poor. Reduced well-being is one of the major negative effects of poor health but others include reduced productivity and a heightened susceptibility to other disease. These result in still further deterioration of health and productivity. In the countries of Asia, malaria is one of the major factors in poor health. Assistance to properly designed and administered malaria control programs can meet each of the criteria suggested by the five foci of AID assistance listed above. The criteria form a set of necessary conditions for AID assistance under the Agency's current policies, and examination of each of them in turn provides a strong case for continued involvement in the control of malaria and other vector-borne diseases.

Health is one of the four priority areas of AID involvement. The spillover or interaction upon other priority areas is substantial and widely recognized. It is sufficient here to note the commonly accepted correla-

tions between infant mortality and fertility and between better health and performance in education. The relationship to the AID priority area of agriculture arises because productivity in agriculture, which with its related industries employs a majority of the work force in the less developed countries and provides the bulk of their incomes, is strongly affected by health. Malaria is a major factor in the lives of many of these farmers, to such an extent that in many countries it is fatalistically accepted as an unalterable fact of life. This has the paradoxical result that the perceived or felt need for the alleviation of this major scourge is reduced or in some instances, practically non-existent. But despite this lack of perception, the impact of malaria and other vector-borne diseases upon the well-being of this major target group is great. In many Asian countries, periods of maximum debilitation from the disease coincide with the periods of maximum labor demand -- planting, transplanting, and harvest -- a circumstance that magnifies their economic import.

The Asian countries in which malaria is endemic are among the poorer nations of the globe.

Malarial Nations In The Region

Country	1973 GNP/Capita (U.S.$Equivalent)	Country	1973 GNP/Capita (U.S.$Equivalent)
Bangladesh	70	Pakistan	150
India	210	Philippines	270
Indonesia	100	Sri Lanka	110
Nepal	90	Thailand	240

The impact upon the poor majority in the recipient countries is direct and marked. The negative impacts of the vector-borne diseases would fall predominantly upon the poor even if their distribution were random or indiscriminate, for the simple reason that the poor are a majority. However, because of the high correlation between the environmental circumstances of families or individuals and their incomes, the expected incidence of these diseases is greater among the poor majority.

The U.S. has a comparative advantage in providing a range of the external inputs required for a successful malaria reduction and control effort. These inputs available from the U.S. include technical assistance (we have a significant pool of trained, experienced

people created by the U.S. participation in the world-wide eradication effort of the 1950's, military involvement in malarious areas, the number and quality of our health training institutions and the attention we give to organization, logistics, general management and administration), equipment, certain chemical and pharmaceutical supplies and research activity.

Not all of these inputs need be or should be provided to each cooperating country's program. Each proposed program should be carefully examined and the type and form of U.S. assistance determined by the particular circumstances of the proposed program, including the availability of financing or inputs from other donors. (This question is discussed at greater length in Sections IV, V, VI and VII of this report). Here it is sufficient to note that since the U.S. does have a comparative advantage in providing some of the needed inputs, another of the necessary conditions for continued U.S. participation in malaria and vector-borne disease programs is satisfied.

The requirement of a sizeable positive ratio between the benefits and costs of malaria control programs calls for a more detailed exposition. An ideal development project selection procedure would compare the benefit-cost measures of all projects which might qualify for consideration on the basis of their incidence, relationship to priority areas, and other less quantifiable criteria, and after such comparison, select for implementation those with the most favorable returns until the available resources were all allocated. In practice it is impossible fully to compare the very large set of qualified projects, so it has become conventional in AID to exclude all projects with an internal rate of return below 15% and to evaluate the remaining projects on the basis of their over-all impact and their administrative, technical, and social feasibility. Other summary evaluation measures such as the discounted present value of the projects' economic benefits net of all economic costs are also usually examined. But the basic rule remains unchanged. A minimum ratio between the benefits and the costs must be reached or exceeded to justify the use of scarce resources for a given project or activity.

"Cost effectiveness", which in the health program case may be defined as the estimated cost per day of illness or death avoided, is a sometimes more easily calculated and understood measure of economic feasibility. Its application to health problems results in the suggestion that available resources should continue

to be applied to the control of a specific disease or disability so long as the application of resources there leads to the expectation (in the technical statistical sense) of more relief for more people than the diversion of those resources for other purposes. Such calculations are obviously uncertain at best. But it is better that they be made on the best judgment of health professionals, by letting that judgment inform the decision of budget makers, than that budget and resource allocations be made on whim or chance. In assessing whether the benefit-cost ratio criterion (or its surrogate -- cost effectiveness) is met, care must be taken that all of the economic costs are properly attributed. The costs of the surveillance and epidemiological intelligence operations incorporated into a continuing malaria control program may be high, particularly since so much of the needed training, equipment and administrative structure must be newly provided. However, the benefits are not limited to relief of malaria. The surveillance operation will be an integral part of a basic health services structure, and associated benefits arise from the alleviation of a wide range of health problems. Some of these costs should thus be allocated to other diseases, and the aggregate cost of the malaria control activity reduced for analytical purposes.

Annex 2, Economic Analysis of Malaria Control, examines the application of a generally accepted formula for calculating the benefit-cost ratio of malaria control programs to three widely divergent country situations: malaria of catastrophic proportions (Sri Lanka), malaria which threatens a major economic development effort (Indonesia), and malaria which threatens economic gains in which the U.S. has a major investment (Nepal). In each instance, the benefits of the program exceed the costs by a figure well in excess of the "conventional minimum".

AID's future involvement in malaria control will clearly be conditioned by the requirement that the cooperating recipient countries take significant self-help measures. These will have to take several forms---financial, administrative, and logistical. Larger budget allocations and expeditous disbursement for malaria control and other health activities will be major steps.

To assure these self-help measures are taken, AID commodity assistance or support of local costs should be, at least in part, on a reimbursable basis. Some countries receiving assistance may, at least initially,

find reimbursable assistance troublesome. They would be required to spend their own money before receiving AID assistance -- even though they would be doing so against an agreement which assures reimbursement if all conditions were met. The funds for reimbursement would be unambiguously available for disbursement, obligated by the project agreement between AID and the recipient cooperating country. AID (and U.S. Government) regulations normally permit such agreement only in those instances where funds have been appropriated and are available.

Because the cooperating country will be purchasing the inputs and arranging the training and, most importantly, will have a proven, working organization and system of its own in place, there is a better chance that self-help measures will be lasting and embodied in a continuing institution or system. (Annex 4, Reimbursable Assistance, examines in greater detail the range of forms of donor assistance inputs and the degree of implicit donor control. Annex 4 also explores the technique of Output Financing.)

In addition, regular evaluation procedures with provision for feed-back of results into modifications of design and administration of the program should be included.

Of crucial importance is the need to structure AID assistance so that it builds on (or helps create) institutions in the recipient country that will be able to continue to provide health services in a cost-effective manner after the termination of AID assistance. This may require some AID assistance beyond the period needed to reduce malaria from epidemic proportions, but the assistance will still be time-limited and probably inexpensive. The termination of AID assistance should be set by achievement of certain purposes (e.g. a cost-effective system of vector-borne disease control installed and operating) rather than by arbitrary time limits. But it should not be forgotten that as the expected incidence of disease declines, so must the cost of operating the system.. Otherwise cost-effectiveness will be destroyed.

AID's future assistance in malaria control should be as completely integrated with assistance from other donors as the agency can make it without losing effective control over its inputs. The reimbursement technique will help to keep such control. This recommendation for multidonor involvement is not intended to suggest that funds should be channelled through a multilateral or international financial

institution. Instead, it is intended to mean that collaborative, consortium planning and monitoring arrangements should be used.

Finally, the new requirements for environmental impact assessments in the preparation of many AID-financed projects also present an opportunity to reduce malaria incidence--an opportunity that should be fully exploited. Appraisal of proposed construction projects should explicitly consider the impact of design, location and borrow pits upon the incidence of a vector-borne diseases. Ways to build consideration of these factors more firmly into the project appraisal process should be investigated, and implemented quickly if found feasible.

IV. CRITERIA FOR AID SUPPORT FOR MALARIA CONTROL

Between 1957, when the U.S. Government first put its full support behind the world-wide malaria eradication effort, and the present time, changes in policy for providing technical and financial assistance to malaria programs have been necessary. The current AID policy on Malaria Programs was issued on July 3, 1973 (AIDTO Circular A-733). This policy was established following the recognition by the World Health Assembly that complete eradication of malaria was not possible in some areas within the foreseeable future and that malaria control should be the goal for such areas.

The reorientation of existing malaria programs from eradication to control involves a number of considerations not previously encountered. The most important of these are:

1. The goal of antimalaria programs has to be changed from a total, permanent interruption of transmission of the disease to the reduction of its incidence to a tolerable level at which it no longer constitutes a major public health problem. However, the degree of tolerance, in terms of morbidity and mortality, has been left undefined.

2. Malaria control operations, to be cost-effective, have to be concentrated in those parts of a country where endemicity is at the highest level and where its impact on the health or economy of the population is greatest. The difficulty in delimiting such priority areas is obvious, not only for social, economic and political reasons, but also because endemicity above a certain degree has a greater effect on infants and children than on the whole indigenous community.

3. Acceptance of the malaria control concept has been slow in some areas because, in contradistinction to malaria eradication, it held no promise of rapid, permanent relief but had to be planned as a long-term, continuous and un-spectacular commitment, not likely to generate much enthusiasm and demanding a great deal of steady devotion to a very distant goal.

4. Considerable uncertainty exists concerning the organization for malaria control. Is a vertical, target-oriented, mass-campaign type of organization required or can the responsibility for

control operations and surveillance activities be adequately carried out by the basic health services? The latter might give malaria control the broad basis that it requires but lack the driving force which has been characteristic of the mass campaigns. A policy judgment on organization cannot easily be made in the absence of a careful country-specific technical evaluation of the extent to which malaria constitutes a problem and the degree to which the basic health services have been prepared to deal with the problem.

5. A most important consideration is whether the technical and financial assistance of international and bilateral agencies, so generously provided to the malaria eradication programs, would continue to be available for malaria control. Uncertainty has arisen because most donors find a long-term aid effort unattractive. Specific short-term results are sought, with foreign aid seen as a series of a specific efforts aimed at specific problems amenable to quick, or at least time-limited, solutions.

Section VI, Organization for Malaria Control, deals with the first four of these points. In respect to point 5, and as it concerns AID, AID's current policy on malaria is set forth in AIDTO Circular A-733, July 3, 1973, a document which also establishes the criteria for considering assistance to country malaria programs.1/ The policy and related criteria are in most respects sound; with a few adjustments, the policy should continue to be effective for the foreseeable future. The Study Group recognizes that its terms of reference do not extend beyond advising the Asia Bureau; it nevertheless recommends AID consideration of certain clarifications of its present policy.

Section III, Justification for AID Support, sets forth in detail the extent to which support of antimalaria efforts reflects the New Directions orientation of current and future AID programs. It is sufficient at this point to observe;

1/ Annex 3, AID Policy on Malaria Programs, extracts AIDTO Circular A-733, including both the policy statement and the criteria for considering assistance to country malaria programs.

(a) that in those countries where malaria is a major public health problem (including all of the countries of the Asian Region), malaria has an inseparable impact on each of AID's priority sectors -- agriculture, population, health and education -- and, in fact, on all aspects of socio-economic development;

(b) that malaria strikes hardest in the poorer countries (none of the countries in the Asian Region has a per capita gross national product as high as $300);

(c) that malaria has its major impact on the poor majority, and, equally significant, malaria mortality is highest among the very young -- infants and children below the age of 14;

(d) that the U.S. has a comparative advantage in providing many and even most of the technological, scientific and material resources required to control malaria;

(e) that benefits of malaria control to the target group are high in relation to the overall costs.

The Study Group believes that AID's policy on malaria (and/or its implementing criteria) should deal specifically and explicitly with eight major points.

1. The Extent to which Malaria Constitutes a Major Problem. AID should be prepared to consider assistance to country malaria programs in those instances where there is a critical need to protect a substantial U.S. investment in terms of gains already made or a need to prevent malaria from becoming a deterrent to other country development programs.

2. The Nature of the Country's Preliminary Preparation. AID should be prepared to provide selective assistance to national antimalaria efforts on a case-by-case basis. As a precondition for consideration of such assistance, AID should insist that the country demonstrate its own interest in and concern about malaria through the development of an appropriate plan to control malaria and the provision of an adequate budget and staff to carry out the country program.

   The malaria plan should be technically, administratively and financially sound -- as determined by AID after review of the recommendations of a

joint WHO/LDC evaluation team. At a minimum, the plan should describe:

(a) the broad strategy to be adopted to reduce malaria incidence to a level where it no longer constitutes a serious public health problem, and the range of tactics to carry out the strategy. Specifically, the technical strategy will control the need for resources and external technical advisory assistance and enable assessment of organizational efficiency.

The plan should make provision for the utilization of various methods of malaria control supplementary and/or alternative to the use of residual insecticides, as appropriate for the individual country; should include a plan for urban malaria control; and should provide for the installation within the host government of a cost-effective system for continued control after malaria incidence has been reduced to a predetermined acceptable level.

(b) the organization through which the plan is to be implemented, including staffing requirements.

(c) the nature of and provision for meeting national training and research requirements.

(d) the extent of national budgetary support for the life of the project.

(e) foreign financing and staffing requirements for the life of the project.

(f) provision for regular, continuing program evaluation.

In this connection, the Study Group notes with approval the impetus and assistance provided by AID and WHO to Sri Lanka in its successful efforts to produce such a plan. Significantly, the degree of forward planning played a major role in the successful elicitation of multidonor funding which characterizes the Sri Lanka program.

One of the first actions which AID might undertake (with WHO) in any country which requests support of its antimalaria effort is to provide assistance to the country in getting its long-range plans in order -- in part because this is essential to the realization of a multidonor effort.

(3) The Extent of Internal Resource Mobilization. As is noted in item 2, above, AID should insist that the country demonstrate its own interest in and concern about malaria not only through the development of an appropriate plan to control malaria but also through the provision of an adequate budget and staff to carry out the country program.

(4) Exploration of External Financial Support. AID should also insist that, in addition to the mobilization of available internal resources, there must also be a systematic exploration of external sources of assistance. (This topic is more extensively developed in Section V, Mobilization of Financial Assistance).

(5) The Nature of AID Support. AID should not restrict itself to a particular input or class of inputs. AID should be prepared to provide those kinds of support which, taken together with inputs of other donors and of the recipient country, will make possible the successful implementation of the plan. Such inputs will include commodity support, funding of training and research when essential to the success of the program, funding of a portion of local costs in special cases where appropriate, and cooperation with WHO on evaluation of malaria programs. In some cases, it may be desirable to provide direct technical assistance. (See item 6 below).

In each case, AID inputs should to the extent possible be concentrated in areas emphasizing those technological, scientific and material resources in the provision of which the U.S. has a comparative advantage. In the case of multidonor-supported malaria programs the areas of U.S. comparative advantage may vary, depending on the composition of the multidonor consortium.

(6) Technical Advisory Services. For the most part, AID should rely on WHO to meet the primary needs of the individual country malaria programs for specific scientific advisory services, including the assignment of advisers as required in such specialties as malariology, epidemiology, parasitology, sanitation, engineering and health education.

It must be noted, however, that WHO has not been uniformly successful in providing the full range of scientific advisory services required. The

Study Group is informed that WHO has "arranged" for the Netherlands to provide an essential engineer in Indonesia, and that the U.K. is providing a transport specialist in Sri Lanka. General reliance on WHO to provide technical expertise should not constitute a strait-jacket under which AID would be precluded from providing a technical advisor whose skills might be imperative to program success.

(7) On-Site Representation. AID should provide a technically qualified and experienced AID officer in each malaria program receiving AID support, to assist in the technical project monitoring aspects of the program and in the management of the pesticides used in this project.

The suggestion has been advanced that the resident advisor be a generalist who could, in addition to the foregoing responsibilities, provide assistance on O & M and related implementation needs, assess progress, and support reporting and information exchange activities between the country and regional or international malaria surveillance networks. The Study Group emphasizes, however, that the AID officer should be a generalist only in the sense that he has a broad knowledge of all aspects of malaria control. Further, regularly recurring evaluations should be undertaken by a combined group of officials from the country concerned and external experts from WHO and other international sources, including AID. The Study Group considers such systematic, continuous, dispassionate expert international appraisal of results achieved, problems faced and improvements required to be vital to the success of malaria control efforts.

(8) Regional and/or International Training. For the reasons set forth in Section VIII, Training Requirements, AID should itself support and actively encourage the support of other concerned bilateral and international agencies for the development of a center for regional and/or interregional advanced and intermediate training and research in the control of malaria and other vector-borne diseases.

While major AID support to country malaria programs should (even for multidonor-supported programs) constitute an element in bilateral AID assistance to the countries concerned, AID support of the regional training center (or centers)

should stem from regional funds, making it possible to provide essential training and improve both planning and execution of malaria programs in countries which are not receiving bilateral AID assistance.

V. MOBILIZATION OF FINANCIAL ASSISTANCE

As far back as 1955, the member governments of the World Health Assembly directed the World Health Organization to provide technical advice, increase research and coordinate resources to implement a global malaria eradication program; to seek financial contributions for research, supplies and essential advisory services. Most of the resources for the Special Malaria Eradication Funds set up by WHO (and PAHO) were in fact supplied by the U.S.; additionally, AID (and its predecessors) provided technical assistance, training and funds for supplies and equipment on a bilateral basis. UNICEF also provided supplies and equipment (and even technical assistance in vehicle maintanance) for malaria projects in other countries, enabling WHO to avoid financing of national projects. WHO concentrated on providing technical aid in the planning and operation of malaria programs, training of personnel, establishing specifications for insecticides and chemotherapeutic drugs, evaluation of program progress and research on special problems. While the kinds of advisory assistance and training assistance required modification as programs moved away from eradication and toward control, the functions assigned to WHO have continued as before.[1/]

Some of the functions were given only nominal attention. For example, research was down-played during the years of euphoria, when eradication programs based on one residual spray, DDT, were so successfully reducing the incidence of malaria. One of the most damaging effects of the malaria eradication effort was that it was generally considered to be the revealed truth, the last word; for that reason, it had the effect of precluding a generation of research--a gap which became evident when the techniques of eradication proved to be inadequate to deal with the technical problems and ecological changes which have contributed heavily to the resurgence of malaria.

Further, the eradication effort had produced a generation of men trained in one technique of dealing with malaria, with consequent lack of attention to needs for epidemiologists, entomoligsts and sanitary engineers. If malaria eradication failed to eradicate malaria, as a current aphorism puts it, it succeeded in eradicating trained malariologists.

If some of WHO's functions received nominal attention, one received almost none: the charge by the World Health Assembly to seek contributions of and to

1/ Including funding from UNDP and UNEP, WHO's 1976 level of support for malaria programs approximated $9 million.

coordinate resources to implement malaria programs. The function was discharged by making requests for contributions to the Malaria Eradication Special Account, to which the U.S. was the only major contributor, and which, with the cessation of the U.S. input, has become virtually moribund. For a time the effect of this passive approach was obscured by a combination of heavy AID financing and by UNICEF contributions to malaria programs. As AID support of malaria programs has declined and the UNICEF support terminated, the lack of a body to stimulate and coordinate support of LDC malaria control efforts has become apparent. WHO has yet to develop a systematic approach to elicit and coordinate the support of bilateral donors, or even to bring to the attention of potential donors such well-planned proposals as are deemed to require and warrant external support.

On its own initiative, Sri Lanka recently prepared (with AID and WHO assistance) a five-year program which is considered, on the basis of an internationally staffed in-depth review, to be technically, administratively and economically sound. The Sri Lankan government approved in principle a five-year budget for the project, assigned malaria control its top priority for external assistance, and then sought assistance from a number of the governments of the countries which have resident diplomatic representation in Colombo. Three countries (including the U.S.) have responded favorably.

Such an approach is of course possible in other countries, although some may lack the sophistication displayed by Sri Lanka. It would be preferable if WHO, already charged with the responsibility for coordination of resources for antimalaria programs, could be induced to discharge that responsibility.

Recommendations:

At the WHO/AID/USPHS Malaria Coordination Meeting, to be held in Geneva on December 8 and 9, 1977, the subject of mobilization of external financial assistance to soundly planned and internally supported malaria control efforts should be placed high in priority on the agenda.

WHO has reservations about the use of such coordination mechanisms as the World Bank (IBRD) and the Asian Development Bank, of which some potential donors are not members; yet wishes to enlarge the number of potential donors. At the same time, WHO officials assert they have no way to determine the interest of

potential donors in supporting malaria control The Study Group is informed that WHO is prepared to welcome a full exploration of the subject. AID should take steps to assure that the mobilization of financial assistance is assigned high priority at the December Meeting.

Subsequently, there should be a second meeting, to which should be invited, in addition to the membership of the existing Malaria Coordinating Group (WHO, AID, USPHS), such potential donors as Australia, Canada, Germany, Great Britain, Japan, the Netherlands, New Zealand, Switzerland, the Scandinavian nations, together with UNICEF, UNDP and PAHO. Furthermore, there is no readily apparent reason to exclude potential Eastern European donors or the petroleum exporting nations, and a number of the foundations could, at a minimum, be expected to take an interest in operational research and pilot projects.

There is no valid reason why AID should predicate its own favorable response to a request for support of a malaria control program upon a demonstration of prior negative responses from other potential donor nations. The donor (or lender) nation of last resort can find itself left with only requests from countries whose proposals offer the least likelihood of success. To the extent possible, it appears preferable to combine the several kinds of assistance to a malaria control program which may be available from different sources in support of a comprehensive, integrated attack on the problem, especially since all donors will presumably place primary reliance on WHO for supplying the bulk of essential technical support. The recent request by Sri Lanka for assistance in support of its program of malaria control, to which the United States, the United Kingdom and the Netherlands have given a favorable response, is a case in point.

Whether or not it proves possible to elicit support of malaria control programs from other donors on a continuing basis, the prerequisites for further AID assistance to malaria programs should be those outlined in Subsection C of the Summary and Recommendations and more fully examined in Section IV, Criteria for AID Support.

VI. ORGANIZATION FOR MALARIA CONTROL

It is readily apparent that, entirely apart from the technical difficulties which have beset malaria programs throughout Asia, a key problem in many countries is organizational structure. This structure must be selected to conduct a program which is not time-limited, which is not applied throughout the entire country and which may vary in methodology and completeness of its application from one area of the country to another.

The Study Group is under no illusions that there is any single organizational structure which would prove to be universally applicable to all countries where AID is (or may be) supporting national programs of malaria control. Individual "states" and provinces in countries like India, Pakistan or Indonesia may deal with the problems of populations greater than the entire population of Nepal or Sri Lanka; each of the 72 zones into which India's basic health service is divided contains an average of about 9 million people. Moreover, the kind of organization required depends a great deal on the nature and incidence of malaria in the country in question.

Initially, in conformity with WHO recommendations, the operations of most if not all malaria eradication programs were centrally directed, centrally planned and centrally funded; their staffs were (in relation to basic health services) better equipped; they enjoyed a privileged status, with virtual or actual autonomy. But their function was believed to be time-limited, and their employees were not tenured civil servants.

With the rapid drop in malaria incidence, the cost of the effective but expensive vertical structure led many countries to devolve the residual responsibilities for surveillance to officials of the basic health services, frequently untrained, without an understanding of the importance of their new functions, and often with a built-in resentment of the autonomous and frequently more liberally funded malaria eradication programs. While WHO had by 1969 come to advocate the integration of antimalaria programs into basic health services, and many WHO officials still follow that line, others are having second thoughts, at least with respect to timing. The Regional Director of SEARO, addressing a 1976 meeting of experts to review the malaria situation in the region and to suggest suitable measures to

deal with the resurgence of the disease in Asia, took the occasion to caution against premature integration of antimalaria activities into the general health services.

The shift in strategy in Asian countries from malaria eradication programs to long-term malaria control operations suggests the need for an examination of program structure, organizational placement, and administrative relationships for continuing antimalaria activities.

With these points in mind, the Study Group sought to identify the characteristics which, embodied in the organizational structure of a malaria control effort, seemed essential to success in any country where malaria is a serious public health problem. First is the necessary training. Precipitous transfer of functions and authority to persons not trained to handle them has been the rock on which many antimalaria efforts have foundered. Another pitfall is the desire to do too much with too little; while there are undoubtedly real savings possible from integration, planners and administrators must not fall into the trap of achieving them at the cost of program failure.

What is needed is an essential combination of central planning and decentralized implementation, maintained in an organization of sufficient strength to seek and secure funds, yet sufficient flexibility to permit prompt, decentralized decision-making in response to epidemiological data; a career service, supported by casual-labor employees as necessary; and criteria for a time-phased devolution of specific responsibilities to general basic health services while retaining as long as necessary responsibility for operational activities in an entity capable of directing programs of concerted action. The Study Group believes that the organizational structure through which a malaria control effort is planned and conducted constitutes an element in the administrative feasibility of any program, including programs for which AID financial support is sought, and should be examined carefully in AID's review of that program prior to the decision to provide such support. The Study Group notes, however, that a policy judgment on organization cannot easily be made in the absence of a careful, country-specific technical evaluation of the program which the organization will carry out.

In considering these issues, the following points are significant:

1. The change in objective (and terminology) from eradication to control should not be interpreted to mean that malaria in Asia is less important now than it was during the so-called eradication programs. The very intractability of the disease has brought about the discontinuance of the eradication effort. The relative success of the eradication efforts has allowed shifts in populations to previously highly malarious areas and has increased expectations of the populace for protection against malaria. In many areas, control is far more important now than was the case prior to the eradication effort.

2. In almost all of the Asian countries of concern in the report, malaria is not now under control; rather, the situation is such that intensive efforts must be undertaken quickly, aimed at major reduction in malaria incidence.

3. The complexity of operations required for an effective malaria control program is equal to or greater than that characteristic of an eradication program.

Changes from organizational patterns established for the eradication programs should be considered, therefore, in terms of achieving a greater effectiveness in dealing with a serious malaria problem.

Although many national malaria eradication programs were established initially as essentially autonomous organizations (in conformance with WHO recommendation), in recent years this arrangement has been changing as the countries have begun shifting to control operations. In a number of countries, antimalaria activities are now operating programs under Communicable Disease Control Directorship within the Ministries of Health. The Study Group considers this to be entirely appropriate if program effectiveness is not jeopardized.

Control measures directed at the mosquito (residual spraying, ULV dispersal, larviciding, and source reduction) usually require methodical planning and execution and involve collection and analysis of voluminous field data by engineers and entomologists, appropriate scheduling, deployment of manpower, supplies, and light and heavy equipment, and, in some cases, agreements at ministerial levels. Such requirements dictate, especially in periods of rising and geographically widespread incidence of malaria, that such control measures should be organized and directed by means of a vertical structure with,

however, as much decentralization of operational decision-making as is consonant with effective and effective operations.

In contrast, malaria control measures related to the detection and handling of cases of malaria can be appropriately integrated with existing general basic health services, at the periphery and at higher echelons. This has the advantage of multiple utilization of health workers, reduced duplication of supporting services, and in some cases, greater job security and opportunity for promotion leading to improved morale and performance. Malaria control, as a continuing program, requires a higher degree of community acceptance, involvement of community leaders and participation by the population at large than does a time-limited, highly-structured eradication program. Promotion of community participation in malaria control activities should be an integral part of the programs at the peripheral level.

With the above considerations in mind, the Study Group has reached the following conclusions:

1. Malaria control should be an integral part of National health planning in Asian countries.

2. Malaria control programs should be organized at as high a level as is required to assure cost-effective achievement of program goals.

3. Malaria control programs integrated with other communicable disease control activities should have organizational identity and designated allocations of funds. Organizational identity means that there must be room for professional recognition of specialists and provision for their promotion in responsibility, pay and status.

4. Malaria control operations aimed at the mosquito vector (e.g., residual spraying, larviciding and large-scale source reduction measures) should be organized vertically until the incidence of the disease has been reduced to a level sufficiently low that effective control can be maintained with a minimum of central direction.

5. Where (and when) general basic health services are adequately developed and effectively functioning, malaria control operations related to epidemiological investigations, distribution of drugs, health education and, ultimately, vector control can be devolved to the local health

infrastructures.

6. Community participation should be promoted in source reduction measures, passive case detection, drug distributions, some spraying operations, and health education activities.

VII MALARIA CONTROL TECHNIQUES

In view of the change of strategy from one of malaria eradication to one of malaria control which has occurred in the country programs in the Asian Region in recent years, it may be well to review briefly the antimalaria measures currently employed and those which will come into play in the near future. Still other malaria control measures, also under development, show promise but will not be available in the near future. These are discussed in Section IX, Research Needs and Priorities.

With the adoption of the principles of malaria control, rather than time-limited eradication, there is some tendency to believe that the task will in some respects be less demanding. This certainly is not the case; if anything, the varying methods to be applied and the selection of the proper methods for a particular vector and ecological situation may be far more demanding, and require considerable additional training of a broader typed. This issue is dealt with in greater detail in Section VIII, Training Requirements.

A. Anti-Vector Measures

1. Residual Spraying

While the intensive malaria control methods carried out in the United States and other western countries in the period up to World War II and immediately thereafter produced excellent results, they could not easily be applied to many tropical areas. The advent of DDT presented the world with a new method of interrupting the transmission of infection by attacking the mosquito vector during its epidemiologically most important stage -- when it feeds on man in his dwellings.

The epidemiological concept of the interruption of malaria transmission by insecticide spraying is simple. After taking her blood meal, the female anopheline mosquito generally rests on a nearby indoor surface for several hours while the blood is digested and a batch of eggs matures. The mosquito feeds every two or three days and the malaria parasite, after being ingested with the blood, requires ten to twelve days for its full development to the infective stage.

Spraying all interior wall surfaces with a long-lasting insecticide like DDT would therefore create conditions in which a substantial proportion of anophelines would be killed before they could transmit malaria.

It should be noted that the concept did not involve the eradication of all mosquitoes capable of transmitting malaria. Rather, it involved the killing of those mosquitoes which had bitten a malarious person, and which were therefore infective. By curing the diseased individual (through the use of antimalarial drugs) and preventing infection (by killing mosquitoes within domiciles) the transmission could be interrupted.

This deceptively simple concept depended for its effectiveness on the killing power of the residual insecticide. However, mosquitoes able to survive after resting on a sprayed surface normally lethal to the species would pass on to succeeding generations their capacity to resist the effects of the insecticide.

The development of resistance to DDT was noted (in house-flies) as early as 1952, and the entire concept of malaria eradication in the early 1950's was keyed to the speedy achievement of a permanent interruption of transmission while DDT remained effective.

The wide-spread use of DDT as an agricultural pesticide had the side-effect of reducing mosquito populations, but in the process, it accelerated the development of resistant strains. As a result, DDT became decreasingly effective as an indoor insecticide; in some areas, mosquitoes are able to tolerate any quantity of the material.

Other residual insecticides were developed -- lindane, dieldrin, propoxur, malathion, fenitrothion and others. Each in its turn proved to be initially effective, but in some areas mosquitoes have now developed resistance to them. As with DDT, the newer insecticides were used as agricultural pesticides, increasing enormously the pace of resistance development.

Environmental concerns have led in some countries to the virtually total abandonment of DDT and many of its successors for agricultural purposes, and the widespread use of persistent, broad-spectrum insecticides may be nearly over for agricul-

tural purposes. Abandonment of these tools for disease-control purposes would be premature. Total reversion to the older principles of disease control would mean protection of a much smaller percentage of the population, and, in particular, acceptance of a very high rate of infant mortality.

The facts of life on vector resistance are chilling: there are no known chemical or microbial vector controls to which vectors have not or may not be expected to develop resistance. Nevertheless, insecticides remain the most useful tool in short-range malaria control; most programs report that resistance is growing but is not yet crippling.

One further problem is the rapid decrease in interest among private producers in developing new insecticides. The costs of developing, testing and securing U.S. Government acceptance for use of any new pesticide have risen astronomically; without the attraction of high-volume sales for agricultural purposes, private producers cannot afford the research and development costs for the limited disease-control market. The U.S. Government may have to support insecticide development as it becomes too expensive for private firms.

In the country programs in South and Southeast Asia residual spraying of dwellings continues to be the primary method for vector control; the Study Group anticipates that this will continue to be the case for the foreseeable future. As noted in Section IX, Research Needs and Priorities, the problem of vector resistance to insecticides continues to expand and become more serious in the Region. However, there remain significant areas where DDT is effective, and other pesticides, such as malathion, remain available, despite possible problems associated with their use. The shift from time-limited eradication to control does not in itself lessen the requirement for residual spraying, nor for the meticulous application of the sprays. It may be expected, however, that total coverage of the malaricus areas of countries may be supplemented by a stratified approach, where country-wide residual spray campaigns give way to selected spraying in areas of the most intensive transmission, with other measures being employed as practical.

2. Larviciding

Since the pre-World War II era there have been relatively few antimalaria programs in which anti-larval measures played a significant role. In the early part of the century, before development of the residual insecticides, larvicides played a central role in many anti-mosquito and antimalaria campaigns, in combination with source-reduction methods. The work of Gorgas in Havana and Panama with oils, and the use of Paris Green by workers in the United States, are outstanding examples. Brown, et al. (1976) have summarized the more recent applications of larvicides in malaria control campaigns of field trials, particularly in the Middle East, Nigeria and El Salvador. It may be anticipated that larviciding, with the safe, biodegradable pesticides now available, such as temephos, (Abate) will play an increasing role in antimalaria campaigns. So, too, may some of the more economical of the available oils. It must be reemphasized here, however, that application of larvicides demands a much more sophisticated approach than residual spraying of domiciles, and a much higher level of training for field personnel and supervisors than has heretofore been available. Even with the very safe larvicides now available, the application to aquatic habitats makes it essential that trained entomologists exercise at least frequent supervision. Where AID supports or cooperates in a country program involving pesticides, particularly larvicides, it is important that a trained professional be available for rapid consultation.

3. Imagociding (Space Spraying, ULV Operations)

One of the earliest demonstrations of malaria control, reported from South Africa by Park-Ross and DeMeillon (1935), was based on the use of pyrethrum space spray to eliminate Anopheles gambiae from native huts.

There were other early examples, limited to in scope. The technique has been almost totally ignored as a public health measure since the development of DDT and later synthetic organic pesticides.

Recently, the development of vector resistance to residual insecticides has led to a revival of interest in the space-spray method. Some work

has been done on space-spraying in India and Indonesia, including the use of back-pack ultra-low volume (ULV) apparatus. The discovery of synthetic pyrethroids offers new and promising possibilities in this field.

Of particular importance for the future may be the use of malathion in the form of an aerially dispersed ULV formulation in India (Jodphur), Haiti and Panama (Brown, et al; 1976). While too expensive for routine use in antimalaria campaigns, this method may offer particular promise for the interruption of epidemics.

In most cases, space spray and ULV spray applications represent a potential supplement to rather than a replacement for residual spraying. There are, however, circumstances (particularly during epidemics) when both space spraying and ULV applications of spray may play primary roles in the rapid reduction of adult Anopheles populations.

While the technology for the use of the space spray method is presently available, considerable field evaluation and pilot study remain to be done before this method can be shown to play an important and cost-effective role in the reduction of malaria to acceptable levels.

4. Source Reduction and Water Management

The work of Sir Malcolm Watson in Malaya, Gorgas in Panama and others in habitats as diverse as Italy, Indonesia and the United States long ago demonstrated the value of source reduction in antimalaria campaigns. The work of the Tennessee Valley Authority in the United States is a particularly important example of what can be achieved in the field of Anopheles control by source reduction and water management techniques. As with larvicides, however, much of this technology was ignored or forgotten in the face of the initial successes with DDT and the other residual imagocides. There are, however, many anopheline vectors whose populations may be reduced drastically by the application of engineering techniques. These may be as simple as the application of hand tools to clear a drainage ditch and as complicated as the regulation of water flow through a major dam, or the construction of tide gates. The essential feature in all cases, however, is that the method chosen must be tailored to the ecology of the particular vector species, the character-

istics of the habitat, and the local situation. Just as the use of larvicides require a much more sophisticated set of workers than residual spraying, source reduction may advance the requirement for training to an even higher level. This is not to say that there are not many habitats which can be reduced by the simplest hand tools, and with relatively little training. Much could be achieved against some Anopheles by village self-help teams, with relatively little supervision. More often, however, significant gains from source reduction will require engineering advice and supervision, if for no other reason than to prevent the creation of problems greater than the one which the source reduction effort is attempting to solve. Improperly designed drainage systems may provide more breeding sites for mosquitoes of a more dangerous species than is to be found in the swampy areas they were designed to drain. Brown et al. (1965) cite only one example of a source reduction attempt in recent years, against Anopheles albimanus in Haiti. Some experimental source reduction efforts have been directed against the same species in El Salvador; there appear to be some opportunities for application of this technique against An. stephensi in Karachi (Carmichael, 1972); and Sri Lanka reports successful water management efforts in 1977.

It may be anticipated that source reduction and water management will play increasing roles in malaria control campaigns, despite the relatively high initial cost of some of these techniques. In the long run, as control campaigns must be considered, they will often prove to be cost-beneficial despite the higher initial capital investment. Given this possible increase in employment of such techniques, AID would do well to sponsor additional training for civil and sanitary engineers in the techniques of anopheline control through engineering methods. In addition, where source reduction or water management techniques play a significant role in a country program receiving support from AID, some method should be found for at least periodic review of the methods and results by a trained source reduction specialist.

In the same vein, the training of civil and sanitary engineers should include Anopheles control, with stress on the importance of an entomological input into the planning of irrigation

and other developmental engineering projects, regardless of the particular ministry responsible for planning and implementation of the project.

5. Biological Control

While there has been an increasi nterest in the possible use of such non-ins cidal measures as the use of predators and para s and genetic manipulations for Anopheles contro , relatively little is presently available. Possibly the sole exception is the use of various species of larvivorous fish, particularly Gambusia. This is an old technique, first developed to a considerable degree in the Southern United States. Brown, et al (1976) review the current use of this technique in antimalaria programs and extensive references to Gambusia have appeared in recent years. Currently, there are a number of attempts to adapt and culture native fish species for various malarious areas to play the same role as Gambusia, with some success. One objection to the widespread use of Gambusia is some environments is their disastrous effect on other fishes, including the fry of valuable food species. This may somewhat limit the use of Gambusia and its analogues to Anopheles habitats where there is no danger that they will interfere with valuable fish species. Nevertheless, there appears to be ample opportunity for application of the technique and its use should be encouraged, at least in pilot demonstrations.

As noted above, none of the other alternative measures under study today appears to be nearly ready for use. These include a wide range of pathogenic protozoa, fungi, bacteria, etc., and non-piscine predators. Also under study are various genetic mechanisms such as lethal translocations. lethal genes, use of sterile males and other manipulations. These are more properly discussed under the portion of the report dealing with research, and it is problematical how many of them may become available for field control operations in the next five years, if ever. Nevertheless, given the present state of insecticide resistance, drug resistance, etc., research in these areas certainly should be encouraged. It would be unwise, however, to promote the idea that some sort of "magic bullet" is about to appear in one of these areas that will solve the malaria problem.

B. Anti-Parasite Measures; Chemotherapy and Chemoprophylaxis

Antimalarial drugs have always played a role in the management of the disease, on a clinical and public health basis, at least since the European discovery of the value of Cinchona bark in the 17th century and the isolation of quinine two centuries later. In the eradication campaigns drugs were employed most abundantly during the consolidation phase. The appearance in Asia of resistance by one species of the malaria parasite (P. falciparum) to the effects of chloroquine, the antimalaria drug most widely used, and subsequently to other drugs, coupled with the change in philosophy from eradication to control, will influence greatly the pattern of drug employment. Drug therapy will without question be used for treatment of those presenting themselves at primary health service units with a presumptive or confirmed diagnosis of malaria.

But beyond this, drugs will be widely employed to reduce mortality in areas where it may not be possible to bring about the desired reduction of disease. In India, for example, where the malaria caseload is unofficially estimated to be as high as 25 million, the current program relies heavily on antimalarial drugs; India produces 150 million chloroquine pills per year, and imports the powder and pelletizes another 1,050 million. Drugs are dispensed through the presidents of the locally elected panchayats (village councils), who are instructed (for one day) on how to recognize malaria, how to treat it, and when to call a physician. Additionally, drugs are dispensed through ayurvedic practitioners; through school teachers; through government-recruited individuals in the tribal areas (where other control methods are minimal or non-existent); and, of course, through the auxiliary nurses at primary health centers and subcenters. The drug program is popularized by radio, television and posters; the pills are packaged in cans labeled in English and 15 other languages, describing symptoms, dosage and precautions. The most recent distribution technique is to use the omnipresent contraceptive dealer, already subsidized under the Family Planning Program, who sells a packet of four tablets for about ten cents. India is currently using a third of all the chloroquine produced in the world.

In Thailand, where the problem of drug resistance is more wide-spread and chloroquine is less effective, Fansidar (the most effective generally available antimalarial drug) has been reserved by the National Malaria Eradication Office as the drug of last resort, to prevent the development of resistance. But the private sector is itself importing 13 million tablets of Fansidar annually; the pills are available in every drug-store, and parasite resistance to Fansidar may be developing. Since serious malaria control in Thailand, including surveillance, is largely limited to hill, forest and border areas, case detection is limited to only part of the country, and reported malaria incidence figures are meaningless. There is simply no way of knowing how many cases of malaria are present in Thailand, and wide-spread use of anti-malarial drugs seems certain to be a major factor in Thailand's control efforts.

In sum, the patterns of employment of chemoprophylactic and chemotherapeutic agents in malaria control programs remain to be developed in detail. Chemotherapeutic agents will certainly be employed as a primary measure during epidemics or seasonal exacerbations, but beyond that, until the incidence of malaria can again be reduced to more tolerable levels through preventive action, the national malaria organizations or the people themselves will rely heavily upon the curative action of antimalarial drugs. Since resistance to the effects of the presently available drugs can be expected to grow, and since there are very few potential substitutes on the horizon (see Section IX, Research Needs and Priorities), the incidence of malaria must be reduced while antimalarial drugs remain effective.

C. Locus of Decision

In malaria eradication programs the program elements were decided at the central level. Even minute details of the operational program were often directed from above and relatively few decisions were required at the lowest operational units. Admittedly, there were deviations, dictated by local conditions, but in general, success were considered to depend on adherence to a set pattern.

In malaria control programs, however, the essence of strategy is to use a combination of methods, the choice to be made to suit the local situation.

Within a single country, for instance, there may be areas where an anopheline vector is particularly susceptible to one method of attack (such as source reduction) whereas in other parts of the same country, source reduction may be relatively ineffective due to the multiplicity of sites, or to the presence of a different vector. Furthermore, the situation may vary considerably from season to season and year to year.

Thus it is important under a control rubric, employing all appropriate means, that decisions on the choice of methods be made as close to the site of operations as possible. With any extensive malarious area, however, this might pose an almost intolerable burden in supplying the highly trained personnel who would be needed. Other sections of this report have drawn attention to the requirements for additional training at all levels in order to operate a multi-faceted malaria control program. Just how far this can be carried -- that is, the provision of highly trained technicians capable of making choices as to the best and most cost-effective among alternatives--remains to be seen. A more practical alternative would be provision of reasonably well trained local personnel operating under the direction of more highly trained provincial or regional technicians and professionals. Whatever approach is taken, the decisions on choice or combination of methods must be made as close to the site of operation as possible.

Inevitably, some broad decisions will have to be made at higher levels, particularly in the choice of equipment, commodities, etc., and central procurement offers the potential of economies of scale. Until the incidence of malaria is brought down to and maintained at a tolerable level, some elements of vertical control must be retained.

Recommendations

It is apparent that, in addition to insecticides, a considerable range of tactics is available for use in the control of malaria vectors. For some, utility and effectiveness are well-established (source reduction; the use of larvivorous fish); others are more limited in usefulness (larviciding); still others are in early stages of evolution and evaluation (pathogens, predators other than fish). All are useful or potentially useful tools which

can supplement the principal existing techniques of malaria control: residual insecticide spray and antimalarial drugs. It is the view of the Study Group that there is in the near future no alternative to the use of insecticides in the strategy of controlling malaria vectors. The Study Group anticipates the gradual emergence of an integrated approach to malaria control (and, indeed, to the control of other vector-borne diseases), using a variety of control tactics as appropriate to the epidemiology of the disease, the behavior of the vector, the terrain and the environment. To the extent possible, choice of tactics should be based on cost-effectiveness and maximum benefit. The goal should be reduction and containment of malaria, carried to the point of eradication where feasible, but without the time limits which characterized the earlier eradication programs.

Implementation of control plans which rely upon a selection of the most beneficial and cost-effective among alternative methods will increase the need for applied research efforts; the Study Group recommends continued and expanded support of operational research.

VIII TRAINING REQUIREMENTS

From the early days of malaria eradication it was agreed that good leadership is an essential factor in achieving success. Although the quality of leadership is related to the individual character of the leader, it can be built up by appropriate technical training and clear lines of delegation of responsibility within the system. Eradication programs throughout the world have been greatly assisted by the support given by WHO, by other U.N. agencies, and by AID to both international and national training centers.

The first International Malaria Eradication Training Center was at Kingston, Jamaica, where nearly 500 medical doctors, entomologists, sanitarians and other professionals received their malaria training. In 1963 the International Malaria Eradication Training Center in Manila, Philippines replaced Kingston as the main training establishment. The Manila Center trained 1,350 professional and technical personnel during the ten years of its existence. It was supported financially by AID, but this support ended in 1971 with a terminal grant for two additional years.

The Center was closed in 1973 in spite of the arguments of WHO which pleaded in favor of its continuation, but which was itself not prepared to support the costs of a center devoted to a single disease. USAID/Manila expressed deep concern over the closing of this major and successful training institution in anti-malaria activities.

Since the change of emphasis in the early 1970's from malaria eradication to malaria control, in those countries where eradication has proved to be difficult for technical or other reasons, it has been recognized that training or re-training of all personnel in the principles and practice of malaria control is of utmost importance. The Executive Board of WHO stressed at its January, 1976 session (EB 57/19) that "most of the antimalaria programs are actually facing great difficulties in replacing and recruiting technically qualified personnel".

The new situation demands personnel possessing technical and managerial competence as great as if not greater than that needed for malaria eradication. The key point is that the techniques are different, and managerial responsibility, including the responsibility for making decisions, extends much farther down the chain of command. It is no longer enough to have such

competence at the top of a vertical structure.

Courses leading to a post-graduate diploma were promoted during the past 5 years in Teheran and in Mexico City; other courses, seminars and workshops were organized by WHO and national governments. Among the national malaria training centers, those in India, Venezuela, Thailand and the Philippines continued their activities. However, the absence of an international training center of the caliber of the former center in Manila is increasingly felt. National governments as well as WHO find increasingly that they are unable to locate enough professionals qualified to manage and operate malaria control programs. This is particularly detrimental to those developing countries where malaria eradication has been converted to malaria control, since the latter involves broader understanding of epidemiological principles and application of many-sided technical methods for reduction of malaria transmission.

This implies, inter alia, that increased laboratory training and equipment will be needed, or the epidemiological work will not be done effectively. At the same time, the epidemiological training will have to be broader than the training typical of eradication programs. In the context of the present requirements, specialist training in this field should provide both theoretical and practical knowledge of control of malaria and other vector-borne diseases. Only in this way will the professional who completes the course of training obtain a status that should secure his long-term career in the public health service of his own country or an international agency.

The training of such a specialist should also be directed towards the development of his skills as motivator and teacher in order to provide the national governments with individuals capable of conducting appropriate courses for technicians and auxiliary public health personnel.

The problem of the technical level of existing national training establishments for intermediate personnel deserves special mention. Some of these establishments, even when glorified by the name of institutes, are less than satisfactory, often because of the quality of training available. For the most part, country-level training is still keyed to the unidirectional techniques of malaria eradication, an oversimplified approach to the problem which, in the words of a senior WHO official, "assigned responsibility for malaria to DDT and spared its practitioners

the need to think." While this overstates the case, it is true that malaria eradication exploited a single approach, applied uniformly throughout a country and, indeed, in all countries where malaria is found. Malaria control calls for a range of skills, adjusted to the local situation in each case, requiring broader training and, in particular, organizational skills. Regional training centers are required for those who will plan, organize, and direct national malaria control programs, or who will provide training to the personnel within their country who will execute programs in the field.

The need for improved regional training (and for new training methodology) was acknowledged and in fact emphasized by every expert -- country malaria program leaders; WHO officials in Geneva, in the regional offices and in the countries visited; AID officials in Washington and in the field -- with whom the Study Group discussed the topic. As to the techniques for providing such training, there were differences of opinion, ranging from the reestablishment of an international or regional training center (or centers) to the upgrading of all national centers to the point where the need for international (regional) training could be met by seminars conducted by WHO and combined with on-going programs of research.

The separation of training and research was favored by one official; some officials consulted felt that ad hoc seminars and case studies based on adequately prepared epidemiological research and keyed to the kinds of circumstances found in particular areas would provide an alternative to a more formal training course at an international or regional center. The large majority, however, supported the view that training in malaria control should be linked to operational research; that an international or regional center is required for those who will plan, organize and direct national malaria control programs, or who will conduct courses of instruction in national training centers); and that the seminar approach, as a supplement to but not as a substitute for an international or regional center, has validity if presented to officials already trained in the several disciplines of malaria control.

Without exception, experts consulted held that national malaria training centers require the stimulus of external technical inputs. Their improvement would be greatly accelerated by the existence of an international or regional center, and the immediacy of the problem of resurgent malaria emphasizes the need for

such a center.

The creation of such a center in no way eliminates the need for in-country technical training. Within (or available to) each country undertaking a malaria control program, there is need for a strong training program to provide competent technical personnel for the various administrative levels and operational areas. Existing national training centers need to be strengthened and curricula reorientated to the needs of malaria control. There is need for a range of skills, appropriate for the local situation; among the subjects to be taught should be entomology, including anti-larval measures and source reduction; serology, immunology, drug resistance and ecology. In no country in Asia did the Study Group find national training which covered these elements. Country-level training is still keyed to the unidirectional techniques of malaria eradication through the use of residual spray.

In countries which receive material support from AID, provision should be made for allocation of AID resources to be used for improvement of training facilities, to the extent that the host government is unable to provide training appropriate to the demands of the program. The need is not necessarily, or even customarily, for construction of buildings; rather, the key requirements are technical and financial. Where possible, WHO should provide resident foreign expertise; local colleges and universities should be drawn upon where they possess the essential skills; but the training should be pragmatic rather than theoretical, stressing the management of resources and the decision process.

Recommendations

Many countries where malaria continues to be an important public health problem are now and will for the indefinite future be in need of experienced staff for their antimalaria programs. With the change of strategy from malaria eradication to a broader concept of malaria control, increased training of specialist and intermediate staff in the practice of control of malaria and other vector-borne diseases has become imperative. The success of malaria control efforts depends largely on the availability of trained technical personnel of all grades; AID's investment in support of national malaria control programs is endangered to the extent that technical personnel are improperly or inadequately trained to carry out programs, however well planned.

In view of this the Study Group recommends:

(a) That an International Training Center for Control of Malaria and Other Vector-borne Diseases, for training of professionals in advanced and intermediate practice of control of these communicable diseases, be set up with AID initiative and with substantial AID financial contribution and technical assistance. Participation of other agencies and governments should be sought and encouraged.

(b) That speedy action be taken with regard to the implementation of this recommendation and decision on the best site for it,1/ taking into account the views of WHO.

(c) That national training institutions in control of malaria and vector-borne diseases, already functioning in most countries where malaria control programs are supported by AID, should receive technical and financial assistance from AID whenever this is regarded as important to the success of the relevant programs.

1/ The problem of location of the future center has been discussed at the meetings of the Study Group but no definite conclusion has emerged. The NICD in New Delhi, the MRI in Kuala Lumpur and the former METC in Manila were considered; Bangkok, from the standpoint of location and readily accessible examples of virtually all of the problems of high incidence and vector and parasite resistance, is also a possibility. In the absence of detailed information, no suggestion as to the preferred site has emerged.

IX RESEARCH NEEDS AND PRIORITIES

A. Requirements for Research in Support of Malaria Control

Many of the critical elements of a successful malaria control program depend upon appropriate analysis of scientific information and acquisition of new information when the existing data prove inadequate. A broad base of information, often area-specific, is required. Success or failure of control may depend on the malariologic data available when strategic or tactical decisions are made. A research element is therefore an absolute necessity for a successful program. Selection of appropriate methodology to be employed from among presently available methods requires area-specific data in epidemiology of malaria, vector biology, vector taxonomy, insecticide susceptibility of vectors and drug susceptibility of the parasite, as well as social and economic data. Where such information is lacking or outdated, poor choices of methodology are inevitable.

Development of new control technology must keep ahead of the capacity of vectors and the parasite to adapt to control pressures. Since present programs are heavily dependent on insecticides and drugs, there is a major requirement for applied and developmental research and field trials.

Of equal and perhaps more importance in the long term is research on new control methodology. There are clear requirements for research at all levels, from basic research to field assessment of new approaches to improve control efforts.

A comprehensive analysis of basic research requirements relating to all aspects of malariology is beyond the scope of this report. It must be stated, however, that basic research relating to both parasites and vectors will provide the data for future advances in concepts of malaria control. The following listing, not necessarily all-inclusive, sets forth the areas of research in which AID must maintain an interest; many, however, are beyond AID's capacity to conduct or support.

1. Research Related to Malaria Control

Epidemiology

Improved surveillance and diagnostic technology
Methodology for stratification; parameters, criteria

Entomology
Vector biology/behavior
Vector taxonomy
Insecticide resistance

Insecticides
Development
Application techniques
Field aasessment

Biological Control
Genetics
Sterile male techniques
Larvivorous Fish
Insect Pathogens
Insect Hormones

Chemotherapy/chemoprophylaxis
Synthesis and screening
Drug development
Drug resistance
Therapeutic and prophylactic trials
Field assessment

Immunology
Immunologic mechanisms
Experiemtnal vaccines

This report will deal with research areas in the context of direct relevance to control programs. Requirements are recognized at several levels:

(a) goal- or problem-oriented basic research

(b) applied/developmental research

(c) field assessment and demonstration

Field assessment, pilot projects and demonstration are clearly the responsibility of the agency supporting operational programs and indeed are an essential intrinsic part of an operational program. Field research would include, but would not be limited to:

(1) Study of the epidemiology of malaria by the identification of the variables having an effect on a malaria situation, and the quantification of their value.

(2) Studies of ecologic changes relating to malaria resulting from development projects -- dams, irrigation schemes, resettlement, etc.

(3) Assessment of the effects of various antimalaria measures through relatively small-scale field experiments, using insecticides, larvicides, larvivorous fish or other biological controls, drugs, etc., either singly or in combination, and with different methods of application and timing.

(4) Studies of improved surveillance methodology.

(5) Ecological studies on the change in the malaria situation that may be brought about through feasible, non-detrimental modification of the environment, and the costs of environmental modification by various techniques.

(6) Studies of immunological changes in a population subjected to the stimulus of malaria itself.

All such studies require base-line data from which to measure the changing pattern of the disease under the impact of intervention measures; should be conducted over periods of time sufficiently long to include all expected seasonal variations; and should record the habits and attitudes of the study population (not to mention migration) which might affect the malaria situation.

WHO has requested its several regional offices to submit lists and descriptions of field research efforts of the past five years, current activities and proposals for future field research, for examination by an expert panel. WHO will then seek to elicit support for appropriate research. The ultimate purpose is to identify a strategy for malaria control: the identification of the measure or combination of measures which had proved successful in a particular malariological situation (climate, vector, endemicity, degree of afforestation, land use, etc), to be applied to similar situations elsewhere. The concept, termed "stratification" by WHO, recognizes that even within a single country, different mariological situations will call for differing responses, but that patterns

of response may prove applicable in similar situations in different countries, and that a sharing of research results can be beneficial to all. The "strategy" is to adapt proven techniques of activity and operation to a particular country (or area within a country) and to the resources available.

In the areas of applied research and especially basic research, the responsibilities of the operating agency are less clear, and careful selection of activities warranting support and coordination with other agencies is essential. It is appropriate for AID to support applied research in areas where a direct impact on control is obvious, e.g., vector biology, and where no research effort exists. Support of such research through international organizations (WHO, PAHO) is appropriate.

B. Chemotherapy and Chemoproplylaxis

Drug resistance of P. falciparum, already a severe problem in the Southeast Asia and Western Pacific regions, can be expected to increase both in geographic distribution and spectrum of drug resistance. Several factors related to present and planned control programs will tend to exacerbate the existing problem. Since control will not be complete, treatment of cases will put continuous drug pressure on the parasite. Further, in some areas chemoprophylaxis and/or chemotherapy may be the sole method employed to control malaria, with resultant long-term continuous drug pressure on a parasite which is highly adaptable and capable of developing drug resistance. Drug usage resulting from private purchase and government distribution has greatly increased in the past decade and will continue to increase, especially where control programs receive outside support. Wide-spread use of pyrimethamine-sulfonamide combinations for treatment of bacterial infections in malarious areas will inadvertently add to the drug pressure problem. In Thailand the present very extensive use of Fansidar for treatment of chloroquine-resistant malaria may cause early emergence of pyrimethamine-sulfa resistance.

In addition to the resistance problems, all existing drugs have deficiencies; most are unacceptable or marginally acceptable for long-term prophylaxis because of side effects; others stimulate gametocytemia or have other undesirable effects.

For the above reasons a major continued effort in drug development research is essential. Industrially supported drug research programs will not meet future requirements. The only major program in existence which can meet the present requirements is the U.S. Army Malaria Drug Development Program. This program includes chemical syntheses, screening, biological testing, clinical testing and field trials. Since its inception in 1963, over 300,000 compounds have been tested; several classes of promising new drugs are in late development stages; and the drug mefloquine has been very successful in treatment trials and prophylactic field trials. Continuation of this program is essential to successful malaria control in the future.

C. Insecticide Development

Section VII, Malaria Control Techniques, sets forth the Study Group's conclusion that there is no adequate available substitute for residual insecticides in controlling malaria. This conclusion is made in full knowledge of the fact that the problem of vector resistance to insecticides continues to expand and become more serious in the region.

The costs of replacement insecticide vector controls are rising exponentially; there have been fewer and fewer entrants into the field as research, development and production costs have risen.

One of the most troubling problems in the development of new insecticides has been that of cross-resistance. Compounds with a chemical structure analagous to that of other insecticides to which resistance had already developed have proved to be shorter in effective life than their predecessors; resistance to one organo-phosphorus compounds appears to create an added potential for the development of resistance to its analogues.

Attempts to develop biodegradable analogues of DDT -- the principal objection to which is its longevity -- have to date proved unsuccessful for control of DDT-resistant mosquitoes. Moreover, even if a successful DDT analogue were to be produced, the likelihood of rapid development of resistance would be high.

The current picture is serious, and could become critical: although fenitrothion has proved to be

of considerable promise in recent trials in East Africa, there is no (to the knowledge of the Study Group) new residual insecticide about to become available, and none is known to be in development. The need for a safe, effective insecticide for agricultural as well as for public health use is obvious. It is apparent that the U.S. Government may have to subsidize insecticide development as it becomes too expensive for private producers.

While basic research on insecticides is principally the responsibility of industry and the Department of Agriculture, a strong case could be made for AID support of developmental research in this area. The Study Group believes that it is appropriate for AID to evaluate new insecticides for malaria control purposes, but is not assured that the insecticide research and development program of the Department of Agriculture is fully adequate to satisfy AID requirements.

D. Malaria Immunology and Vaccine Research

Research on malaria immunology and parasitology has in recent years progressed to the point where goal-directed research on vaccines is a worthwhile long-term endeavor. The feasibility of inducing protective immunity has been established in several model systems (including P. falciparum) and advances in culture techniques offer hope that immunogenic products can be produced in in vitro systems. Projecting time-to-goal is not yet possible, since many scientific, technical and practical problems remain to be solved.

Nevertheless, the Study Group is emphatic in stressing the potential value of a research effort sufficiently high to enable a long-term commitment as an integral part of long-term strategy. AID's present program has produced good value to date for funds expended. Since the technology base(on which the applied aspect of this research is dependent) is derived from basic research conducted by another agency (National Institute of Health, Army, Navy), interagency coordination is essential. Field immunology research and possible future field trials may best be undertaken through international health agencies (WHO, PAHO); AID support of such research is appropriate.

Recommendations

1. The Study Group emphasizes the fact that the intrinsic nature of present malaria control programs is such that research in support of an operational program is an absolute necessity for long term success. The investment in control-related research should be commensurate with the investment in the overall program.

   Recommendation: Not less than 10% of funds allocated to malaria control should be devoted to research.

2. Field assessment of new or improved control techniques is often needed for short-term improvement of program effectiveness. Examples of such projects are trials of improved insecticides or application techniques, field trials of available drugs, evaluation of improved serologic tests for surveillance.

   Recommendation: The Asia Bureau should include area-specific field assessment projects in the malaria strategy.

3. Present control methods are imperfect at best and the expectancy for long-term usefulness of any given method is limited because of biologic adaptation of vectors and parasites. Effective long-term solutions to the problem of malaria will therefore depend on successful research efforts in one or more of three areas; vaccine research, drug research, vector control research. Of these, the most important area for long-term support by AID is in research aimed at development of an antimalaria vaccine.

   Recommendation: Long-term (5-10 year) support for basic and applied vaccine research at the present level, with expectation of increased funding when research results indicate the feasibility of vaccination for preventing malaria.

4. Biological control methods range from practical alternatives to long-term opportunities; from distribution of larvivorous fish to genetic control of mosquitoes. AID should concentrate its support of biologic research on those methods which show early promise.

Recommendation: AID should support field trials for assessment of biologic control methods where feasibility appears likely.

5. Insecticides will for the foreseable future continue to be required for malaria control. The need for a safe, effective insecticide for public health as well as for agricultural use is apparent. There is no assurance that the basic research now being conducted by industry and the Department of Agriculture will meet public health needs.

   Recommendations: Support for field assessment of new insecticides is appropriate for AID funding. Additionally, the Study Group recommends an in-depth evaluation of the Department of Agriculture's development research program as it relates to AID requirements, and a reevaluation of the judgment that USDA research will to a satisfactory degree focus on the need for a safe, effective insecticide for malaria control.

6. Development of new antimalarial drugs must continue, both to provide effective prophylactic curative drugs for malaria control and to treat individual cases. At present the U.S. Army is the principal agency in the U.S. Government for this research.

   Recommendations: AID should encourage continued DOD support of drug development research. Support for field assessment of developed prophylactic drugs is appropriate for AID funding.

X. EVALUATION

Section IV, Criteria for AID Support for Malaria Control, details the criteria which, in the judgment of the Study Group, should govern AID's consideration of assistance to country malaria programs. A key criterion is the condition that the country's malaria control plan should prescribe a process of continuing program evaluation.

Specifically, regular annual or at most biennial reviews of the operation of every AID-assisted program should be provided for at the very outset of the program. These reviews should be conducted by teams consisting of experts in the malaria field, selected from the professional communities of AID and other U.S. agencies, WHO, and the cooperating country, supplemented as appropriate by other outside expertise. Provision for such external situation analysis appraisals should be made in the agreements governing AID assistance. While AID clearly cannot surrender to outside teams its responsibility for making program decisions, it must also guard against foreclosing by too rigid plans and agreement the acceptance and implementation of such teams' recommendations.

The Study Group is entirely aware of the fact that the preceding paragraph describes present AID practice -- at least in the Asian region -- and wishes to commend that practice. It should most certainly be continued.

External appraisals are conducted by combined teams of senior officials of the national programs and internationally recognized experts in malaria, normally supplied by WHO, AID, other U.S. agencies such as the Center for Disease Control of the U.S. Public Health Service, and individually recruited specialists (including, on several occasions, members of the Asia Bureau Malaria Strategy Study Group). These appraisals are based in each case upon on-site inspection of actual operations in the field, detailed data review, and comparison of achievements against targets. They identify shortcomings and recommend corrective action. They form a vital part of the evaluation system which AID has wisely made a precondition of assistance to country efforts, which WHO strongly recommends to all countries where its technicians are stationed, and which the countries themselves consider to be an imperative element in their own efforts to convince national leadership

of the effectiveness (or, alternatively, of the need for added national support) of their antimalaria programs and their conduct of such programs.

There is, to the knowledge of the Study Group, no other field in which there exists a comparable system of systematic, continuous, dispassionate, expert international appraisal of results achieved, problems faced and improvements required, conducted for all countries maintaining a program which deals with a problem common to all. The evaluation system of world-wide malaria programs is unique, and warrants more attention than it has received.

AID's input into these appraisals is a major contribution to national efforts to control malaria; additionally, such participation by AID, in countries where AID no longer provides financial support to malaria control efforts, provides a breadth and depth of knowledge of the world-wide malaria situation which could be obtained in no other way and a continuing influence over the content and conduct of malaria programs beyond the point of direct AID participation in and support of such efforts. The modest dimensions of AID's malaria staff in the Bureau of Technical Assistance, Office of Health, as contrasted with the major time requirements of the evaluation system, impose a staggering burden of travel time and time away from the central office on the part of individual staff members; the benefits from their participation in such evaluations is beyond question.

In Section IV, Criteria for AID Support for Malaria Control, the Study Group identified as a critical need a technically qualified AID officer in each country to whose malaria program AID is providing direct support. Such an officer can unquestionably monitor and report day-to-day progress in the conduct of the program; he should not, however, be AID's member of the External Appraisal Team which periodically evaluates performance. The entire principle on which the External Appraisal Team concept is based -- dispassionate expert international appraisal of results achieved, problems faced and improvements required -- mandates that the AID participant may not be directly involved in the implementation of the program under evaluation. With the best will in the world, evaluation is subject to bias if performed by a person or group which is carrying out a program. Moreover, it is essential that AID's representative in external appraisal speak with the authority of long experience and internationally recognized qualifications which AID's country-based malaria officers may not in

every case possess.

Recommendation

The Study Group recommends the expansion of the Malaria Staff, including the possible establishment of a position for an experienced, broadly qualified, Asia-based malaria specialist, to carry at least the Asian portion of the world-wide evaluation effort, to assure sharing of experience and information among participants in AID's largest effort in support of malaria control, and to serve as coordinator and technical backstop for country-based malaria officers in Asia. Being based in Asia, he would help conserve the Agency's increasingly limited operational travel funds.

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ANNEX 1

FROM MALARIA ERADICATION TO MALARIA CONTROL

(Leonard J. Bruce-Chwatt, Emeritus Professor of Tropical Hygiene at the University of London and presently with the Wellcome Museum of Medical Science, participated in both the first and second colloquia of the Study Group. In addition to his contributions to the Study Group's report, Dr. Bruce-Chwatt prepared the following special study on the genesis of the global malaria eradication effort of the 1950's and early 1960's, the reasons underlying the conversion of this effort to national programs of malaria control, the desiderata for successful control, and the relationship between effective malaria control and successful limitation of population growth).

Malaria has a major place among the endemic tropical diseases. It has been estimated that twenty years ago the annual incidence of the disease was of the order of 250 million cases with 2.5 million people dying of malaria every year.

Soon after the Second World War, the newly born WHO recognized that malaria not only killed more people than any other disease, but also interfered with the development of agriculture and growth of industry in the tropics. The intensive control methods carried out in some western countries produced excellent results but could not be easily applied in many tropical areas. The advent of DDT presented the world with a new method of interrupting the transmission of infection by attacking the mosquito vector during its epidemiologically most important stage when it feeds on man in his dwellings.

The epidemiological concept of the interruption of malaria transmission by insecticide spraying is simple. After taking her blood meal the female anopheline mosquito generally rests on a nearby indoor surface for several hours while the blood is digested and the batch of eggs matures. The female mosquito feeds every 2-3 days and the malaria parasite, after being ingested with the blood, requires at least 10-12 days for its full development to an infective stage. Spraying all inside wall surfaces of human dwellings and other domestic shelters with a long-lasting insecticide like DDT would therefore create conditions in which a substantial proportion of anophelines would be killed before they could transmit malaria.

It soon became obvious that the eradication of malaria did not require the total elimination of all the vectors, and several examples of successful campaigns (Italy, Cyprus, Greece, Guyana, Puerto Rico, and Venezuela) were most impressive. It appeared that the widespread use of DDT and other residual insecticides for indoor spraying was the most reliable, feasible, and economical method for the interruption of transmission (the attack phase), especially in rural areas. In the next phase of the eradication program (the consolidation phase) the remaining foci of infection could be detected by proper surveillance and eliminated by distribution of anti-malarial drugs and local application of insecticides.

The eradication program has been defined as an operation aimed at stopping the transmission of malaria and eliminating the reservoir of infected cases in a campaign limited in time and carried to such a degree of perfection that, when

it comes to an end, there is no resumption of transmission.

This simplified description of the principle of malaria eradication gives no idea of the operational complexity of a large-scale program. Few other public health endeavors need such careful planning, efficient administration, adequate financing, and detailed evaluation.

The world-wide program of malaria eradication was formally endorsed by the Eighth World Health Assembly in 1955 and in 1957 the WHO took over the coordinating activities and the provision of technical assistance.

The concept of malaria eradication was accepted by all the member governments of WHO. Previous control programs were converted to eradication programs and eradication programs were initiated in all malarious countries in the Americas and Europe, and in the majority of countries in Asia and Oceania. But only pilot projects were attempted in Africa.

What is the situation today after 22 years? According to the latest reports for 1975 malaria has been eliminated from the whole of Europe, most of the Asian part of the USSR, several countries of the Near East, most of North America including the whole of the USA, most of the Caribbean, large areas of the northern and southern portions of South America, Australia, Japan, Singapore, Korea, and Taiwan. There is little official information about China, but it seems that malaria has been virtually eliminated from most of that country. An assessment of progress during the past two decades (in terms of population protected) shows that malaria eradication has been achieved or was in operation in about 80 per cent of originally malarious areas. The remaining twenty percent of the unfinished task represents most of the developing world.

Progress of Anti-malaria Programs Between 1957 and 1975

Location	Population (million) 1957	1975
Areas of the world with anti-malaria programs in various phases	789	1672
Areas without anti-malaria programs	421	343
All previous and present malarious areas	1210	2015

These overall results are of great interest; they justify the original concept and yet show that under some conditions it cannot be pursued to a successful conclusion.

In African countries south of the Sahara malaria is responsible for about ten percent of annual deaths of infants and children below the age of fourteen years. These estimates of mortality and morbidity are no more than informed guesses, because of the well known shortcomings of statistical data in that part of the world. The most striking feature of the disease in tropical Africa is its high endemicity with hardly any seasonal or annual changes; thus, the individual is infected at an early age and is subjected to repeated infections throughout his life. The toll of African malaria falls mainly on the very young, and those who survive gradually develop an increasing immunity. This means that spectacular epidemic outbreaks are usually absent, but the disease kills many infants and young children, and contributes in a large measure to the vicious circle of disease and poverty.

Various malaria-control activities, especially the distribution of drugs for prevention and treatment of infection, are being carried out in urban and some rural areas but the overall situation has not greatly improved in tropical Africa. On the other hand, one should point out that in northern and southern Africa malaria is either absent or definitely on the retreat, while its eradication has recently been accomplished in Mauritius and Reunion.

In other parts of the world the situation varies between a slow but steady fall in the incidence of malaria and a virtual absence of any change. However, in several countries there is evidence of resurgence of malaria and this is causing much concern. Among these countries one should mention Pakistan and Bangladesh, many parts of South-East Asia, Indonesia, Sri Lanka (Ceylon), and the states of Gujarat, Maharashtra, Mahdya Pradesh, and Rajasthan in India.

Since India's malaria eradication program is by far the largest in the world, its recent appraisal is of particular interest. During the period 1962-1976, the annual number of reported cases of malaria rose from 60,000 to 5.8 million (actual incidence is estimated as high as 15-25 million) and the constant increase of the incidence is disquieting. In areas of the country inhabited by nearly twenty percent of the population the feasibility of eradication is

doubtful under present administrative and economic conditions.

Although the overall costs of successful antimalaria activities in India are extremely low, averaging ten U.S. cents per person per year, the total amount of money available for this public health program is manifestly insufficient when spread over a population of over 600 million.

The present resurgence of malaria indicates how far we are from the conquest of this disease; it also emphasizes the role of malaria as one of the many factors at the core of the great issue of socioeconomic development of tropical countries.

There is no denying that, in spite of the great achievements of global program, a large reservoir of endemic malaria remains over most of the tropics. The problems as seen in tropical Africa and Asia explain why the eradication of malaria from the whole of those continents is now considered unlikely as long as basic health services are qualitatively and quantitatively inadequate.

One of the consequences is the increasing concern with malaria as one of the tropical diseases now frequently seen in Europe, the USA, and other parts of the temperate world. The constantly rising speed and volume of international travel and the lure of exotic holidays at a moderate cost have created new conditions for massive importation of communicable disease into countries where these infections were unknown or from which they had gradually disappeared with the advance of public health.

The reasons for the present lack of progress and possible further reverses of the global malaria eradication program are complex. Technical obstacles such as the exophilic habits of some anopheline species, resistance of malaria vectors to insecticides, resistance of plasmodia to anti-malarial drugs, inaccessibility of outlying groups of houses, the primitive structure of dwellings, are of undoubted importance.

More realistic assessment of the difficulties that have stopped the striking advance of global malaria eradication recognizes the importance of administrative, socioeconomic, financial, and political difficulties. These affect the problem of improving health in countries which have inadequate basic health services and are short of trained manpower.

A re-examination of the global strategy of malaria eradication was recommended by the 20th and 21st World Health Assemblies. Special studies on the socioeconomic impact of malaria, the relationship of malaria eradication programs to national health planning, and the technical or other aspects of malaria eradication activities have been carried out during the past few years and their results were presented to the 22nd World Health Assembly in 1969.

The main conclusions of this report stress that malaria eradication should remain the final goal; a long-term investment because of its overall impact on health and its socioeconomic benefits.

Wherever malaria eradication programs have good prospects they should be pursued with vigor towards their defined goal. In countries where eradication does not appear to be feasible because of the inadequacy of financial resources, manpower requirements, or basic health services, malaria control operations may form a transitional stage toward the future launching of an eradication program.

Within the general agreement on the urgency of better malaria control three needs emerge: the improvement of basic health services, research into control techniques, and a reduction in the birth rate to balance the reduction in the death rate.

The expansion of health services is limited by the supply of trained manpower, especially in rural areas where the needs are immense. It is here that the role of medical auxiliaries is of growing importance and much more must be done to increase their numbers as well as their skills and responsibilities.

Our technical means of controlling, let alone eradicating malaria from many endemic areas of the world are inadequate. A concentrated research effort may find new ways to attack the malaria parasite and its vector. Fields in which research is felt to be particularly important include the improvement of immunological surveillance techniques, study of the behavior of mosquito vectors and their resistance to insecticides, better and more acceptable insecticides, and the development of new antimalarial drugs.

Much has been said and written about the possibility of a prospective malaria vaccine, but the present experimental results, however encouraging, show the practical difficulties of this method. It seems that synthetic antimalarial drugs will be our most reliable weapon for many years. Nevertheless, research in the feasibility of a malaria vaccine should be stimulated and supported. The imaginative and generous assistance provided in this respect by AID is timely and commendable.

The place of chemotherapy in malaria eradication depends on both the local epidemiology of the disease and operational facilities. The use of drugs for large-scale treatment is difficult since all those in use at present are rapidly excreted and have to be administered very frequently to be effective. Another handicap is the appearance of drug resistance due to the modified response of the parasite to the chemical compound. Such instances of resistance have been reported in various parts of the world.

The research program of the Walter Reed Army Institute for Medical Research has discovered some 12 groups of new compounds (out of over 300,000 examined) that represent potentially new and valuable antimalarials. This splendid effort should be further carried through by testing some of the new compounds in the field, providing that their toxicity has been fully investigated and that their use in humans present no undue hazards.

On a world scale the health gains of malaria eradication are immense; this can be judged from the fact that the 1950 annual malaria morbidity rate of well over 250 million has now declined to about 100 million clinical reported cases. The corresponding mortality rate has decreased from 2.5 million in less than one million per annum. Over the past decade the probable reduction of mortality attributed directly to malaria amounted about 15 million; with the approximately 35 million lives saved through the reduced impact of other diseases or malnutrition which are normally aggravated by malaria, the total reduction of mortality resulting from antimalaria programs amounted to some 50 million. This should be seen in the proper perspective of the general demographic trend as the world population increased during the period by about 500 million!

The impact of any large-scale control of an endemic disease is bound to lower the amount of sickness and death and thus increase the population pressure wherever a high reproductive potential exists.

If the ideal aim of community medicine is to keep an ecological balance between human society and its environment, the drastic reduction of sickness and death should be counter-balanced by a corresponding reduction of the birth rate. Deliberate limitation of a family is alien policy to most of the developing countries, especially those where the fearful mortality rates for infants and children indicate the burden of sickness carried by the young and are closely related to socioeconomic conditions.

A family needs to feel certain of survival before it gives some thought to limiting its size. Only when the protection of the health of the mother and child removes the instinctive fear of premature death will restrictive measures on procreation be accepted.

In considering the relationship of the population to the available resources it would be unwise to think only of food production as the most serious potential shortage. The size of the population must also be related to the availability of social services, investment policy, industrial development, and conservation of the natural environment and the resources of land.

The pursuit of a well defined campaign against one specific disease may often provide an effective lever for economic progress if it lifts from the community a heavy burden of sickness. But this should be regarded as part of the general process of orderly growth of national health determined by existing priorities.

Today's problems of malaria control, let alone those of eradication, are part of the unsolved dilemma of the developing world. The current economic upheavals, which are a result of the energy crisis, may aggravate the situation, but wealthier countries must fully realize the future danger of a divided world and accept the obligation of providing adequate technical and financial assistance to bridge the present gulfs.

In this respect the farseeing, imaginative and wholehearted effort of the United States of America deserves admiration and should be better known throughout the world.

ANNEX 2

ECONOMIC ANALYSIS OF MALARIA CONTROL

In the face of limited AID resources and large numbers of activities for which support might be considered, AID has, especially in recent years, tended to focus its efforts on projects and activities where the ratio between the benefits to the target group and the overall costs are relatively high, and, in any case, above a conventionally accepted minimum. While it is evident that limited resources should be concentrated on activities which provide a good rate of return on investment, the ratio of benefit to cost is a measure which is subject to marked limitations.

The costs of an investment are, in the main, quantifiable in monetary terms; the principal limitation on cost data is the difficulty of precise attribution of expenditures to the attainment of benefits. This is particularly the case for activities which serve multiple purposes. In the case of malaria control, for example, the costs of the surveillance and epidemiological intelligence operations may appear to be relatively high. However, the benefits are not limited to relief of malaria. The surveillance operation will be an integral part of a basic health services structure, and associated benefits arise from the alleviation of a wide range of health problems. Some of the costs should thus be allocated to other diseases, and the aggregate cost of the malaria control activity reduced for analytical purposes.

If the calculation of attributable costs presents problems, the calculation of the monetary value of the effects of a malaria control program is even more difficult. It is possible to identify the benefits of malaria control -- some direct, some indirect -- but their quantification in monetary terms has for each approved country program represented a gross understatement of the true value of the activity to the country and to the target population, since some very tangible benefits have no assigned monetary value.

Some of the benefits can indeed be given monetary value: avoidance of lost income to society and avoidance of higher medical cost to society. Both of these benefits are measured by the estimated "profit" to society: projected wages to earned by employed individuals who would, in the absence of the program, have been incapacitated by malaria, and saving of projected expenditures for drug treatment and/or hospitalization of individuals who would, in the absence of the program, have been malaria victims. The

first of these figures is subject to sophisticated rodifications, based on the average wage of agricultural workers, the percentage of unemployment and underemployment in the economy, the percentage of the target population of a "working age", the percent agriculturally employed, and numerous others. The second benefit -- avoidance of higher medical costs -- is less subject to manipulation; it consists of reduced expenditure for drug imports, hospitalization costs, and the higher calorie requirements of individuals suffering from a febrile disease like malaria.

There are numerous variations on this basic theme, each designed to take into account the conditions in a particular country. For example, in Nepal, a country where land-use patterns have changed and are still changing, the unwillingness of potential migrants to move into under-cultivated, highly malarious areas has a calculable cost in terms of loss of potential agricultural production. The abandonment of presently cultivated land in the face of resurgent malaria will have a similar cost.

The fact that an individual is spared illness has only two quantifiable values -- the saving of the costs of treatment, higher calorie requirements and hospitalization and the wages to be earned during periods when he would otherwise have been unable to work (discounted to the extent that the individual might be unemployed or underemployed).

If it has been necessary to discount some benefits, it has been necessary to omit from calculations a wide range of (to date) unquantifiable factors. These include, among others:

1. Agricultural production in home gardens: Entirely apart from commercial crops, an appreciable proportion of agricultural production takes place in garden plots owned (or rented) by agricultural workers. Protection against the short-term incapacity and/longer term debility brought on by malaria is reflected in a higher level of home-garden production. Absence of such production results in higher levels of food imports, reduced exports and/or malnutrition.

2. Income of persons providing home care: There are losses of productive services when family members (housewives and children) who are not themselves ill are nevertheless unable to work because they are providing care to malaria victims at home or in hospitals (where, in Asia, family members usually provide care and feeding). Even less measurable are the household services which malaria-ridden housewives and

children are unable to perform. Such services have no market price, but the loss is nevertheless a real economic loss. Freedom from malaria, therefore, provides a parallel economic gain.

3. Educational gains: Malaria-caused absences from school, by pupils (each a factor of one) and by teachers (a factor of one multiplied by the number of pupils per class) have a direct negative effect on the amount and quality of education; school attendance by pupils and teachers suffering post-malaria debility is less productive than normal attendance. The impact on education budgets as well as learning postponed or foregone may or may not be precisely calculable in monetary terms, but the loss is real, and the educational gains deriving from freedom from malaria are equally real.

4. Post-malaria illness and debility: The frequent result of malaria debility is a high degree of susceptibility to other diseases; likewise, malnutrition frequently has its origins in inability to provide the higher caloric requirements of individuals suffering from malaria. In some instances, an effort has been made to quantify the deaths resulting from such secondary impacts of malaria, but as is noted below, deaths prevented are assigned no monetary value. At a minimum however, freedom from malaria would produce the value of employment made possible and medical treatment avoided for diseases suffered during the period of post-malaria debility.

5. Tax collections: Few if any countries in Asia receive major portions of their income from taxes on land, or on paddy and wheat production. The factor of increased tax yields as a result of the higher productivity resulting from effective malaria control would not, therefore, bulk large in benefit calculations. Nevertheless, the factor is not totally negligible.

6. Well-being: The sense of well-being for which citizens of more developed countries (and their employers) pay billions of dollars annually in prepaid medical care appears to have no quantifiable value. The sense of well-being is something more than a simple absence of illness, although the two are of course related.

7. Freedom from suffering: Reduction in medical costs (to the state) and gains in man-days of employment are quantifiable, and may enter benefit-cost ratio calculations. The absence of suffering, illness, and debility has no monetary value.

8. Self-treatment: Entirely apart from the easily measurable expenditures by Ministries of Health to provide cost-free treatment for malaria, there are also expenditures for self-treatment by individuals. In Thailand, for example, private-sector imports of the antimalaria drug Fansidar run to 13 million tablets last year -- for sale to individuals for self-treatment. The pattern is repeated, with variations, in other countries. The individual expenditures made unnecessary, and the savings in foreign exchange resulting from reduced private-sector imports of chemotherapeutic drugs, constitute benefits of malaria control which may indeed be calculable.

9. Reduced mortality: A death averted as a result of effective malaria control is assigned no value. It should be possible, however, to calculate the potential earnings of an individual at the median age of those dying of malaria through to the end of a normal lifespan in the country -- appropriately discounted to take into consideration national levels of unemployment, underemployment, etc. Such a figure, multiplied by the number of lives saved, would provide a quantifiable monetary value to reduction in mortality. There would still be unquantifiable human benefits.

Attached are the economic analyses which supported three malaria programs approved for AID support in the relatively recent past -- Sri Lanka, Indonesia and Nepal -- none of which took monetary account of any of the five factors listed above. The three cases selected represent the rate of return on investment in malaria control typical of a successful cost of effort in a country having a malaria incidence of catastrophic proportions (Sri Lanka), malaria which threatens or would frustrate a major economic development effort (Indonesia), and malaria which endangers previous as well as future economic gains in which the U.S. has a major investment (Nepal).

In each instance, the benefit-cost calculation has been conservative; despite this fact, each analysis demonstrates a defendable return on investment, net of all costs, well in excess of the conventionally accepted minimum of 10%.

Yet if a particular minimum benefit-cost ratio is to constitute an absolute threshold, a "go, no-go" of acceptability, for AID consideration, the calculation must take into account all costs and all benefits -- not merely those which are convenient and easily measured.

The Study Group recommends further examination of the more readily quantifiable benefits of malaria control; their incorporation into the calculation of benefit-cost ratios would provide a more accurate measure of the return on investment.

A. ECONOMIC ANALYSIS - SRI LANKA

1. PROJECT ECONOMIC ANALYSIS

Summary and Conclusions 1/

This economic analysis appraises a malaria control project in Sri Lanka in terms of whether the project is worthwhile from an economic standpoint.

Malaria has always been a major health problem in Sri Lanka and the disease is highly endemic in the dry zone which constitutes about three fifths of the country and contains over 65 percent of its population. An increase from the previous year of over 200 percent of malaria cases detected and treated in 1975 seems to indicate that without the constraints imposed by the project, the annual parasite incidence (API) will reach an average of 425 per thousand (comparable to that which existed from 1931 to 1947). The project will prevent 28.9 million malaria cases and enable the economy to save U.S. $40.0 million equivalent from 1977 to 1981.

Project economic costs are estimated at U.S. $20.0 million equivalent, excluding duties on import items (which are transfer payments), and estimated at a shadow exchange rate of U.S. $1.00 = Rs 20.

The project will produce substantial direct and indirect benefits. This analysis has quantified only those expenditures and losses avoided that can be valued in money terms. The avoided expenditures and losses during the five year project are as follows: U.S. $27.5 million equivalent in medical treatment; U.S. $4.3 million equivalent in malaria drugs; U.S. $7.7 million equivalent in loss of earnings; and U.S. $9.6 million equivalent in the value of food imports (rice) required to satisfy excess caloric intake. Current estimates indicate that the economic rate of return on alternative investments lies somewhere between 8 percent and 22 percent; we have estimated it at 15 percent.

The project was subjected to three of the most commonly used primary tests of value. The benefit-cost ratio is 1.8 indicating that the project is acceptable in terms of generating benefits in the excess of cost (i.e., for every $1 spent on malaria control the project will yield $1.80 in benefits). The net present worth is U.S. $11.2 million when discounted with an opportunity cost of capital of 15 percent (i.e., $11.2 million in benefits will be generated over the useful life of the project after all economic costs are covered, including the opportunity cost of capital). Finally, the internal rate of return to the project is well over 50 percent which compares very favorably to the average 15 percent rate of return accruing to alternative investments.

1/ Supporting tables to be found on Annex.

Since accurate projections in estimating costs, and especially benefits, in health projects is considerably difficult, several sensitivity analyses were conducted in order to determine the economic profitability of this project under changed circumstances.

If the price of the inputs were either underestimated or would incur a 30 percent increase during the life of the project, the internal economic return would still be over 50 percent.

Assuming that either the benefits were overestimated by 40 percent (i.e., we overestimated by 40 percent the number of cases that will occur in the absence of the project) or that the projected losses avoided would be 40 percent less than expected, the internal economic return would be approximately 28 percent.

If the project were to be faced at the same time with a 30 percent cost overrun and a 20 percent decrease of benefits, the internal economic return would be approximately 32 percent.

The last sensitivity analysis shows that if the cost of the inputs were to increase by 10 percent and the benefits were reduced by 40 percent, the chances of which are negligible, the return would be slightly less than the opportunity cost of capital of 15 percent. Thus, it is important to note that the sensitivity analysis reveals the project to be very sensitive on the benefit side. That is, the project is socially beneficial provided the benefits accrue over 60 percent of the number of people as projected by A.I.D.

On the basis of this economic analysis, the project is suitable for AID loans to the GSL totaling U.S. $12.0 million.

Methodology

The essence of this economic analysis is the comparison of what the economy's expenditures and losses would be without the project and what they would be with the project. The difference between the two, minus the project costs, enables us to identify the benefits derived as a result of the malaria control program.

Because we have felt that, as in most developing countries, in Sri Lanka the official exchange rate understates the scarcity value of foreign exchange, the evidence being the existence of a market where foreign exchange is being purchased at prices that are substantially above the official rate (between Rs 25 and Rs 30 per U.S. $1.00), we have determined the equilibrium rate to be U.S. $1.00 = Rs 20.

The monetary expressions are all at domestic market prices since we have not found significant subsidies or administrative price controls which would require the use of shadow prices for domestic commodities.

The values of costs and benefits have been divided by years during the life of the project (5 years) and appropriately discounted over time to yield present values.

The discount rate selected is 15 percent which is the marginal opportunity rate of return to agriculture.

Project Cost Estimates

All the resources, both physical and human, that will go into the construction and operation of this project have been identified and quantified.

Project cost estimates are based on current costs but include physical and price contingencies of 15 percent for capital items, 10 percent for equipment and spares, 3 percent for utilities, postage and rent, 13 percent for insecticides and drugs, and 8 percent for AMC staff salaries, wages, travel and training. The total economic cost of the project is estimated at Rs 407 million (U.S. $20 million). Tables 1, 2, 3 and 4 on Annex summarize the project costs in local currency and foreign exchange.

Malaria Cases Projection

The data used to estimate the number of malaria cases that can be expected from 1977 to 1981 without a malaria control project, and the number of cases expected and avoided as a result of the project, was obtained from AMC (refer to Tables 5 and 6 on Annex).

Tables 7 and 8 on Annex disaggregate the expected cases by the type of medical treatment required and type of malaria.

Costs Without the Project

In an economy where the annual per capita growth rate is 1.75 percent, the average per capita income level is around U.S. $120, where food imports are 45 percent of total imports and where the government is strongly committed to provide free medical services to all the people, the negative economic impact of widespread malaria is pervasive.

In the absence of a malaria control project the economy will be faced with additional annual expenditures of U.S. $7.0 million for medical treatment, U.S. $2.0 million for drugs import, U.S. $0.7 million for additional food imports and the agricultural population in the malarious zone will lose an average of U.S. $1.0 million per year in earnings. The allocation of economic resources to palliate these and other effects can only hinder the development process of the country.

The projected expenditures to be incurred without the project in medical treatment and drugs imports are presented on Tables 9 through 15 on Annex. Because even with the project it cannot be expected that no malaria cases will occur during the life of the project, we have also estimated the costs incurred by the economy in treating those cases.

An additional cost to the economy is represented by the loss of earnings of agricultural workers as a result of malaria (see Table 16 on Annex). It should be emphasized that in our projections we have not included the loss of earnings of the [illegible] or the parent looking after the ill person.

The procedure used to estimate the loss of earnings of employed agricultural workers affected by malaria is presented in the next table. The projections were estimated on the basis that in 1976 the population of Sri Lanka was 14 million with an average annual increase of 1.8 percent per annum. Forty percent of the population is between 15 and 60 years old and in 1976 they comprised 5.6 million people. Seventy percent of the labor force is engaged in agricultural activities and in 1976 the employable labor force in the sector was 3.9 million people.

Although it is difficult to determine the level of employment in the agricultural sector, we have assumed a rate of unemployment of 16 percent in the sector. Thus, the estimated gainfully employed labor force in 1976 was 3.3 million. We have also considered the fact that every year 109 thousand people enter the labor force and 70 percent seek employment in the agricultural sector.

Year	Total Population	Malaria Zone Population [1]	Employable Ag. Labor Force	Employed Agric. Labor Force [2]	Gainfully Employed Ag. Labor Force Malaria Zone	Employed Ag. Labor Force Affected by Malaria [3]
1977	14.3	9.1	3.9	3.3	2.2	1.0
1978	14.5	9.3	4.0	3.4	2.2	1.1
1979	14.8	9.4	4.1	3.5	2.3	1.1
1980	14.9	9.7	4.2	3.5	2.3	1.1
1981	15.2	9.9	4.3	3.6	2.3	1.2

[1] Over 65 percent of the population lives in high malaria risk zone.

[2] Eighty-four percent of the agricultural labor force are gainfully employed.

[3] We assume that only 50 percent of those gainfully employed will suffer malaria in the absence of the project.

Although the total income (money wages and in-kind) of an agricultural worker is over Rs 10 per [illegible] day, we have considered only that portion of his income expressed in money wages which on the average equals Rs 5 per day with an average annual increase of 8 percent.

Individuals who suffer from any febrile disease have excess caloric requirements. In malaria the excess caloric intake required daily is 400 kilo calories or 100 grams of carbohydrates for an average of 5 days. Because the GOI is especially concerned with improving the nutritional standard of the people, and those most likely to suffer malaria are food producers, it is safe to assume that the excess caloric requirement will require additional food imports. Table 1/ on Annex provides the projected losses as a result of this additional consumption.

Benefits

The project's direct gross benefits are the expenditures avoided in medical treatment and drugs imports, and the losses avoided as a result of the farmers' loss of earnings and the additional food imports avoided as a result of excess caloric requirement.

To arrive at the net benefits we have subtracted from the gross benefits the costs incurred in the construction and operation of the project and the expenditures and losses due to malaria during the operation of the program.

Besides the direct benefits that lend themselves to quantification, we have encountered an equal or greater number of benefits whose impact cannot be assessed directly in economic terms. The most significant ones being:

- strengthening of the general health delivery system;

- decrease of the incidence of other diseases (malaria reduces the general state of an individual's health);

- an indirect contribution to food production and labor productivity; and

- creating the needed malaria free environment in the dry zone where major irrigation and settlement schemes are in progress.

2. Current Health Expenditures

A major reason for the rise in the incidence of malaria in the mid 1960's and early 1970's was the withdrawal of Government financial support for the Surveillance Phase of the program. As the following table indicates, the Government has again given priority to malaria control.

Year	Expenditure on Malaria (Rs. 1000's)	
1968	11,758	(actual)
1969	21,455	(actual)
1970	15,738	(actual)
1971	14,057	(actual)
1972	26,018	(actual)
1973	19,192	(actual)
1974	28,467	(actual)
1975	32,829	(actual)
1976	53,416	(actual)
1977	95,730	(planned)
1978	97,425	(planned)
1979	96,932	(planned)
1980	78,416	(planned)
1981	53,497	(planned)

It is also important to note the relative priority accorded malaria in the Government's Health Sector budget where during the five year project malaria control activities will account for about 20 percent of the Government's resource allocation to the sector. This represents an extreme bias to malaria given the fact that the Government budget supports an estimated 80 percent of country wide expenditures for western type clinical and public health services and about 95 percent if only rural areas are considered.

The following table details Government health expenditures in Sri Lanka for the years 1974-1976. Support for malaria control will almost double during the first three years of the intensive spraying program, remain relatively high through the Surveillance Phase and decline somewhat after integration.

Government of Sri Lanka Health Sector Expenditures, 1974-1976 (Rs.)

Recurrent Expenditures	1974	1975	1976
General Administration	4,176,905	4,095,960	4,567,454
Regional Administration	7,516,208	9,702,770	12,144,543
Training & Scholarships	8,451,338	7,817,980	12,062,453
Subtotal	20,144,451	21,616,760	28,774,547
Patient Care Services			
Colombo Group of Hospitals	39,402,005	44,019,100	52,755,306
Provincial & Base Hospitals	60,886,837	66,953,833	79,165,710
District Hospitals	38,209,874	44,429,632	50,587,605
Peripheral Units & Rural Hospitals	18,578,362	21,570,093	21,573,160
Central Dispensary's & Maternity Homes	12,049,323	12,804,950	13,180,145
Specialized Hospitals	20,400,780	21,277,410	26,270,580
Laboratory & Other Diagnostic Service	8,260,220	9,004,070	10,245,260
National & Blood Transfusion Service	2,100,972	2,107,590	2,241,890
Maintenance of Equipment	1,201,870	1,505,850	2,585,490
Quality Control Laboratory	123,260	158,450	97,170
Medical Research Institute	2,239,300	2,737,320	3,066,903
Assistance to Private Organizations & Local Authorities	1,762,777	1,786,777	1,796,777
Subtotal	205,265,680	228,354,987	263,566,016
Community Health Service			
General Preventive & Environmental Sanitation	9,924,190	11,584,090	13,733,732
Family Health	17,367,991	15,710,770	25,006,785
Health Education	834,841	712,330	1,060,560
School Healths Including School Dental Health	2,126,196	2,513,810	2,350,020
Quarantine	594,060	635,120	712,080
Malaria Control	27,536,605	29,601,530	53,416,100
Filaria Control	2,626,888	2,837,620	3,097,660
Veneral Diseases Control	1,194,476	1,093,300	1,251,300
Subtotal	62,205,247	64,688,570	81,628,237
Total Recurrent	287,615,378	314,660,267	393,468,800
Capital	16,603,591	16,511,220	23,161,797
Total	304,218,969	331,171,497	416,630,597

Table 1

MALARIA CONTROL PROJECT - FINANCIAL COSTS SUMMARY

(Million Sri Lanka Rupees)

	1977	1978	1979	1980	1981	Total
Capital Items and Inputs:						
Vehicles	1.376	3.368	4.049	4.049	4.049	16.892
Spares for Vehicles	.495	.252	.252	.495	.495	1.989
Fuel and Oil	1.800	1.800	1.800	1.800	1.350	8.550
	3.671	5.420	6.101	6.344	5.894	27.431
Contingencies 15%	.551	.813	.915	.951	.884	4.114
Sub-total	4.222	6.233	7.016	7.295	6.778	31.545
Laboratory Equipment	1.422	1.422	1.422	1.215	.882	6.363
Spraying Equipment	.315	.315	.225	.135	.045	1.035
Office Equipment and Supplies	.270	.270	.270	.270	.270	1.350
Spares Laboratory and Spraying Equip.	.360	.360	.360	.360	.180	1.620
Local Commodities and Equipment	1.422	1.422	1.422	1.215	.888	6.369
	3.789	3.789	3.699	3.195	2.265	16.737
Contingencies 10%	.379	.379	.369	.319	.226	1.673
Sub-total	4.168	4.168	4.068	3.514	2.491	18.410
Utilities and Postage	.378	.378	.378	.360	.360	1.854
Rent	.153	.153	.153	.099	.099	.657
	.531	.531	.531	.459	.459	2.511
Contingencies 3%	.016	.016	.016	.014	.014	.075
Sub-total	.547	.547	.547	.473	.473	2.586

Table 1 (Continued)

MALARIA CONTROL PROJECT - FINANCIAL COSTS SUMMARY

(Million Sri Lanka Rupees)

	1977	1978	1979	1980	1981	Total
Capital Items and Inputs:						
Insecticides	56.457	56.457	35.262	16.596	15.309	180.072
Drugs	2.520	1.800	1.098	.702	.698	6.816
	58.977	58.257	36.360	17.298	15.998	186.888
Contingencies 13%	7.667	7.573	4.726	2.248	2.079	24.295
Sub-total	66.644	64.010	41.086	19.546	18.077	211.183
Total Capital Items and Inputs	75.581	74.958	52.717	30.828	27.819	265.724
Operations and Maintenance:						
Salaries and Wages	22.518	24.249	27.207	23.670	22.176	119.790
Travel	1.400	1.400	1.400	1.400	1.400	7.000
Local Training	.126	.144	.261	.261	.261	1.053
	24.044	25.793	28.868	25.331	23.837	127.843
Contingencies 8%	1.923	2.061	2.309	2.026	1.907	10.227
Sub total	25.967	27.824	31.177	27.357	25.744	138.070
AID Training	.054	.054	.054	.054	.054	.270
WHO Technicians	.816	.909	.972	.972	.972	4.671
Sub-total	.900	.963	1.026	1.026	1.026	4.941
Total O & M	26.867	28.787	32.203	28.383	26.770	143.011
TOTAL COSTS	102.448	103.745	84.920	59.211	54.589	406.735

Table 2

MALARIA CONTROL PROJECT - ECONOMIC COSTS SUMMARY

(US $1.00 = Rs 20) (Million United States Dollars)

	1977	1978	1979	1980	1981	Total
Capital Items and Inputs:						
Vehicles	.069	.168	.202	.202	.202	.843
Spares for Vehicles	.025	.013	.013	.025	.025	.101
Fuel and Oil	.090	.090	.090	.090	.068	.428
	.184	.271	.305	.317	.295	1.372
Contingencies 15%	.028	.041	.046	.048	.044	.207
Sub-total	.212	.312	.351	.365	.339	1.579
Laboratory Equipment	.071	.071	.071	.061	.044	.318
Spraying Equipment	.016	.016	.011	.007	.002	.052
Office Equipment and Supplies	.014	.014	.014	.014	.014	.070
Spares Laboratory and Spraying Equip.	.018	.018	.018	.018	.009	.081
Local Commodities and Equipment	.071	.071	.071	.061	.044	.318
	.190	.190	.185	.161	.113	.839
Contingencies 10%	.019	.019	.018	.016	.013	.084
Sub-total	.209	.209	.203	.177	.126	.923
Utilities and Postage	.019	.019	.019	.018	.018	.093
Rent	.008	.008	.008	.005	.005	.034
	.027	.027	.027	.023	.023	.127
Contingencies 3%	.001	.001	.001	.001	.001	.005
Sub-total	.028	.028	.028	.024	.024	.132

Table 2 (Continued)

MALARIA CONTROL PROJECT - ECONOMIC COSTS SUMMARY

(US $1.00 = Rs 20) (Million United States Dollars)

	1977	1978	1979	1980	1981	Total
Capital Items and Inputs:						
Insecticides	2.823	2.823	1.763	.980	.765	9.154
Drugs	.126	.090	.055	.035	.035	.341
	2.949	2.913	1.818	1.015	.800	9.495
Contingencies 13%	.380	.379	.236	.132	.104	1.234
Sub-total	3.332	3.292	2.054	1.147	.904	10.729
Total Capital Items and Inputs	3.781	3.748	2.636	1.541	1.391	13.186
Operations and Maintenance:						
Salaries and Wages	1.126	1.211	1.360	1.184	1.109	5.990
Travel	.070	.070	.070	.070	.070	.350
Local Training	.006	.007	.013	.013	.013	.602
	1.202	1.288	1.443	1.267	1.192	6.942
Contingencies 8%	.096	.103	.115	.101	.095	.510
Sub-total	1.298	1.391	1.558	1.368	1.287	7.452
AID Training	.003	.003	.003	.003	.003	.015
WHO Technicians	.042	.045	.049	.049	.049	.234
Sub-total	.045	.048	.052	.052	.052	.249
Total O & M	1.343	1.439	1.610	1.420	1.339	7.701
TOTAL COSTS	5.122	5.187	4.246	2.960	2.730	20.245

Table 3

SUMMARY OF ECONOMIC COSTS AND BENEFITS

(Million Sri Lanka Rupees)

	Project Costs				
Year	Capital Items	O & M Costs	Gross Costs	Gross Benefits	Net Benefits
1977	75.581	26.867	102.448	100.638	- 1.810
1978	74.958	28.787	103.745	129.350	+ 25.605
1979	52.717	32.203	84.920	151.770	+ 66.850
1980	30.828	28.383	59.211	194.586	+ 135.375
1981	27.819	26.770	54.589	225.833	+ 171.244
TOTAL	261.903	143.010	404.913	802.177	+ 397.264

Table 4

SUMMARY OF ECONOMIC COSTS AND BENEFITS

(Million United States Dollars)

US $1.00 = Rs 20

	Project Costs				
Year	Capital Items	O & M Costs	Gross Costs	Gross Benefits	Net Benefits
1977	3.779	1.343	5.122	5.032	- .090
1978	3.748	1.439	5.187	6.468	+ 1.281
1979	2.636	1.610	4.246	7.589	+ 3.343
1980	1.541	1.419	2.960	9.729	+ 6.769
1981	1.391	1.339	2.730	11.292	+ 8.562
TOTAL	13.095	7.150	20.245	40.109	+ 19.864

Table 5

NUMBER OF MALARIA CASES TREATED FROM 1972 TO 1975[1]

Year	Indoor Patients	Out-Patients	Total Patients	Percentage Change
1972	49,414	314,211	363,625	
1973	65,409	347,010	412,419	13%
1974	121,572	587,029	708,601	71%
1975	90,538	1,345,902	2,251,290	220%

Source: AMC

1 Only detected and treated. Represents about 40 to 50 percent of actual cases.

Table 6

ESTIMATED NUMBER OF MALARIA CASES

WITH AND WITHOUT THE PROJECT[1]

Year	Number of Cases Without the Project	Number of Cases With the Project	Number of Cases Avoided
1977	6,096,000	1,280,160	4,815,840
1978	6,205,000	744,600	5,460,400
1979	6,317,000	631,700	5,685,300
1980	6,431,000	6,431	6,424,569
1981	6,547,000	1,310	6,545,690

Source: AMC

1 By the end of 1979 it is expected that all active foci of transmission would cease to exist.

Table 7

ESTIMATED NUMBER OF MALARIA PATIENTS BY TYPE OF TREATMENT REQUIRED

WITHOUT THE PROJECT, 1977 - 1981

(Average API 1931-1947 = 425/1000)

Year	Indoor Patients	Out-Patients	Total
1977	609,600	5,486,400	6,096,000
1978	620,500	5,584,500	6,205,000
1979	631,700	5,685,300	6,317,000
1980	643,100	5,787,900	6,431,000
1981	654,700	5,892,300	6,547,000

Source: AMC.

Table 8

ESTIMATED NUMBER OF INDOOR PATIENTS BY TYPE OF MALARIA

WITHOUT THE PROJECT, 1977 - 1981

Year	Uncomplicated Malaria	Cerebral Malaria[1]
1977	426,720	182,880
1978	434,350	186,150
1979	442,190	189,510
1980	450,170	192,930
1981	458,290	196,410

Source: AMC

[1] Thirty percent of indoor cases are caused by cerebral malaria.

Table 9

ESTIMATED COST OF MEDICAL TREATMENT OF OUTDOOR PATIENTS WITHOUT PROJECT, 19"" - 1981 [1]

Year	Number of Cases	Cost per Patient [2]	Total Cost (Rs million)
1977	5,486,400	Rs 0.58	3.82
1978	5,584,500	0.67	3.741
1979	5,685,300	0.77	4.378
1980	5,787,900	0.89	5.151
1981	5,892,300	1.02	6.010
	28,436,400		22.463

1 Excluding the cost of drugs.

2 In 1976 the cost of medical treatment of outdoor patients at medical institutions was Rs 0.50 per day. We have assumed a one day visit to a hospital. We have also estimated a 15% increase per annum of the cost of medical treatment.

Table 10

ESTIMATED COST OF MEDICAL TREATMENT OF INDOOR PATIENTS

BY TYPE OF MALARIA WITHOUT PROJECT, 1977 - 1981

Year	Uncomplicated Malaria[1]			Cerebral Malaria[3]		
	Number of Cases	Cost per Patient[2]	Total Cost (Rs million)	Number of Cases	Cost per Patient[4]	Total Cost (Rs million)
1977	426,720	Rs 28.75	12.268	182,880	Rs 375	68.580
1978	434,350	33.06	14.360	186,150	435	80.975
1979	442.190	38.03	16.812	189.510	495	93.807
1980	450.170	43.72	19.681	192.930	570	109.970
1981	458,290	50.28	23.043	196,410	660	129.631
	2,211,72-		86.164	947,880		482.963

[1] Excluding the cost of drugs.

[2] In 1976 the cost of medical treatment of a patient was Rs 5 per day and the average number of days in a hospital is 5. We have estimated a 15 percent increase per annum in the cost of medical treatment.

[3] Including the cost of drugs.

[4] In 1976 the cost of medical treatment of a cerebral malaria patient was Rs 21.25 per day. The average number of days in a hospital is 15. We have estimated a 15 percent increase per annum in the cost of medical treatment.

Table 11

Estimated Cases and Cost of Medical Treatment With and Without the Project, 1977 - 1981

Indoor Patients - Uncomplicated Malaria

Year	Cases Without Project	Cases With Project	Cases Avoided	Cost per Patient	Cost Without Project (Rs million)	Cost With Project (Rs million)	Net Benefit (Rs million)
1977	426,720	89,611	337,109	Rs 28.75	12.268	2.756	9.692
1978	434,350	52,122	382,228	33.06	15.360	1.723	12.636
1979	442,190	44,219	397,971	38.02	16.812	1.681	15.131
1980	450,170	450	449,720	43.72	19.681	.197	19.662
1981	458,290	92	458,198	50.28	23.043	.005	23.038
	2,211,720	186,494	2,025,226		86.164	6.182	80.159

Table 12

Estimated Cases and Cost of Medical Treatment With and Without the Project, 1977 - 1981

Indoor Patients - Cerebral Malaria

Year	Cases Without Project	Cases With Project	Cases Avoided	Cost per Patient	Cost Without Project (Rs million)	Cost With Project (Rs million)	Net Benefit (Rs million)
1977	182,880	38,405	144,475	Rs 375	68.580	14.402	54.178
1978	186,150	22,338	163,812	435	80.975	9.717	71.258
1979	189,510	18,951	170,559	495	93.807	9.380	84.427
1980	192,930	193	192,737	570	109.970	.110	109.860
1981	196.410	39	196,371	660	129.630	.026	129.604
	947,880	79,926	867,954		482.963	33.635	449.328

Table 13

Estimated Cases and Cost of Medical Treatment With and Without the Project, 1977 - 1981

Outdoor Patients

Year	Cases Without Project	Cases With Project	Cases Avoided	Cost per Patient[1]	Cost Without Project (Rs million)	Cost With Project (Rs million)	Net Benefit (Rs million)
1977	5,486,400	1,152,100	4,334,300	Rs .58	3.182	.668	2.514
1978	5,584,500	670,100	4,914,400	.67	3.742	.449	3.293
1979	5,685,500	568,500	5,116,800	.77	4.378	.438	3.940
1980	5,787,900	5,800	5,782,100	.89	5.152	.006	5.146
1981	5,892,300	1,100	5,891,200	1.02	6.010	.001	6.009
	28,436,400	2,397,600	26,038,800		22.464	1.562	20.902

1 Excluding the cost of drugs.

Table 14

Estimated Cost of Drugs With and Without the Project, 1977 - 1981

Indoor Patients - Uncomplicated Malaria

Year	Cases Without Project[1]	Cases With Project	Cases Avoided	Cost per Patient[2]	Cost Without Project (Rs million)	Cost With Project (Rs million)	Net Benefit (Rs million)
1977	320,040	25,283	294,757	Rs 3.00	.960	.076	.884
1978	325,763	39,092	286,671	3.45	1.124	.135	.989
1979	331,643	23,215	308,428	3.92	1.300	.091	1.209
1980	337,628	338	337,290	4.51	1.523	.002	1.521
1981	343,628	69	343,559	5.19	1.783	.001	1.782
	1,658,702	87,997	1,570,705		6.690	.305	6.385

[1] Taking the different age groups into account, the total drug requirement would be approximately 75% of the requirements for adults only.

[2] The average adult malaria patient takes 10 tablets of amodiaquin and 10 tablets of of primaquin. In 1976 the price of amodiaquin was Rs 153 per thousand and the price of primaquin was Rs 23 per thousand.

We have assumed a 15% increase per annum in the cost of drugs, although the price of amodiaquin rose from Rs 23 per thousand to Rs 153 per thousand in 1975.

Table 15

Estimated Cost of Drugs With and Without the Project, 1977 - 1981

Outdoor Patients

Year	Cases Without Project[1]	Cases With Project	Cases Avoided	Cost per Patient[2]	Cost Without Project (Rs million)	Cost With Project (Rs million)	Net Benefit (Rs million)
1977	4,114,800	846,100	3,250,700	Rs 3.00	12.344	2.538	9.806
1978	4,118,700	494,100	3,624,500	3.45	14.210	1.705	12.505
1979	4,264,000	426,400	3,837,600	3.92	16.715	1.671	15.044
1980	4,340,000	5,200	4,335,700	4.51	19.573	.023	19.550
1981	4,419,200	900	4,418,300	5.19	22.936	.005	22.931
	21,257,600	1,772,700	19,466,800		85.778	5.942	79.836

[1] Taking the different age groups into account, the total drug requirement would be approximately 75% of the requirements for adults only.

[2] The average adult malaria patient takes 10 tablets of amodiaquin and 10 tablets of primaquin. In 1976 the price of amodiaquin was Rs 153 per thousand and the price of primaquin was Rs 23 per thousand.

We have assumed a 15% increase per annum in the cost of drugs.

Table 16

Estimated Loss of Income With and Without the Project, 1977 - 1981

Year	Workers Affected Without Project	Workers Affected With Project	Cases Avoided	Average Income Loss per Worker	Average Income per Day	Income Lost Without Project (Rs million)	Income Lost With Project (Rs million)	Net Benefit (Rs million)
1977	1,089,500	228,795	860,705	Rs 25.05	Rs 5.01	27.292	5.731	21.561
1978	1,108,500	133,200	975,480	27.05	5.41	29.985	3.598	26.387
1979	1,127,500	112,750	1,014,750	29.20	5.84	32.923	3.292	29.631
1980	1,146,500	1,146	1,145,354	31.55	6.31	36.172	.036	36.136
1981	1,166,000	233	1,165,767	34.05	6.81	39.702	.008	39.694
	5,638,000	475,944	5,162,056			166.074	12.655	153.409

Table 17

Estimated Cost of Rice Required to Satisfy Excess Caloric Intake
With and Without the Project, 1977 - 1981[1]

Year	Adults Affected Without Project[2]	Adults Affected With Project	Avoided Adults Cases	No. of Days	Price per Kg.[3]	Cost Without Project (Rs million)	Cost With Project (Rs million)	Net Benefit (Rs million)
1977	2,438,400	512,064	1,936,336	5	Rs 2.08	2.536	.533	2.003
1978	2,482,000	297,840	2,184,160	5	2.09	2.594	.311	2.282
1979	2,526,800	252,680	2,274,120	5	2.10	2.653	.265	2.388
1980	2,572,400	2,572	2,569,828	5	2.11	2.714	.003	2.711
1981	2,618,800	524	2,618,276	5	2.12	2.776	.001	2.775
	12,638,400	1,065,680	11,572,720			13.272	1.112	12.160

1
In malaria, the excess caloric intake required daily by an adult (those between the ages of 15 and 60 years) is 400 kilo calories or 100 grams of carbohydrates for an average of 5 days.

2
According to the latest demographic study, the population structure by age group will remain as follows: 0 - 6 years: 15%; 7 - 14 years: 30%; 15 - 60 years: 40%; over 60 years: 15%.

3
By the end of 1976 the world price of 1 kilogram of rice was Rs 2.
Over the last ten years the price of rice has increased by an average of 4 percent per annum.

Benefit-Cost Ratio, Net Present Worth and Internal Economic Return of Malaria Control Project, 1977 - 1981

(Million United States Dollars)

Year	Gross Costs	D.F. 15%	P.W. 15%	Bene-fits	P.W. 15%	Incre-mental Bene-fit 15%	P.W. 15%	D.F. 30%	P.W. 30%	D.F. 50%	P.W. 50%
1977	5.122	.870	4.456	5.032	4.378	- .090	- .078	.769	- .069	.667	- .060
1978	5.187	.756	3.921	6.468	4.890	+ 1.281	+ .968	.592	+ .758	.444	+ .569
1979	4.246	.658	2.794	7.589	4.994	+ 3.345	+ 2.200	.455	+1.522	.296	+ .990
1980	2.960	.572	1.693	9.729	5.565	+ 6.769	+ 3.872	.350	+2.369	.198	+ 1.340
1981	2.730	.498	1.360	11.292	5.623	+ 8.562	+ 4.264	.269	+2.303	.132	+ 1.130
	20.245	3.354	14.224	40.109	25.450	+19.865	+11.226	2.435	+6.883	1.667	+ 3.969

Benefit-Cost Ratio at 15% . . . . . $\frac{25.450}{14.224}$ = 1.8

Net Present Worth at 15% . . . . . = $+11.226

Internal Economic Return over 50%

Project Sensitivity Analysis

Most Probable Outcome

Year	Costs	Benefits	Incremental Benefit	D.F. 15%	P.W. 15%	D.F. 50%	P.W. 50%
1977	5.122	5.032	- .090	.870	- .878	.667	- .060
1978	5.187	6.468	+ 1.281	.756	+ .968	.414	+ .569
1979	4.246	7.589	+ 3.343	.658	+ 2.200	.296	+ .990
1980	2.960	9.729	+ 6.769	.572	+ 3.872	.198	+ 1.340
1981	2.730	11.292	+ 8.562	.498	+ 4.264	.132	+ 1.130
	20.245	40.109	+19.865	3.354	+11.226	1.667	+ 3.969

The internal economic return is over 50%.

Assuming a 30% Cost Overrun

Year	Costs	Benefits	Incremental Benefit	D.F. 15%	P.W. 15%	D.F. 50%	P.W. 50%
1977	6.659	5.032	- 1.627	.870	- 1.415	.667	- 1.085
1978	6.743	6.468	- .275	.756	- .208	.444	- .122
1979	5.520	7.589	+ 2.069	.658	+ 1.361	.296	+ .612
1980	3.848	9.729	+ 5.881	.572	+ 3.364	.198	+ 1.164
1981	3.549	11.292	+ 7.743	.498	+ 3.856	.132	+ 1.022
	26.319	40.109	+13.791	3.351	+ 4.958	1.667	+ 1.591

The internal economic return is still over 50%.

Assuming a 40% Decrease of the Benefits

Year	Costs	Benefits	Incremental Benefit	D.F. 15%	P.W. 15%	D.F. 30%	P.W. 30%
1977	5.122	3.019	- 2.103	.870	- 1.830	.769	- 1.617
1978	5.187	3.881	- 1.306	.756	- .987	.598	- .781
1979	4.246	4.553	+ .307	.658	+ .202	.455	+ .140
1980	2.960	5.837	+ 2.877	.572	+ 1.646	.350	+ 1.007
1981	2.730	6.775	+ 4.045	.498	+ 2.014	.269	+ 1.088
	20.245	24.065	+ 3.820	3.354	+ 1.045	2.441	- .163

$$IER = 15 + (30 - 15)\ \frac{+ 1.015}{(+1.045) - (-.163)}$$

The internal economic return is approximately 28%.

Assuming a 30% Cost Overrun and a 20% Decrease of the Benefits

Year	Costs	Benefits	Incremental Benefit	D.F. 15%	P.W. 15%	D.F. 35%	P.W. 35%
1977	6.659	4.026	- 2.633	.870	- 2.291	.741	- 1.951
1978	6.743	5.174	- 1.569	.756	- 1.186	.549	- .861
1979	5.520	6.071	+ .551	.658	+ .363	.406	+ .224
1980	3.848	7.783	+ 3.935	.572	+ 2.251	.301	+ 1.184
1981	3.549	9.034	+ 5.485	.498	+ 2.732	.223	+ 1.223
	26.319	32.088	+ 5.769	3.354	+ 1.869	2.220	- .081

The internal economic return is approximately 32%.

Assuming a 10% Cost Overrun and a 40% Decrease of the Benefits

Year	Costs	Benefits	Incremental Benefit	D.F. 15%	P.W. 15%
1977	5.634	3.019	- 2.615	.870	- 1.977
1978	5.706	3.881	- 1.825	.756	- 1.380
1979	4.661	4.553	- .108	.658	- .071
1980	3.256	5.837	+ 2.581	.572	+ 1.476
1981	2.903	6.775	+ 3.872	.498	+ 1.928
	22.160	24.065	+ 1.905	3.354	- .024

The internal economic return is slightly less than 15%.

B. INDONESIA

AN ECONOMIC ANALYSIS OF MALARIA CONTROL IN JAVA-BALI-MADURA AND OUTER ISLANDS

Summary and Conclusions

An economic analysis of Malaria Control in Java-Bali-Madura and the Outer Islands indicates that economic benefits are very minimal from control in Java-Bali-Madura, but very large from control in the Outer Islands. The major difference between the two regions being that Java-Bali-Madura has had previous control programs and a follow-on program can be expected to further reduce malaria by only 9.9 persons per thousand population. The Outer Islands, however, have had control in only a few priority areas so an initial program can be expected to reduce malaria by 99 persons per thousand population.

Various sensitivity tests indicate that: 1) A $35 to $50 million program in the Outer Islands is economically justified; 2) A $35 to $50 million program in Java-Bali-Madura is not economically justified; 3) A joint program that embraces Java-Bali-Madura and the Outer Islands, but with the majority of investment taking place in the Outer Islands, is economically justifiable; and, 4) A joint program involving Java-Bali-Madura and the Outer Islands with the majority of investment in Java-Bali-Madura is not economically justified.

Not all health investments are desirable from an economic point of view. This, however, in no way implies that pain and discomfort are economically desirable - - we find such a notion repugnant. Aside from a humanitarian desire to free people from pain and discomfort, we find that malaria control programs in Indonesia have desirable income distribution properties. Since malaria disproportionately affects people in rural areas, the prime beneficiaries of malaria control are the rural poor.

Introduction

The Government of Indonesia with assistance from the United States Government and the World Health Organization proposes to extend malaria control to the Outer Islands of Indonesia. Existing programs provide effective coverage for Java-Bali and a few priority areas of the Outer Islands. Throughout the Outer Islands, however, malaria continues to be a serious health problem. This economic evaluation assesses, in light of what has occurred in previous campaigns in Java-Bali, the probable magnitude of the benefits that will be generated under the Outer Island Activity.

Benefits from health investments in general and communicable disease investments in particular are notoriously difficult to estimate. The present analysis has proved to be no exception. What is offered here should only be taken as impressionistic. Data, when not altogether lacking, is for the most part incomplete and consequently we can only provide general trends or rough magnitudes of the expected benefits from the proposed malaria activity.

Evaluation of Benefits

Conceptually, the benefits from malaria control fall into three broad categories: A) avoidance of lost income to society; B) avoidance of higher medical cost to society; and , C) prevention of pain and suffering on the part of the affected individual.

Income (or production) to society is lost when members of the labor force are prevented from working or when at work they are less than efficient due to malaria. Additionally, there are losses of productive services when family members (housewives and children) are prevented from performing household services. Household services have no market price and we have no way of inputing a price, but nevertheless, we should be aware that their loss is a real economic cost. In the present study, we attempt only to measure the lost output of affected members of the labor force. In Indonesia, the labor force is defined as all persons ten years of age or older who are employed or unemployed and actively seeking work. From our labor force estimates, we have subtracted out the unemployed. Official Government statistics put the unemployment rate at about five percent per annum, but there is considerable evidence of hidden unemployment. Academic economists from Indonesian universities have estimated the true unemployment rate to about nine percent and we have used this higher estimate. A far more serious problem than unemployment is that of under employment or disguised unemployment. The economic efficiency of a malaria control program is clearly affected by whether it saves people from illness to resume a productive

life, or whether it only saves people to pursue an unproductive life. Indonesia is clearly a labor surplus economy with disguised unemployment occurring in about thirty percent of the labor force. In all probability the amount of time lost, due to malaria among the under-employed, would result in little or no loss of output. In this analysis, we use the average market real wage to reflect the lost output from an employed member of the labor force. For the output of thirty percent of underemployed, we have assigned a shadow wage that is one-half the market wage of the employed. The output of the unemployed, of course, is evaluated at a price of zero (See Table 3).

The medical costs for the percentage of malaria cases that are treated are incurred for material and personnel which include drugs, clinical cost and sometimes hospitalization cost. Additionally, while not strictly a medical expenditure, but somewhat related, is the higher calorie requirement for the number of days a person suffers a febrile disease. These treatment costs represent a use of resources that society would otherwise not have committed in the absence of the disease. They are benefits, in the sense of being costs avoided, and apply to all cases that will be treated throughout the life of the project.

A third benefit arising from malaria control is the consumption benefit of allowing people to be free from pain and discomfort. Health investments are somewhat peculiar in that they normally have a large consumption component. Considerable pain and suffering are avoided through health investment, and in most cases, the investment will be made regardless of economic efficiency. A prime example is the considerable amount of resources expended for terminal cancer patients. Because consumption is the ultimate goal of all economic activity, we are willing to make these investments for only their consumption component. The amount of money a person is willing to pay to avoid pain and discomfort may be a measure of the value of avoiding the disutility. However, in the present study, we have no method for measuring the consumption benefits of prevented pain and discomfort. Nevertheless, it is important to keep in mind that these consumption benefits are very important (albeit non-measurable) and may very well exceed in importance the other benefits of avoided income loss and medical cost.

Evaluation of Cost

The total cost of the loan is expected to be 50 million U. S. dollar equivalents (U.S.G.$35 million, GOI $15 million*) expended over a five year period. Since the exact structure of the expenditures (portion to be expended upon Java-Bali and Outer Islands and the timing of expenditures) is not known, we have assumed the following divisions.

*The Government of Indonesia expends for malaria control from developmental and routine budgets. The routine budget is used to pay regional health personnel in the Outer Islands. It is not known whether routine budget expenditures are included in the GOI $15 million contribution.

$50 MILLION MALARIA PROJECT

Year	Program Only In Java-Bali-Madura	Program Only In Outer Islands
1979	$ 15 million	$ 5 million
1980	10	10
1981	10	15
1982	10	10
1983	5	10
	50 million	50 million

The above time distribution reflects the fact that investment funds can be expended sooner in Java-Bali-Madura because of existing malaria institutions. New programs in the Outer Islands will, of course, require institution building and hence a delay of about three years before expenditures are expected to peak. Under a $35 million total investment program we have assumed the same annual expenditure pattern as in the larger program.

The costs are further categorized by whether they are domestic expense or foreign exchange outlays. Labor and domestically procured equipment-supplies are examples of domestic costs while imported vehicles, DDT, commodities and laboratory equipment will involve foreign exchange outlays. We draw this distinction because we will evaluate domestic expenses at their domestic rupiah value, but the foreign exchange outlays will be evaluated at a shadow exchange rate. Illegal markets for foreign exchange do not exist in Indonesia, but it is known that the demand for import licenses exceeds the Government supply of import licenses at the present rate of exchange (US $1= R 415). In other words, the excess demand for foreign exchange indicates that one unit of foreign currency (to import goods or services) is capable of earning more rupiah domestically than the official rate indicates. Accordingly, we must raise the price of foreign exchange through the use of a shadow exchange rate. This will, of course, raise the import cost for any imported commodities used in the malaria project. If we assume that the rupiah is 20% overvalued vis-a-vis the U. S. dollar, then the shadow rate of exchange becomes 500 rupiah per dollar.

Results of Calculations*

1. The first internal rate of return (IRR) is generated for the most likely program size. In all probability the program will involve approximately 50 million U. S. dollar equivalents expended over a five year period. If $50 million is allocated to malaria control exclusively upon Java-Bali-Madura, the IRR will be well in excess of negative 50%. If, however, the same

*See Table 8 for Summary of Economic Analysis.

$50 million program were spent upon malaria control in the Outer Islands the IRR will be slightly in excess of positive 50%. Two factors produce these diverse results. Java-Bali-Madura have had malaria control for some time and the present follow-on project will be able to further lower malaria by only 9.9 persons per 1000 population. In the Outer Islands, however, where only a few priority areas have had malaria control the project will be able to lower malaria by 99 persons per 1000 population. Secondly, there are sharply increasing marginal costs to malaria control. New programs (as on the Outer Islands) can achieve dramatic reductions in malaria at moderate cost while follow-on programs will reach increasingly smaller numbers of people but at increasing cost.

2. In this second set of outcomes, we assume that the total project cost for the Government of Indonesia and the United States will not exceed $35 million. Secondly, it was necessary to assume that the benefits that are attainable under the $50 million program are also attainable under a $35 million program (hopefully an unrealistic assumption).

If a $35 million malaria program is conducted in Java-Bali-Madura the IRR would still be greater than negative 50% (indeed, the sum of the discounted benefits, discounted at an opportunity cost of capital of 15%, are not greater than the sum of discounted costs unless a malaria control program on Java-Bali-Madura does not exceed $8 million in total costs). Again, the same reasons in paragraph one above apply. Any malaria program on Java-Bali-Madura in excess of $8 million (Rp 3.3 billion) will incur rapidly diminishing returns to the marginal investment dollar.

The IRR to a $35 million malaria program in the Outer Islands rises to well above the positive 50% internal rate of return.

3. There is a third possible investment configuration that involves conducting the program simultaneously on Java-Bali-Madura and the Outer Islands. We assume the following investment mix for a $35 million program and a $50 million program.

	$35 Million Program		$50 Million Program	
	Java-Bali	Outer Island	Java-Bali	Outer Island
1979	$3 million	$5 million	$4 million	$7 million
1980	2	5	3	7
1981	2	5	3	7
1982	2	5	3	7
1983	1	5	2	7
	$10 million	$25 million	$15 million	$35 million

Further, we assume that the benefits from the investment program will accrue to the geographical region (Java-Bali, Outer Islands) in the same proportion as costs are incurred. That is, the program in Java-Bali will generate 30 percent of the benefits (and 30% of costs) and the Outer Islands will generate 70 percent of all benefits (and 70% of costs). Finally, we must again assume that the amount of benefits available under a $50 million program are also possible to a $35 million program.

Under this set of circumstances we find the IRR to a $35 million investment package within Java-Bali-Madura and the Outer Islands is well in excess of 50 percent. Similarly, the $50 million investment mix yields an IRR of around 50 percent. Under a mixed malaria program it is important to keep in mind that the majority of the benefits are generated in the Outer Islands and they, in a sense, carry the burden of a joint program.

4. A final investment configuration with which we can test the sensitivity of the internal rate of return is to reverse the above procedure. That is, we assume the preponderance of investment activity will take place in Java-Bali-Madura. We assume the same investment amounts by year but assign 70% of the investment cost to Java-Bali-Madura and 30% to the Outer Islands. In this situation, the internal rates of return are calculated to be about a negative 50 percent and well in excess of negative 50 percent for the $35 and $50 million programs, respectively.

(Note: In paragraph number two above we assume that the same objective outputs (reduce malaria to .1 persons per thousand population on Java-Bali-Madura and 1 person per thousand in the Outer Islands) are possible under a $35 or a $50 million dollar program. This, of course, is not true. A $35 million program would not be able to reach as many people as would a larger program -- but how fewer people we cannot say. We do know, because malaria control is subject to increasing cost, reduction in program size will involve disproportionately smaller reduction of benefits. It suffices to say that benefits are biased upward in a $35 million program).

TABLE 1. POPULATION PROJECTIONS*
(000 Omitted)

Year	Java-Bali-Madura	Outer Islands	Total
1971 base year	76,105	42,918	119,023
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
1979	89,169	50,167	139,336
1980	90,953	51,155	142,108
1981	92,772	52,163	144,935
1982	94,627	53,191	147,818
1983	96,520	54,235	150,755

* Annual regional population growth rates, based upon 1961-71 census data. are 2.00% for Java-Bali-Madura and a population-weighted index of 1.97% for all of the Provinces in the Outer Islands. Source: Central Bureau of Statistics, Social Indicators - 1973/74.

TABLE 2. LABOR FORCE PROJECTIONS*
(000 Omitted)

Year	Java-Bali-Madura	Outer Islands	Total	Net of Unemployment and Underemployment Java-Bali-Madura	Outer Isl.	Total
1971 base year	37,970	21,416	59,394	24,191	13,642	37,833
1979	46,632	26,298	72,930	29,705	16,752	46,457
1980	47,845	26,981	74,826	30,477	17,187	47,664
1981	49,089	27,683	76,772	31,270	17,634	48,904
1982	50,365	28,403	78,768	32,082	18,093	50,175
1983	51,675	29,141	80,816	32,917	18,563	51,480

*The labor-force participation rate for Java-Bali-Madura and the Outer Islands is 49.9%. While the general population has been growing at about 2.00% per year, the labor force has been growing at 2.6% per annum (See American Embassy Jakarta's Annual Labor Report, 10 June 197-, p.3.). The projections are based upon the assumption that the labor force will continue to grow at 2.6% per annum through 1983. The labor force here is defined as all persons 10 years of age and over who are employed or unemployed and seeking work. We have adjusted the labor force downward by taking out an annual unemployment rate of 9%.

The 9% unemployment rate used is slightly more than two times greater than the reported official unemployment rate and is undoubtedly closer to the true unemployment rate. Further, we have adjusted for the substantial underemployment believed to exist in Indonesia by adjusting downward the labor force by 30%. (See: Population and Manpower Patterns and Trends in Indonesia, Dr. L. Berouti, ILO, Jakarta 1974, p. 28.)

TABLE 3. REGIONAL DAILY REAL WAGE RATES*
(Rupiah/day)

	Base Year 1972	....	1979	1980	1981	1982	1983
Market Wage Rate for Employed							
Java-Bali-Madura	269	....	291	294	297	300	303
Outer Islands	390	....	418	422	427	431	435
Shadow Wage Rate for Underemployed							
Java-Bali-Madura	135	....	146	147	149	150	152
Outer Islands	195	....	209	211	214	216	218

*The wage projections are based upon an extrapolation of 1972 wage data. Most observers have noted that the majority of Indonesia's unskilled and semi-skilled workers probably have experienced little or no real wage increase. Hence, we have increased real wages by one percent per annum over the period. The average daily real wage is a composite of 1) money income composed of salaries and wages from principal, secondary, overtime and occasional work; 2) non-money income in payment in rice, transportation, medical care, housing, etc. In Java-Bali-Madura and the Outer Islands non-money income is approximately 15% and 16% respectively, of total receipts.

The wage data was obtained from a survey of ten major cities throughout Indonesia. Since a wage disparity exists in favor of cities over rural area, the estimates are biased upward when used as national wage data.

Sources: "Regional Price Disparities", H. W. Arndt and R. M. Sundrum, Bulletin of Indonesian Economic Studies, July 1975, p. 56.

"Household Income Patterns", R. M. Sundrum, Bulletin of Indonesian Studies, March 1974, p. 86.

"Regional Income Disparities", Hendra Esmara, Bulletin of Indonesian Economic Studies, March 1975, p. 54.

Annual Labor Report, American Embassy, Jakarta June 1977, p. 18.

TABLE 4. MALARIA INCIDENCE WITH AND WITHOUT CONTROL*

Year	Java-Bali-Madura Malaria Avoided Through Project	Outer Islands Malaria Avoided Through Project
1979	882,773	4,966,533
1980	900,435	5,064,345
1981	918,433	5,164,137
1982	936,807	5,265,909
1983	955,548	5,369,265

*For purposes of analyzing the beneficial impact of the present project upon malaria incidence, we need to know incidence without the present project. In the absence of malaria projects financed by foreign donor agencies, the Department of Health of the Government of Indonesia maintains a limited program in Java-Bali-Madura and priority areas in the Outer Islands. This limited program is capable of holding malaria incidence to 1% of the population on Java-Bali-Madura and about 10% in the Outer Islands. The malaria control expected from the present project will yield incidence rates of .01% and .1% on Java-Bali-Madura and the Outer Islands, respectively. It is important to recognize that these incidence rates are very uncertain estimates. Malaria is focal and hence geographic areas will differ markedly. Moreover, the positive rates reported from field clinics are subject to wide margins of error. Most importantly, malariometric surveys are not systematic, especially in the Outer Islands, and in most cases we simply do not know the extent of malaria. The above estimates were taken from: Report of the Situation Analysis of the Malaria Control Program of Indonesia, GOI/AID/WHO Joint Team, Jakarta, July 1976, p. 24. and Malaria Control Programme, WHO, Jakarta, 1977, p. 9.

TABLE 5. BENEFITS FROM MALARIA CONTROL IN JAVA-BALI-MADURA
(In Millions of Rupiah)

Year	Value of Avoided Income Loss[1]	Value of Avoided Caloric Loss[2]	Value of Avoided Treatment Costs[3]	Value of Avoided Pain and Discomfort[4]	Total Benefits
1979	624	88	216	-	928
1980	637	90	221	-	948
1981	671	92	224	-	987
1982	695	94	229	-	1,018
1983	720	96	234	-	1,050

1. The value of avoided income loss is calculated by multiplying the number of people in the labor force who will be affected by malaria by six days (the average number of sick days per year for untreated malaria) times the average daily wage rate. The product is discounted for each year. For the underemployed in the labor force we use the same procedure except that we substitute a shadow wage for the market wage.

2. The value of excess caloric intake is the product of the total number of malaria cases avoided in a given year multiplied by the cost of excess rice (Rp 20/day) and multiplied by 5 days (the average length of febrile treated malaria).

3. The value of treatment cost is the sum of drug cost plus clinic cost plus hospitalization cost. Drug cost is arrived at by multiplying the number of malaria patients who will be out-patients (67% of all malaria) by 100 rupiah (10 tablets of chloroquine at 10 rupiah per tablet). Clinic cost is the value of the number of malaria cases that will be clinic treated (33% of all malaria) multiplied by the cost of one clinic visit (Rp 400). Finally a small fraction of the malaria cases (.006) will require hospitalization. Daily hospital costs vary from Rp 1500 to Rp 5000. We use an average daily hospital cost of 1500 rupiah for an average five days of hospitalization.

4. Cannot be estimated. Note also that we have not estimated the value of avoided mortality in children and adults. The author did this and found the results to be too insignificant to warrant inclusion.

TABLE 6. BENEFITS FROM MALARIA CONTROL IN OUTER ISLANDS
(In Millions of Rupiah)

Year	Value of Avoided Income Loss[1]	Value of Avoided Calorie Loss[2]	Value of Avoided Treatment Costs[3]	Value of Avoided Pain and Discomfort[4]	Total Benefits
1979	5,051	497	1,216	-	6,764
1980	5,231	506	1,240	-	6,977
1981	5,434	516	1,264	-	7,214
1982	5,627	527	1.289	-	7,443
1983	5,826	537	1,315	-	7,678

1. The value of avoided income loss is calculated by multiplying the number of people in the labor force who will be affected by malaria by six days (the average number of sick days per year for untreated malaria) times the average daily wage rate. The product is discounted each year. For the underemployed in the labor force we use the same procedure except that we substitute a shadow wage for the market wage.

2. The value of excess calorie intake is the product of the total number of malaria cases avoided in a given year multiplied by the cost of excess rice (Rp 20/day) and multiplied by 5 days (the average length of febrile treated malaria).

3. The value of treatment cost is the sum of drug cost plus clinic cost plus hospitalization cost. Drug cost is arrived at by multiplying the number of malaria patients who will be out-patients (97% of all malaria) by 100 rupiah (10 tablets of chloroquine at 10 rupiah per tablet). Clinic cost is the value of the number of malaria cases that will be clinic treated (20% of all malaria) multiplied by the cost of one clinic visit (Rp 400). Finally a small fraction of the malaria cases (.006) will require hospitalization. Daily hospital costs vary from Rp 1500 to Rp 5000. We use an average daily hospital cost of 1500 rupiah for an average five days of hospitalization.

4. Cannot be estimated. Note also that we have not estimated the value of avoided mortality in children and adults. The author did this and found the results to be too insignificant to warrant inclusion.

TABLE 7. DOMESTIC AND FOREIGN EXCHANGE COSTS OF $50 MILLION MALARIA PROJECT[1]
(In Millions of Rupiahs)

Year	Total Project Costs Allocated to Java-Bali-Madura			Total Project Costs Allocated to Outer Islands		
	Domestic Costs[2]	Foreign Exchange Costs[3]	TOTAL	Domestic Costs[2]	Foreign Exchange Costs[3]	TOTAL
1979	3,361	3,450	6,811	1,121	1,150	2,271
1980	2,241	2,300	4,541	2,241	2,300	4,541
1981	2,241	2,300	4,541	3,361	3,450	6,811
1982	2,241	2,300	4,541	2,241	2,300	4,541
1983	1,121	1,150	2,271	2,241	2,300	4,541

1. The expected division of costs into domestic and foreign exchange components will be assumed to be the same percentages as occurred in the 1974-1979 Malaria Control Program. Under the previous program, 46% of all costs were foreign exchange outlays.

2. Domestic costs include expenditures upon labor, locally procurred equipment and supplies, construction and domestic transportation.

3. Foreign exchange costs are outlays for imported vehicles and spares, DDT commodities, laboratory and spraying equipment and international transportation charges. These costs are expressed in rupiah by converting them at the shadow exchange rate of Rp 500 = 1 U.S.$.

TABLE 8: SUMMARY OF ECONOMIC ANALYSIS

1. $50 Million Malaria Program:

   A.) Java-Bali-Madura only
   Internal Rate of Return = greater than negative 50%
   Benefit-Cost Ratio (discounted at 15%) = .21

   B.) Outer Islands only
   Internal Rate of Return = greater than positive 50%
   Benefit-Cost Ratio = 1.63

2. $35 Million Malaria Program:

   A.) Java-Bali-Madura only
   Internal Rate of Return = greater than negative 50%.
   Benefit-Cost Ratio = .29

   B.) Outer Islands only
   Internal Rate of Return = greater than positive 50%.
   Benefit-Cost Ratio = 2.31

3. 30% of Program in Java-Bali-Madura, 70% of Program in Outer Islands:

   A.) $35 Million Program
   Internal Rate of Return = greater than positive 50%
   Benefit-Cost Ratio = 1.66

   B.) $50 Million Program
   Internal Rate of Return = about positive 50%
   Benefit-Cost Ratio = 1.17

4. 70% of Program in Java-Bali-Madura, 30% of Program in Outer Islands:

   A.) $35 Million Program
   Internal Rate of Return = about negative 50%
   Benefit-Cost Ratio = .88

   B.) $50 Million Program
   Internal Rate of Return = greater than negative 50%
   Benefit-Cost Ratio = .62

C. Economic Analysis- NEPAL

1. Parameters

The approach in this section is to use available data on financial returns to individual agricultural labor and an average farm's family labor to estimate potential losses in non-commercial agricultural production precluded by implementation of the proposed project. (Very rough estimates are used of the pattern over time of malaria case incidence in the project's absence.) In addition, public health direct costs averted by project implementation are estimated.

The potential losses in non-commercial agriculture are derived from two different hypotheses. First, output per farm would be affected adversely by sickness in the labor force, but such losses would be for brief periods and would be experienced by a different farm population from day to day. Second, output would be lost due to land not being cultivated, either because farms (or parts of farms) would be abandoned or because settlers would delay opening new farms when malaria reached very high levels. Abandonment of viable farms would have long-term, very high costs, while delayed migration would have a once-for-all impact.

There is no double - counting of "production losses averted" between these calculations (the two flows are non-additive) because one loss occurs on farms in continuing production while the other occurs due to lands either ceasing to be tilled or

to postponement of initial cultivation. Project benefits are calculated for a 25-year period. Project costs, given in Part I (3), are increased at an annual rate of four percent from the "maintenance" base of 1980.

The analysis deals only with primary, non-commercial agriculture because of: i. Wage differentials which enable industries at the low level of technology characterizing Nepal to hire replacement labor away from agriculture at will, ii. Lack of data on returns to labor in the service industries, and iii. The overwhelming preponderance of agricultural labor in the active labor force in malarious areas.

Production of Different Crops - 1972-73

(Regional Breakdown)

Approximate % of Total Country Production

Originating in Primary Malarious Areas

Area	Paddy	Maize	Wheat	Oil Seed	Sugar cane
Eastern Terai	47	8	34	26	51
Western Terai	23	11	23	28	30
Inner Terai	7	14	6	35	2
Total	77	33	63	89	83

Percentages for paddy, maize and wheat can be significantly increased to account for production in (formerly) malarious hill river valleys.

There would be deaths primarily associated with epidemic malaria in the project's absence (above the few occurring under the

project) and malaria would be the secondary cause of approximately an equal number of deaths from other primary causes. It can be estimated that between 1%-2% of the cases would die or approximately 4,000 deaths per year from direct effects of malaria and 4,000 deaths per year from malaria as a secondary cause. No cost analysis has been made for deaths averted due to many variations of the nature of such calculations.

An estimate has been made regarding the number of malaria cases avoided by the program. It has been the experience in other countries in this part of Asia for malaria to double in incidence each year until a stable level of malaria has been reached. In Nepal, malaria cases since 1971 - 1974 have roughly followed this pattern.

Total	1971	1972	1973	1974
cases	2778	2320	8397	15,500

A projection of the cases occurring if no extensive malaria control is carried out over the next five years, cases assumed to occur with successful project implementation, and cases prevented, is given below:

	1975	1976	1977	1978	1979	1980
1. Est. total cases with no program	25,000	50,000	100,000	200,000	300,000	400,000
2. Est. total cases under Plan Ops.	25,000	25,000	15,000	7,000	5,000	3,000
3. Est. total cases prevented	0	25,000	85,000	193,000	295,000	397,000

4. Total cases prevented over project - approximately 1,000,000

Obviously, the massive impact of the 1978 and 1979 projections would be unacceptable and action would be taken on an emergency basis. It is assumed that cases would stabilize at 400,000 per year. (To the above figures would be added approximately 2500 imported cases of malaria from outside the country each year or 12,500 over the Plan Ops. period.)

The estimate of approximately 55,000 cases over the period 1976-1980 with the proposed program, subtracted from the estimate of 1,050,000 cases which would occur with no program, gives a balance of 995,000 cases of malaria averted by project implementation. The geometric growth characteristics of the disease of malaria clearly results in a dramatic public health impact and provides high returns to early control measures.

The flow of net project benefits is calculated according to the conditions specified above, and the project's internal rate of return is found. Additional, potential, project benefits are discussed but not quantified.

2. Economic Impact Assessment

a. Impact on Labor Productivity

During 1976-1980 it is assumed that 53% of the population will be in the labor force (54.3% in 1971) and that 92% of this labor force will be employed in agriculture (93% in 1971). Thus, of the 995,000 cases of malaria precluded by the proposed project's control activities, 48.76% or 485,650 are assumed to be in the agricultural labor force.

Section C provides a yearly estimate of the total population to be covered by this project. If 48.76% of the population in each year is estimated to be in the agricultural labor force, and malaria is assumed to occur at random (48.76% of malaria victims are in the agricultural labor force), then the following proportion of the calculated agricultural labor force in malarious areas would contract malaria each year in the project's absence (fiscal years and percentages):

1976	1977	1978	1979	1980
0.7	1.5	2.9	4.2	5.5

On the average, a worker loses five days of employment outright and is severely weakened for an additional month per attack of malaria. It is reasonable to assume that this means a loss in potential employment per worker of 18 days (five full days and 26 half-days) per attack of malaria. It is assumed that each agricultural worker would have a 4-in-5 chance of being employed during the entire time he is instead out sick, due to the coincidence between planting and harvesting seasons (peak labor periods) for major teral crops (paddy and wheat) and malaria transmission (May-June and September-November). The average daily return to agricultural labor in six malarious districts sampled in 1968/69 was Rs 8.04. In an attempt to equate average wage and marginal productivity of agricultural labor in the malarious areas, this base is reduced 10% (only, due to the coincidence between peak labor requirements for paddy and wheat and peak periods of malaria

transmission). The wage/productivity rate is increased by 2% a year to account for increases in average labor productivity.

Eighty percent of the 485,650 presumed malaria cases prevented by the proposed project are thus assumed to be both in the active labor force and employed (388,520 persons). The proposed project means that an average potential loss of approximately Rs 158 in product per infected worker will not occur during the life of the project. The potential loss in production averted by implementation of the project would be some Rs 61.4 million during 1976-80, Rs 314.6 in the subsequent ten years and Rs 469.2 in the following ten-year period.

b. Impact on Agricultural Wealth

The incidence of malaria is not randomly distributed in space but is clustered in limited, albeit shifting, areas. The IBRD "Agricultural Sector Survey in Nepal" notes that some 67,000 families moved into formerly malarious areas in 1961-71. Projecting a linear trend, this implies that by 1979 roughly 144,000 families would have settled in areas that used to be so malarious that few people inhabited them. It is in such areas that a sharp recurrence of malaria almost certainly would be concentrated.

We arbitrarily assume that 90% of these families open one average farm each; that an annual malaria case incidence of over 300,000 would induce one-third of these families to abandon their farms (in 1979) and join the ranks of the underemployed (average productivity assumed at one half the pre-move level);

and that th abandoned lands would remain unutilized due to very high, continuing localized malaria incidence. A loss to national income of nearly Rs 41 million per year would result. (Instead of farms abandoned outright, portions of many farms could be underutilized, i.e., in fodder, due to a resurgence of malaria). 1/

To this should be added the national income foregone due to decisions of potential migrants from the hills to the terai to delay departure from their home villages rather than move to virgin lands in the terai when malaria reached a level of 300,000 cases per year. Some 24,700 farm families (linear trend of IBRD data) are assumed to choose not to migrate in 1979 and 1980. 2/ Using the assumption that average income

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1/ Using data developed by the Nepal Rastra Bank, the average net income per medium-sized terai farm in 1969/70 was Rs 1589. This figure, increased by two percent (assumed productivity increase) per year to 1979, is halved (to account only for income assumed foregone by moving) and multiplied by 90% of one-third of assumed "maximum risk" families.

2/ Calculated as a two-year phenomenon through the following scenario: as the case load rises towards 400,000 and stabilizes, potential migrants become accustomed to the high level of malaria and decide to move in any case, due to land pressure in the hills.

per migrant family is equal in the two-year period of delay to average income foregone, the two-year delay in reaching full productivity (direct cost) for these families is equivalent in national income foregone to Rs 24.6 million.

c. Impact on Public Health Costs

The materials cost of treating one malaria outpatient was estimated in Indonesia in 1974 at roughly $0.32. Inflated by 15% (to $0.368), this per patient cost applied to Nepal yields a direct value to drugs saved by the project's successful operation of Rs 3.8 million. To this must be added hospital outlays saved for the seven-in-one-thousand patients requiring hospitalization (at Rs 265 each), or Rs 1.8 million, plus the value of extra calorie intake required to maintain a malaria victim at a subsistence level (one kilogram of rice over a ten-day period is considered the minimum), or Rs 4.0 million at Rs 4/kilo parboiled rice (present average terai price is Rs 3.3/kilo). Total directly-derived savings in public health costs during 1976-80 are calculated at Rs 9.6 million, Rs 39.4 million in the following ten years and Rs 42.8 in the next ten years.

3. Other Economic Benefits

Commercial crops in the terai (mustard, jute, sugarcane and tobacco) together account for some five percent of agricultural GDP (excluding livestock, forest and fish products). While both their cultivation and processing require substantial labor inputs, these activities are not so uniquely clustered with periods of malaria transmission as are paddy and wheat sowing/harvesting.

They also enjoy much higher per unit returns than food grain cultivation, so that workers can be hired from the seasonal surplus (including underemployed) labor force in the terai. Therefore, the cost impact of a malaria resurgence upon the commercial crop sector is not considered.

Very little GON revenue is received directly from taxes on land. Little of either customs or sales taxes is collected on the paddy and wheat production which would suffer the most from a resurgence in malaria (although the GON is attempting to "institutionalize" rice exports to India). Most of the nominal collection of direct personal taxes is based upon income generated in the Kathmandu Valley. The direct effects on government revenues of a resurgence in malaria probably would be slight, although indirect effects over several years could be considerable.*

Similarly, although one-fifth of Nepal's exchange receipts in FY 1974 was from tourist expenditures, little of this source of exchange would be affected by a malaria resurgence. Most tourists visit only areas above 4,000 feet (non-malarious) except for the Pokhara Valley (where, perhaps, the highest payoffs to a very limited malaria control effort might accrue), and, in any case, the bulk of tourist travel to Nepal occurs in seasons of low malaria transmission.

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*Principally, a decline in the marginal propensity to import, resulting in a decline in customs receipts. Secondarily, some decline in monetization (reduced excise collections) and increased velocity of circulation (some inflationary impact).

As is well known, the preponderant impact of malaria is upon long-term patterns of land use and investment. Left unchecked, malaria can make large areas unsuitable for permanent cultivation and render impossible otherwise very attractive investments. However, malaria control is cheap (on a per capita basis), well understood, safe and effective, so an analysis cannot reasonably assume that malaria will be "left unchecked".

There are malaria program benefits which cannot be assessed directly in economic terms. The MMCO program has reduced the risk of malaria to upwards of 6.5 million people and has delivered direct services including spraying of houses and medication for treatment and cure of malaria to this group. The very process of bringing direct services and health education to many remote areas which previously had not received such service from any government agency has created a positive environment for other government actions in the population. This environment facilitates efforts by the government to expand other development programs and in establishing a base for increased central government revenue collections. The MMCO program has also created a large cadre of trained health workers who are now taking on other health activities and responsibilities. The MMCO has also introduced a number of administrative mechanisms into government thinking which are now being absorbed into the procedural mechanisms of a number of Government agencies. For example, the MMCO was the first major developmental organization to decentralize its operation and give operational authority and planning to its

regional offices. Also, the distribution of incoming insecticides to field units was organized using a new administrative pattern and represented a new approach to supply logistics for Nepal.

4. Conclusion

Within the parameters outlined in section (1) above, the flow of project benefits was calculated according to the methodology sketched in section (2). The project's internal rate of return over fifteen years was then found to to be 21.4% (over a twenty year period: 22.8%). This respectable rate of return could be increased somewhat by imputing values to some or all of the factors discussed in section (3) above. However, even the very tenuous type of data on which the detailed analysis is based is not available to enable marginal additional benefits to be calculated.

The results are quite sensitive to assumptions about the degree of peak-season unemployment in malarious areas, and to the extent of land assumed abandoned/underutilized due to a "massive resurgence" of malaria. Returns are lower in Nepal, with its very high CIF costs and low levels of labor productivity, than in more developed countries.

ANNEX 3

AID POLICY ON MALARIA PROGRAMS

AID's current policy on malaria is set forth in AIDTO Circular A-733, July 3, 1973. This document also establishes the criteria for considering assistance to country malaria programs.

AIDTO Circular A-733 gave note to "serious outbreaks of epidemic malaria and/or a return to a high level of continuing malaria transmission" in Pakistan, Thailand, India and Indonesia, to the likelihood of aggravated malaria incidence in Vietnam, Cambodia and Laos, to the withdrawal of UNICEF commodity support to malaria programs, to the termination of the PASA arrangement with HEW's Center for Disease Control under which DCD was the major source of malaria expertise available to AID, to the virtual completion of the "multilateralization" policy transferring from AID to WHO the responsibility of providing technical advisory assistance for malaria eradication, and to the fact that "in many country programs, the management/logistics advisors required to increase the LDC managerial capability have not been made available from multilateral (i.e., WHO) sources". It stated, further, that "the resurgence of malaria is now threatening the substantial investments already made in the eradication or reduction of malaria. The continued widespread return of malaria to those areas already identified and to other areas with its substantial deleterious effects could also hamper LDC agricultural, industrial and other development".

The major elements of AID's malaria policy were (and continue to be) defined as follows:

"1. To provide for selective assistance to worldwide malaria programs on a case-by-case basis when a country demonstrates its own interest and concern for malaria through the provision of an adequate budget and staff to carry out the program.

"2. AID will continue to provide commodity support, funding of local costs in special cases where appropriate, and cooperation with WHO on evaluations.

"3. AID will continue to rely on WHO to provide scientific advisory services to LDC malaria programs including the assignment of advisors as required in such specialties as malariology, epidemiology, parasitology, entomology, sanitation, engineering, and health education.

"4. AID will consider on a case-by-case basis, the interim provision of administrative management/ logistics advisors to country malaria programs. The provision of such assistance need not, however, be tied to AID financed commodities."

Attachment A to AIDTO Circular A-733 summarizes AID's malaria policy more fully:

"The U.S. Government supports the WHO global strategy of malaria eradication. In the implementation of U.S. support under the foreign assistance program, current AID policy places emphasis on the following:

"1. LDC's who demonstrate a willingness to help themselves by providing whatever resources they have available to carry out the program.

"2. Realistic assessment of assisted projects to obtain a sharper definition of those targets which can be reasonably expected to be reached within a time-limited effort and those which are likely to be delayed due to administrative, technical or political problems.

"3. Retention of malaria eradication as the ultimate objective for projects which meet and maintain the minimum WHO and AID conditions (as expressed by the Fourteenth WHO Expert Committee on Malaria, 1968, and in conformance with the Twenty-second World Health Assembly resolution on malaria, 1969).

"4. Maintenance of the option to support malaria control activities where projects do not currently meet eradication criteria, if the economic, social, or political value of the project merits support.

"5. Promotion of multilateralization of technical services through encouraging assisted governments to request advisory services from WHO while effecting an orderly withdrawal of U.S. scientific advisory technicians.

"6. Continuation of support in the context of foreign assistance policy to research, commodities, local costs, and evaluation; cooperation with other U.S. agencies and WHO in assisting multilateralization of technical services; and consideration of interim provision of staff assistance in managerial areas where WHO may not be able to provide such staff.

"7. The A.I.D. Office of Health, Technical Assistance Bureau (TA/H) has an overall central responsibility for development of AID policy for malaria eradication and assuring its implementation. TA/H has a direct responsibility for AID central support to malaria research projects. Assistance to the country projects is implemented through the AID Regional Bureaus."

Criteria for Considering Assistance to Country Malaria Programs

"AID assistance to country malaria programs will be considered when:

"1. The country demonstrates its own interest and concern for malaria through the provision of an adequate budget and staff to carry out the program;

"2. There is a critical need to protect a substantial U.S. investment in terms of gains already made or a need to prevent malaria from becoming a deterrent to other country development programs;

"3. The country provides a malaria plan which is technically, administratively, and financially sound and is based on an AID review of the recommendations of a joint WHO/LDC evaluation team;

"4. Available resources within the country have been mobilized and available external sources of assistance have been explored."

ANNEX 4

REIMBURSABLE ASSISTANCE

The forms of donor assistance inputs, whether om AID, another bilateral donor, a foundation, a priv voluntary organization or an international agency, can b lassified with respect to the kind of activity to which ..ch is suited and the degree of donor control implicit in the form of assistance. They may also be rated as to the likelihood that the changes sought through the project inputs are likely to be institutionalized into the permanent framework or pattern of performance of the recipient cooperating country.

The spectrum of assistance ranges between direct provision of commodities, personnel and even an operating, controlling organization at one extreme, and at the other, the provision of a specified sum of money. The first estreme is exemplified by installation of a working factory or school. The use of this model in health sector assistance is most common by private voluntary organizations which may, for example, build, staff and operate a hospital.

The degree of effective donor control over the quality, use and relevance of the inputs provided declines as the form of assistance moves closer and closer to the opposite pole: provision only of funds.

A common AID practice is to allow the recipient country to solicit bids and arrange for deliveries, after which AID makes payment directly to suppliers for commodities and contract services. Such assistance is characterized by tight specifications (including source specifications) or scopes of work, all of which are subject to AID approval. AID frequently combines with such assistance the provision of direct hire advisors. Such input financing has been most successful where the purpose of the assistance and the provision of the input are practically the same (e.g., the building of a dam).

When the purpose is to create an organization or a working system (such as a continuing vector-borne disease control system), input financing of thisnatures suffers from the likelihood that the development of the organizational and human aspects of the system may get out of phase with the provision of equipment or other AID inputs. One solution may be a greater degree of AID involvement in the management of all phases of the project, but this is costly in money, time andpersonnel; it involves a degree of foreign control that may be unacceptable to many countries; and,

most importantly, it inhibits the growth of an indigenous organization and system which will survive the termination of external support. The servicios of the programs of the old Institute of Inter-American Affairs (IIAA) of the 1940's and 50's provide examples of the difficulties inherent in this approach.

In recent years, AID has been moving increasingly toward output financing. This technique of assistance involves payment, by AID to the recipient, of previously agreed-upon amounts when project outputs are produced or are in place. The best-known variant as the Fixed Amount Reimbursement (FAR) techniques pioneered by USAID/Philippines, where AID paid for school buildings and other public works. The donor is able to maintain direct control over the quality of inputs by insisting on approval rights for supplying contracts, for the specifications of the inputs, for inspection of the furnished product, or some combination of these devices.

Applied to a health delivery system or to a vector-borne disease control program, the FAR technique could involve payment of specified amounts at various stages of development, or reimbursement for the cost of specified inputs when certain components had become operational. As an example, AID might reimburse for insecticides, antimalarial drugs, laboratory equipment, spray equipment or vehicles after spray teams were in the field and had sprayed an agreed number of houses or villages in locations consistent with the previously agreed-upon plan. The output performances which trigger payment might include training (to an agreed acceptable minimum standard) and placement of a given number of technicians -- again, consistent with plan. Still another example: a certain percentage of the population at risk (from locations identified in the plan as significant in a control program) tested for infection -- as evidenced, possibly, by blood slides collected, examined and analyzed. The selection of the performance or output items for which payment is made would be decided by the importance to program objectives of alternative outputs, the difficulty of achieving such outputs, the relative ability of the recipient country to provide the forward funding needed, and the higher administrative cost of selecting more detailed and smaller pieces of the total system for payment.

The institution or system developed in this fashion is more likely to be truly indigenous and less likely to be a hothouse plant, unable to survive the removal of the artificial environment of foreign aid. There is a real carrot to the cooperating country for good performance -- reimbursement -- and a real stick -- the possibility of seriously delayed or even no AID disbursements.

ANNEX 5

COMMUNITY PARTICIPATION

Community participation is difficult to define in operational terms. Conceptually, it represents a return to an earlier idea, involving community responsibility to pave the way for delivery of health services, and a departure from what WHO's Director General describes as "urban health palaces."

"Extending the government's presence into villages while the village paves the way" is easier said than done, and the concept of building a national program (especially a program as complex as malaria control) on the basis of village decisions and village priorities is visionary.

Nevertheless, one of the greatest differences between the concepts of malaria eradication and malaria control lies in the degree of active community participation required for success. In the main, during the period of time-limited malaria eradication, it was considered that the people being protected need only participate passively -- permit their houses to be sprayed, answer questions of surveillance agents and take the drugs provided. Successful control operations, which will continue year after year, will require well-organized community participation, and such participation will in turn require stimulation.

It is apparent that local resources are available, but are used haphazardly. The problem is to identify, mobilize and put them into harness. Community participation in the field of malaria control may be easier to generate than in some other fields. Especially where people have experienced freedom from malaria, there may be a positive desire on the part of the community to preserve or to regain such freedom

Five countries in the region (Burma, India, Indonesia, Thailand and Nepal) have already built a measure of community participation into their programs of primary health care -- although in the case of Nepal, the "volunteer" health worker is government-supported. The Philippines also cites an example of direct community participation in malaria control, but since it consists of source reduction efforts by prisoners in a penal colony, its replicability is questionable.

Sri Lanka, however, reports a highly effective contribution toward malaria control by the Srimadana movement, a non-political, non-sectarian volunteer group (which appears, however, to have had external assistance from private sources). Srimadana has undertaken a successful pilot project of malaria control under which all control measures were assigned to the movement. Leaders were trained in all malaria control measures -- drug distribution, source reduction, larviciding and even residual spraying with the toxic insecticide malathion. Government inputs included training, supervision and a measure of logistic support.

(It is to be noted that with the exception of a limited village trial in Burma many years ago, no other country has felt it desirable to entrust the application of toxic residual spraying to volunteers).

Dr. Somboon Vachrotai, Director-General of the Department of Health in the Thai Ministry of Public Health, believes that the voluntary health worker can provide a major part of the answer to the problems of resurgent malaria -- at least in Thailand. Dr. Somboon heads the Lampang Health Development Project, a major AID-supported pilot project in northern Thailand which is highly regarded by USOM/Thailand and which, with some modification, is serving as a model for replication throughout the country. The project relies heavily on the unpaid voluntary health worker who is the first link in a chain extending to the community health paraphysician, the district-level rural health center and the provincial hospical, which now has a Department of Community Health. Dr. Somboon sees the malaria control role of the voluntary health worker as incorporating prophylactic drug treatment for any fever plus case detection, more successful than the normal health service unit because the volunteer worker actively visits homes, rather than waiting in the center for visits of sick patients.

In general, programs of community participation focus on a community-selected health worker who gives (or is paid for) part of his time. He advises villagers on sanitation, gives assistance to special program workers (e.g., secures acceptance for malaria spraying) and undertakes such duties as case detection, slide preparation and dispensation of presumptive or radical treatment.

There are numerous examples of community involvement in solving their own economic and social problems; they include examples in the health field. The attached

bibliography, by no means encyclopedic, deals with differing techniques of bringing health services to the people and of involving the people served in the provision of such services. Each example selected stresses the time required to engender such cooperation. It is apparent that many obstacles must be overcome before achieving the degree of active community participation desired. Some factors that must be considered:

1. Malaria control may not have a high priority on the people's list of community needs, and highest priority needs may have to be satisfied before community action will be taken on malaria control. Malaria control services should be coordinated with other efforts to meet the social and economic needs of the community.

2. The villagers should have a voice in assigning priorities to the health problems to be serviced.

3. Selection of personnel to provide health services in a village should be made by the villagers themselves.

4. Village health workers require not only adequate training (and refresher training as needed) but regular supervisory visits by local government medical specialists.

5. The community will be more concerned with the success of the village health worker if it provides, in whole or in large part, the costs of his services.

6. Attempts to stimulate community participation should take into consideration the resources of the community.

A WHO-UNICEF joint group on policy will be conducting a seven-country workshop this year, including study tours of community participation in India and Sri Lanka, to develop further guidelines for the elicitation of

group participation in the delivery of health services. The results of this workshop may prove helpful in suggesting ways in which the limited health budgets (and malaria budgets) of the developing countries may be extended.

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ANNEX 6

MALARIA INCIDENCE

Malaria incidence data throughout the countries of South and Southeast Asia were derived from officially detected cases revealed by malaria-positive blood slides, as reported by WHO. Since WHO's definitions of its regions differ from those used by AID, the country groupings do not coincide.

WHO's South-East Asia Region includes Bangladesh, Burma, India, Indonesia (Java and Bali), Nepal, Sri Lanka and Thailand. (It also includes the Maldive Islands). It excludes Pakistan and the Philippines.

Thus, figures for Pakistan and the Philippines are not incorporated in the overall chart for South-East Asia. The individual country charts for Pakistan and the Philippines were prepared on the basis of data provided by the countries themselves.

The following charts do not represent the incidence of malaria in Asia. They depict the number of cases detected by malaria-positive blood slides, within the areas where anti-malaria operations were being conducted. For the countries of the South-East Asian region, the blood examination rate for 1976 was some 7.79%[1/] of the population at risk;[2/] of the 69 million slides examined, some 6.5 million (9.47%) were malaria-positive. For the entire population at risk, the annual detected parasite incidence was 7.37 cases of malaria per 1000. If the incidence of malaria among individuals actually tested (as indicated by the percentage of malaria-positive slides) were evenly applied to the entire population at risk, the total incidence (including cases among the 92.21% of the population at risk who were not tested) could have run as high as 84 million cases in the region.

1/ Blood examination rate differed from country to country — more than 13% in Nepal and Sri Lanka, and less than 1% in Burma.

2/ Some areas within the region are naturally malaria-free ; others achieved freedom from transmission during the malaria eradication period. Population at risk reside in areas where transmission continues; of the total population in the South-East Asia Region (983.3 million), almost 95% (887.2 million) reside in malarious areas. SEARO officials state frankly that the entire population living in areas which were malaricus at the inception of anti-malaria efforts should now be considered at malaria risk.

In practice, a high proportion of the malaria-positive slides came from sick individuals who came in to health centers for treatment (passive case detection) -- as against a group of slides taken from an entire population area (active case detection) -- and the percentage of positive slides is quite obviously far higher among a group seeking treatment for disease than would be the case for the general population.

Nevertheless, the health centers are frequently quite remote with respect to a substantial proportion of the rural population; many infected individuals are unable or unwilling to seek treatment, preferring to allow the disease to run its course or to purchase the chemotherapeutic drug from the ubiquitous rural pharmacy.

Thus, while it is improbable that the malaria incidence in the South-East Asia region was as high as 84 million cases in 1976, it is readily apparent that the officially detected 6.5 million cases was far below the actual incidence. The true figure for the region may well have been as high as 30 to 40 million.

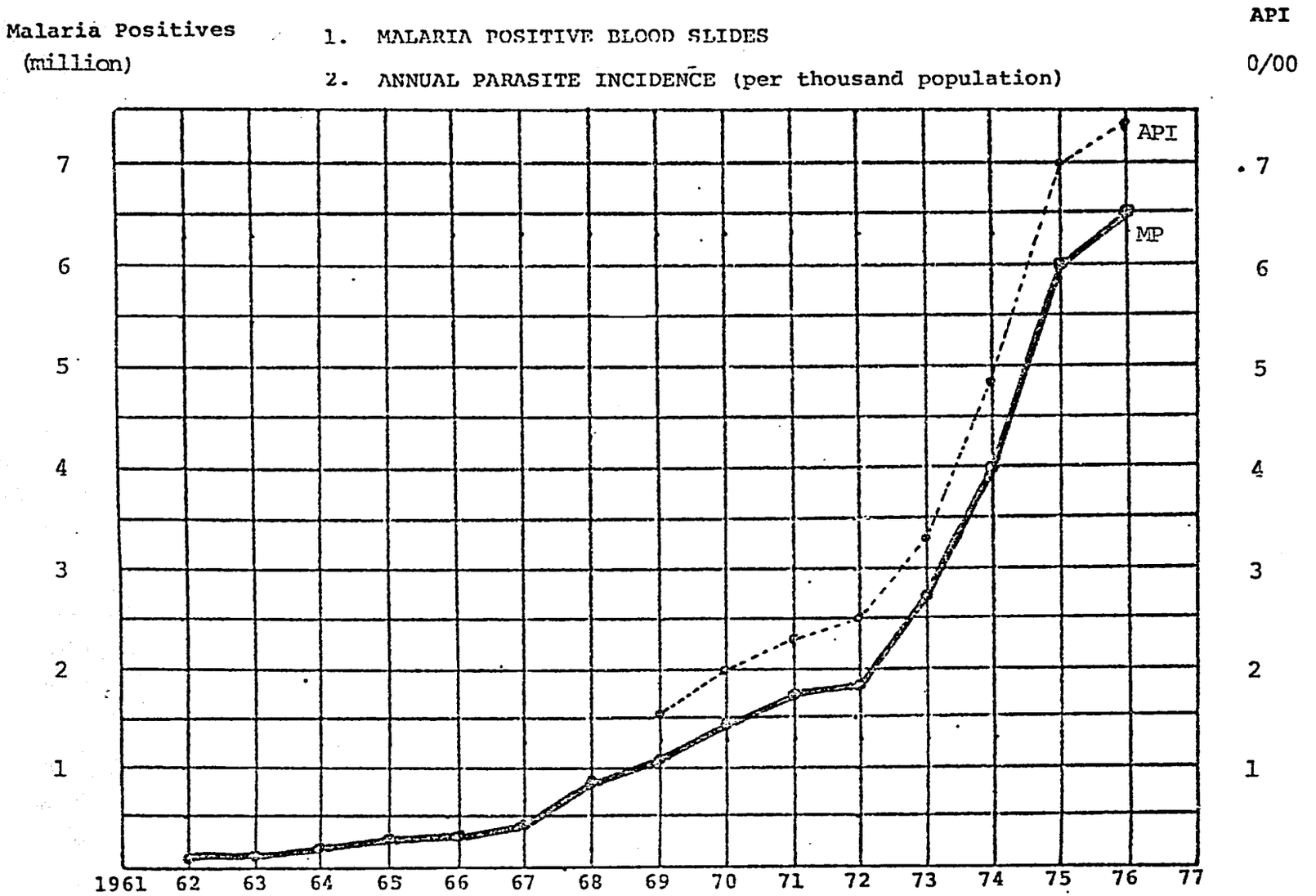
As noted above, charts of numbers of cases detected by malaria-positive blood slides do not reliably depict the true incidence of malaria; they do, however, reveal trends. They suffer the draw back that an increased effort to detect malaria through a more active surveillance program will produce a greater number of malaria-positive slides.

A somewhat more accurate trend indicator is the percentage of malaria-positive slides among all slides examined. This percentage figure, known as the Slide Positivity Rate (SPR), is also graphed for each of the countries in the region.

Yet a third indicator is the Annual Parasite Incidence (API) per thousand population. As is the case with other two indicators, the API is based on detected incidence. Depending on the degree of infection within the population and numbers of slides taken, the API trend may be higher or lower than the trends in total numbers of malaria-positive blood slides or the Slide Positivity Rate. The charts also set forth API figures for the region and its member countries.

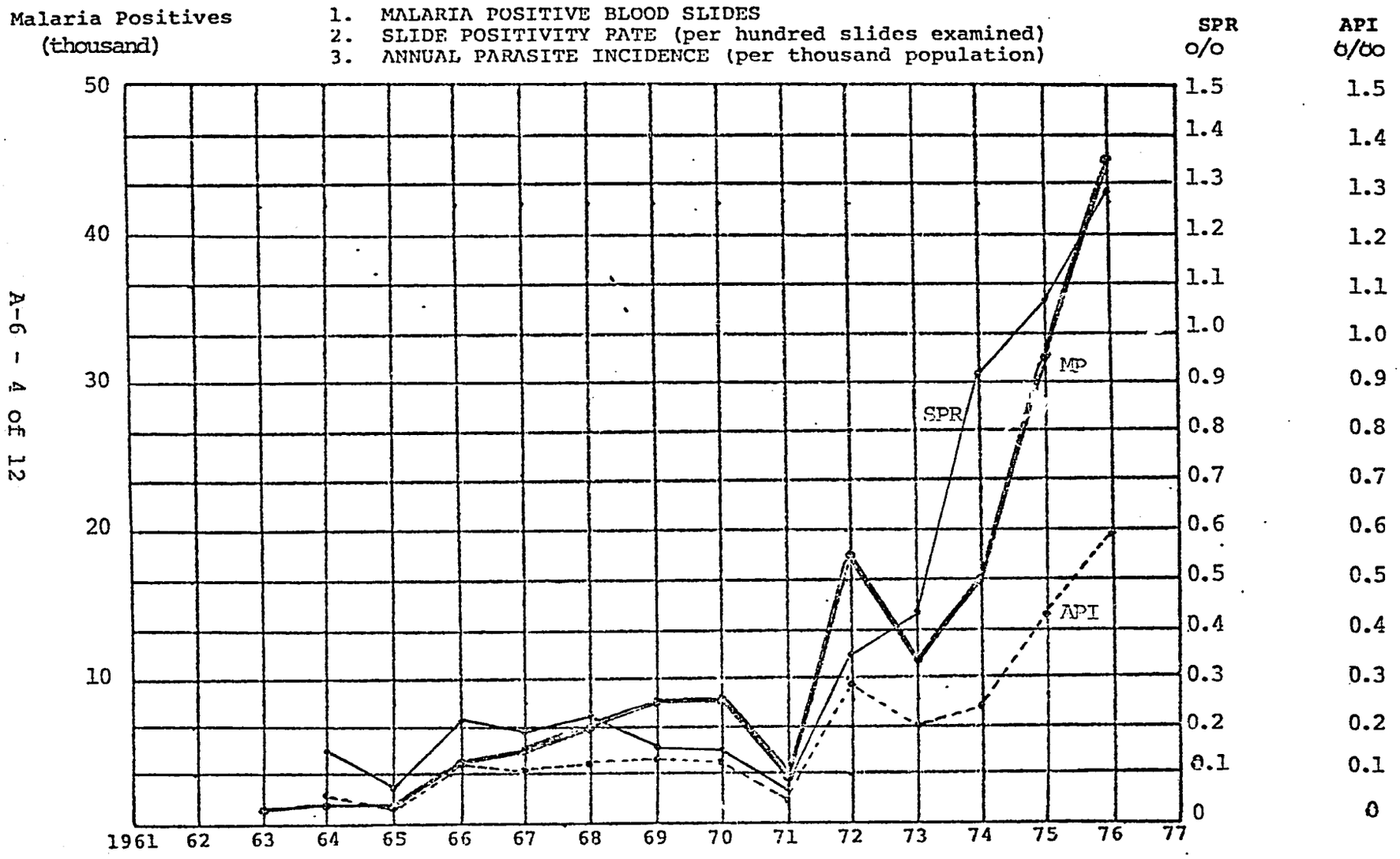
The following charts, then, show three different indicators of trends in malaria incidence. Each of the indicators clearly shows the dangerous degree of malaria resurgence in Asia.

S O U T H E A S T A S I A



Excluding Afghanistan, Pakistan, the Philippines and the Outer Islands of Indonesia

B A N G L A D E S H


Malaria Positives
(thousand)
1. MALARIA POSITIVE BLOOD SLIDES
2. SLIDE POSITIVITY RATE (per hundred slides examined)
3. ANNUAL PARASITE INCIDENCE (per thousand population)
SPR
o/o
API
o/oo
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40
30
20
10
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
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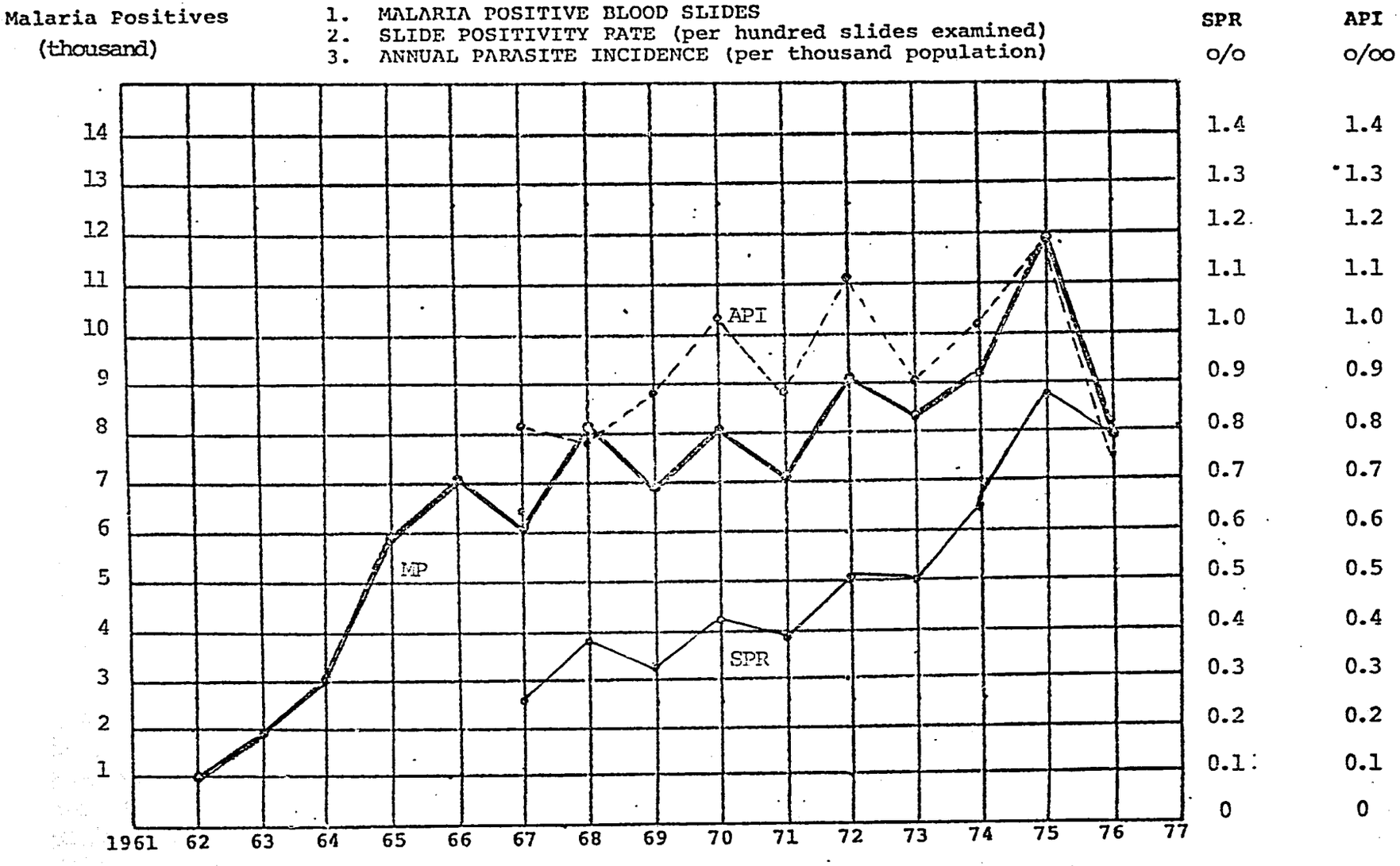
MP
SPR
API
1961 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77

BURMA


Malaria Positives
(thousand)
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2. SLIDE POSITIVITY RATE (per hundred slides examined)
3. ANNUAL PARASITE INCIDENCE (per thousand population)
SPR
o/o
API
o/oo
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13
12
11
10
9
8
7
6
5
4
3
2
1
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
API
MP
SPR
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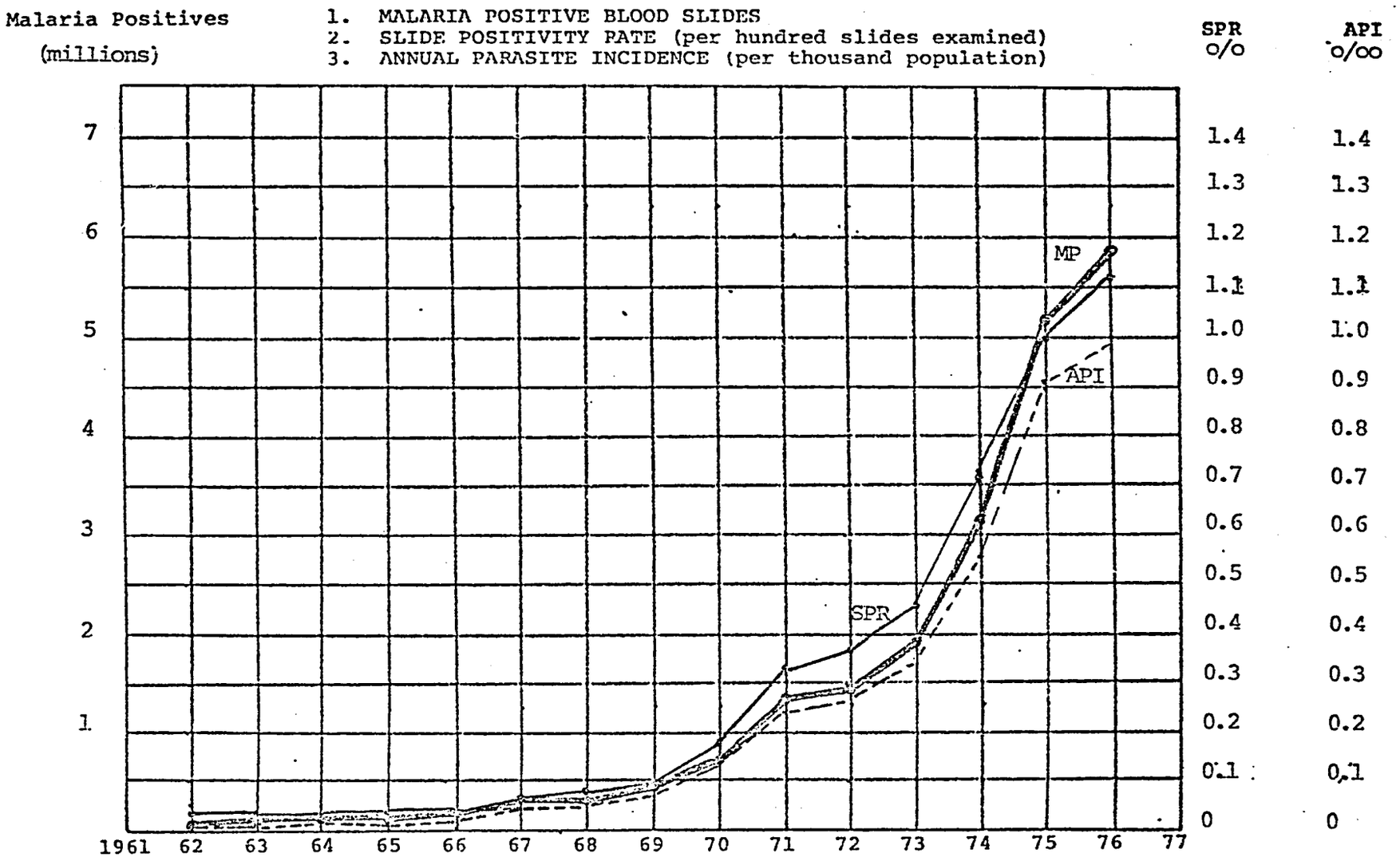
I N D I A


Malaria Positives
(millions)
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2. SLIDE POSITIVITY RATE (per hundred slides examined)
3. ANNUAL PARASITE INCIDENCE (per thousand population)
SPR o/o
API o/oo
MP
API
SPR
7
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1.4
1.3
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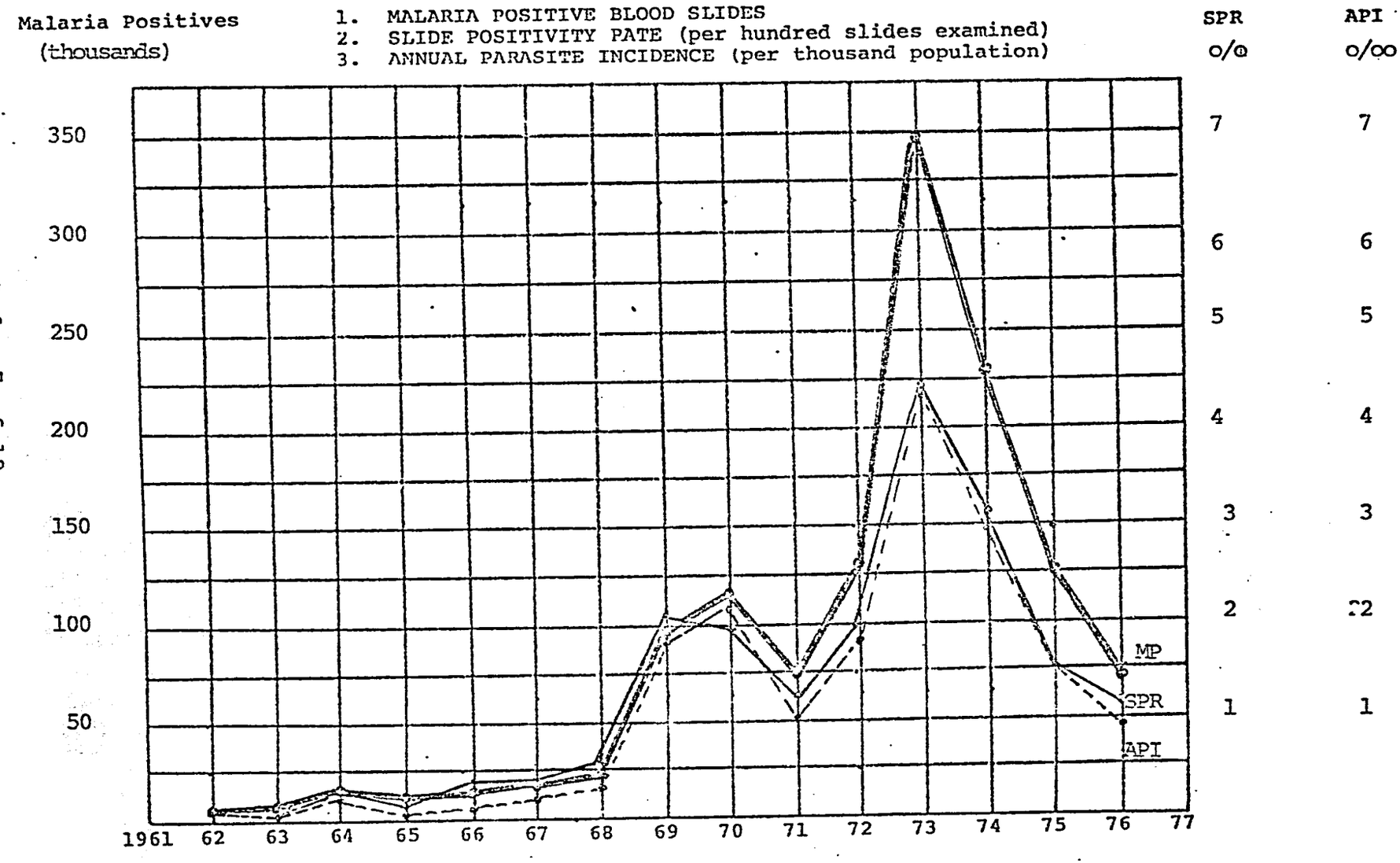
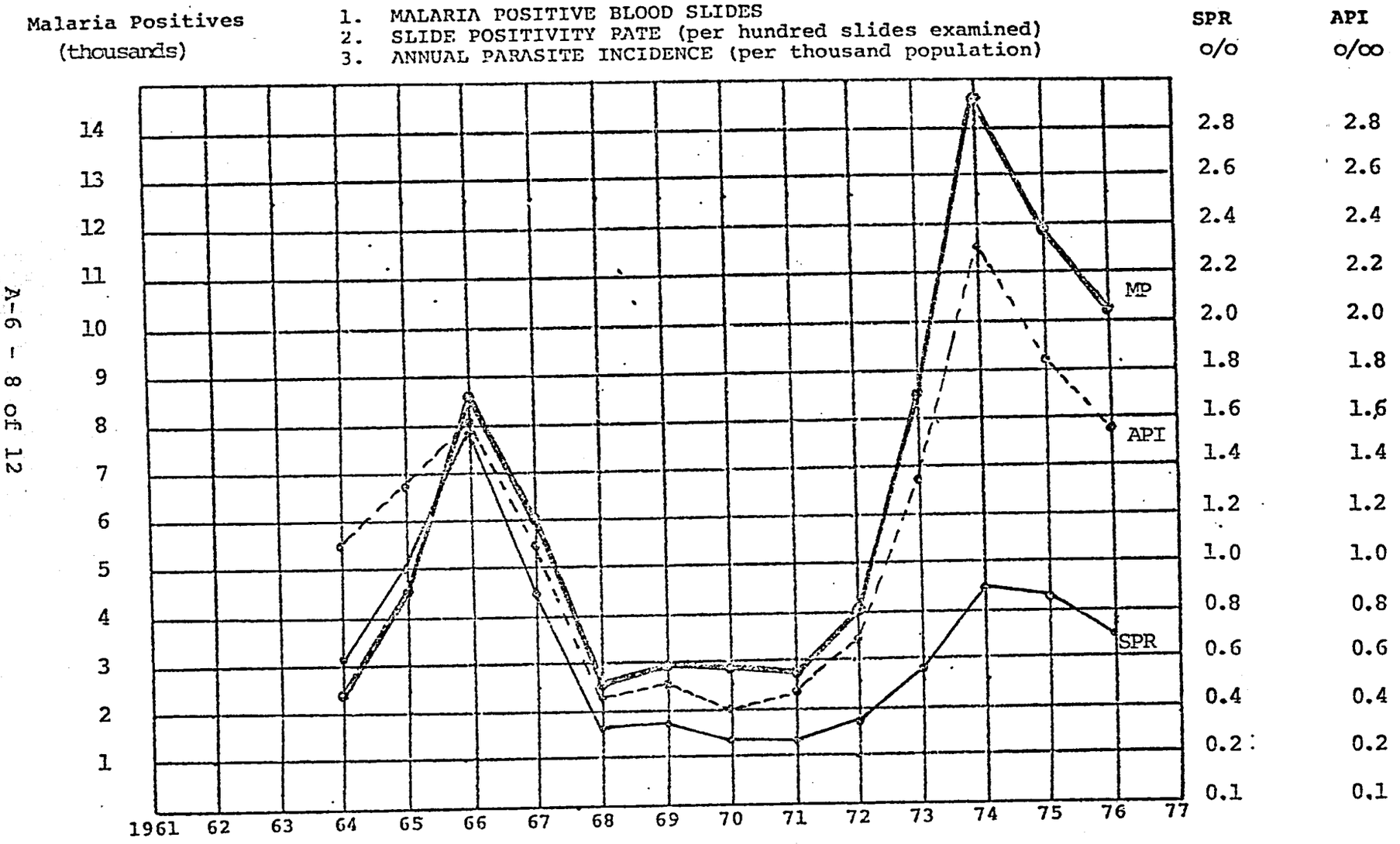
I N D O N E S I A
(Java and Bali)



N E P A L


Malaria Positives
(thousands)
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2. SLIDE POSITIVITY RATE (per hundred slides examined)
3. ANNUAL PARASITE INCIDENCE (per thousand population)
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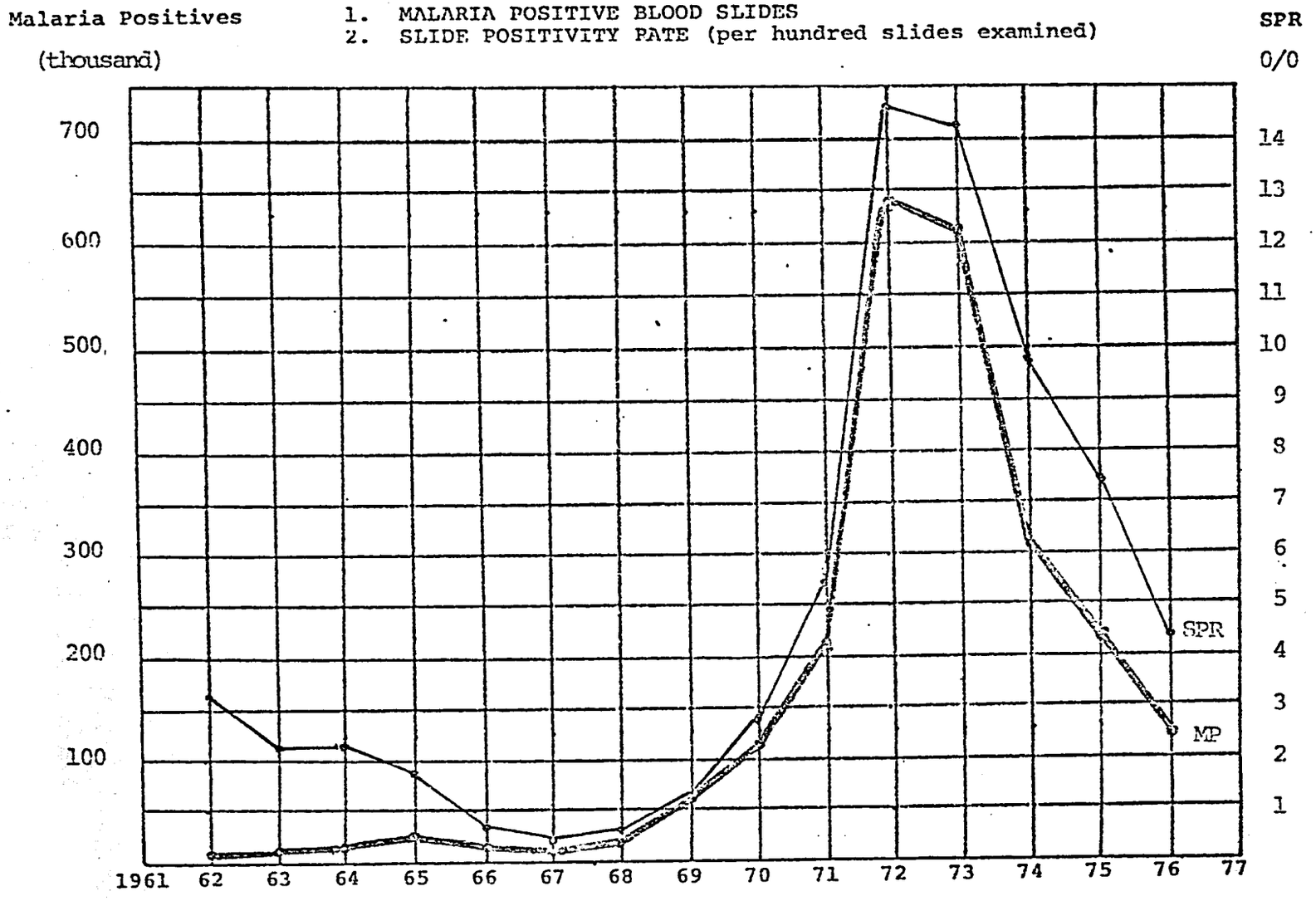
P A K I S T A N


Malaria Positives
(thousand)
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2. SLIDE POSITIVITY RATE (per hundred slides examined)
SPR
0/0
700
600
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200
100
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10
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SPR
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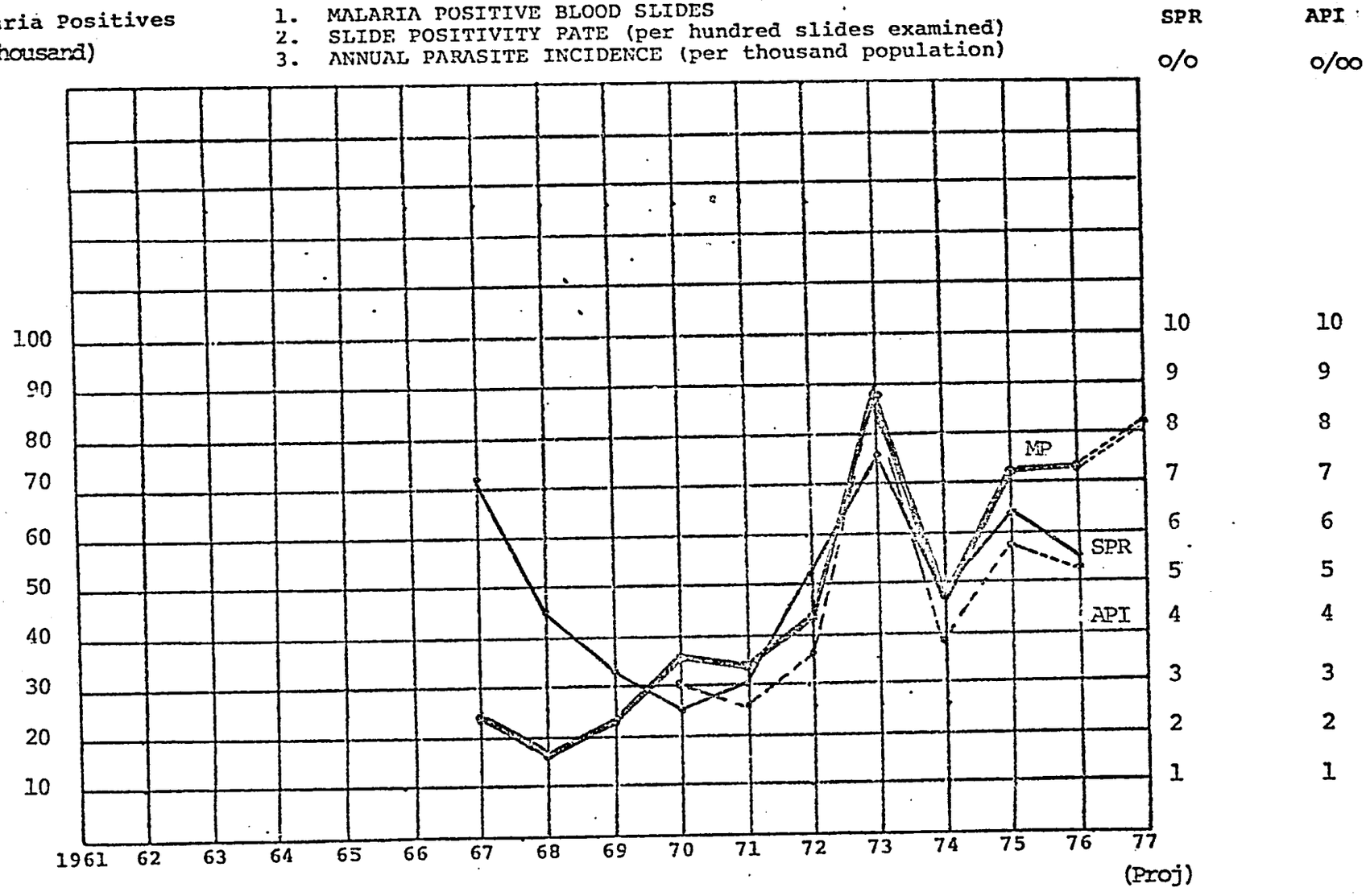
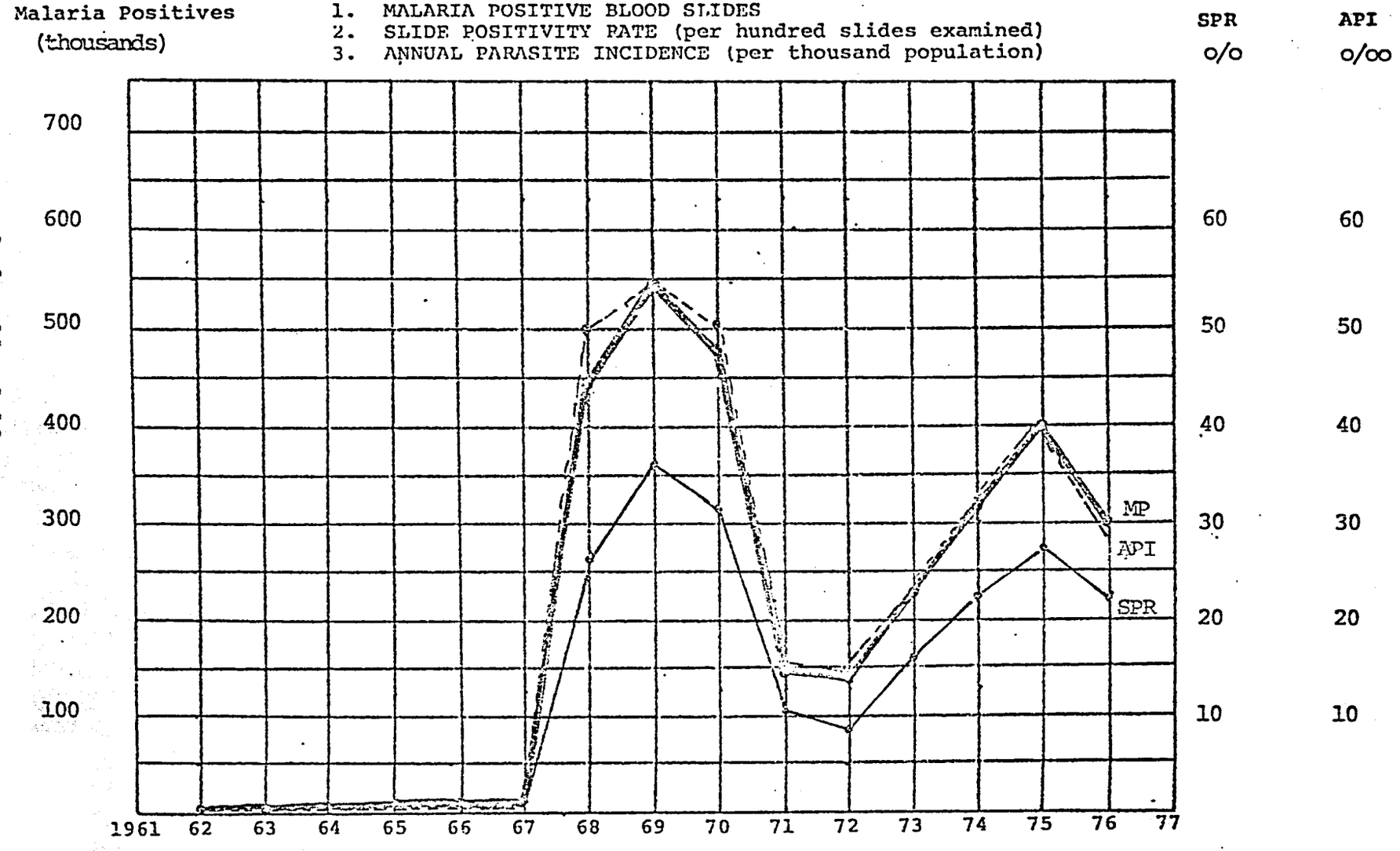
P H I L I P P I N E S

Malaria Positives
(thousand)

1. MALARIA POSITIVE BLOOD SLIDES
2. SLIDE POSITIVITY PATE (per hundred slides examined)
3. ANNUAL PARASITE INCIDENCE (per thousand population)



S R I L A N K A


Malaria Positives
(thousands)
1. MALARIA POSITIVE BLOOD SLIDES
2. SLIDE POSITIVITY RATE (per hundred slides examined)
3. ANNUAL PARASITE INCIDENCE (per thousand population)
SPR
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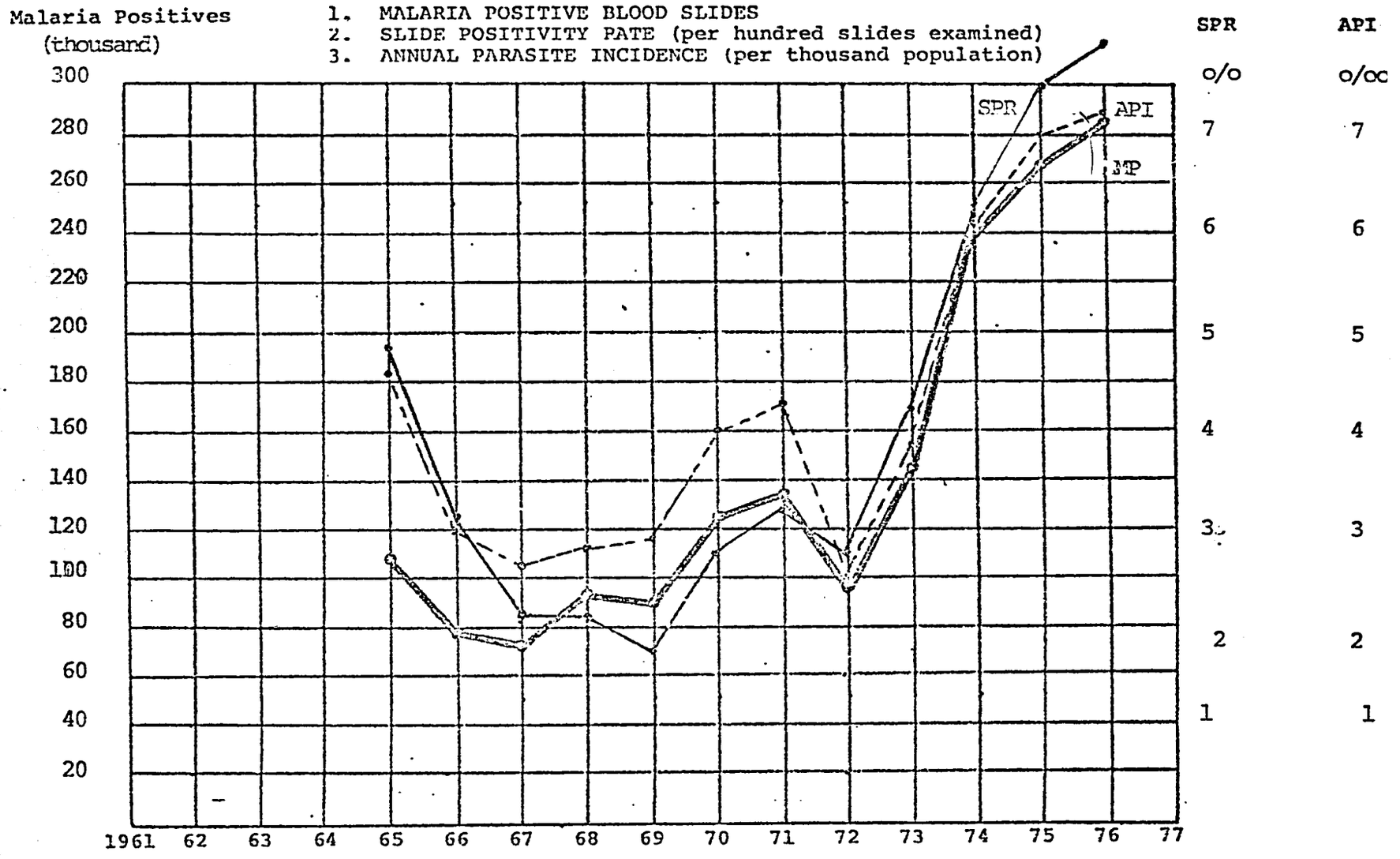
THAILAND


Malaria Positives
(thousand)
1. MALARIA POSITIVE BLOOD SLIDES
2. SLIDE POSITIVITY PATE (per hundred slides examined)
3. ANNUAL PARASITE INCIDENCE (per thousand population)
SPR
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API
o/oo
SPR
API
MP
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240
220
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180
160
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120
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ANNEX 7

AGRICULTURE AND MALARIA

(Dr. Omer J. Kelley, who participated in the first colloquium of the Study Group, had the following observations to make on the potential contribution of sound agricultural land and water management practices to vector control source reduction).

* * * *

Agricultural lands are in many countries of Asia among the primary breeding grounds for malaria vectors; proper management of such lands and associated water use can play a major role in malaria control.

All agricultural lands, except those receiving such limited or even distribution of rainfall that there is no ponding or runoff, may provide potential areas for mosquito breeding. In the rainfed areas of the world, the primary problems are associated with low areas, which provide shallow, stagnant water basins; drainage areas, including rivers; borrow pits, buffalo wallows, etc.; and in some cases, flooded rice or other crop fields. Except for crop-field flooding, which occurs during monsoons or other long periods of heavy rainfall, good land and water management practices should prevent the conditions which provide areas for mosquito breeding. Good surface drainage, as a general rule, will remove the water from the land sufficiently fast that enough time does not elapse with free-water to provide time for hatching of mosquitoes. With the scarcity of land and water in most of the world today, good farming practices which provide for efficient use of the land and water resources usually will more than pay for the necessary practices, and hence the resulting mosquito control is a free by-product.

In addition to the problems of rainfed areas, irrigation of agricultural lands provides additional aquatic habitats suitable for mosquito production. Moreover, in a number of countries malaria mosquitoes are produced in reservoirs. Conditions associated with impoundments that are conducive to malaria mosquito production include emergent and/or floating vegetation, accumulations of floatage and debris in shallow water areas or embayments protected from wave

action, and undrained depressions. In some countries, the major sources of malaria mosquitoes are related to faulty irrigation and drainage practices. The sources include seepage areas, obstructed canals and ditches, and collection of irrigation waste water in undrained areas.

Poor land leveling, resulting in low spots in the fields, is prevalent on nearly all irrigated farms in most of the developing countries; similarly, irrigation ditches that are too low, or meander over much longer distances than are necessary and often water-log the lower areas, are found almost universally through the irrigated areas.

Excessive irrigation, leaving the water on the land much longer than is necessary, is a frequent practice in many irrigated areas of the world--including parts of the United States.

All of the conditions mentioned above that provide breeding areas for mosquitoes are associated with poor water management. Good water management practices should go a long way toward removing irrigated areas as a source of breeding grounds for mosquitoes. In most if not all cases, the cost of installing and maintaining good water management practices will be small compared with the increases in crop yields and reduced water use.

Research conducted recently in Pakistan showed that nearly 50% of the water being applied to farmer fields by the traditional method could be saved with good water management practices. This not only made water available for additional acreages, but it lowered the water table and provided conditions for improved crop yields. In some cases, crop yields per hectare were more than doubled. To provide these types of savings and increased yields required a complete renovation of the farmer irrigation distribution system, including straightening and lining of the canals, land leveling and the installation of drainage ditches. This made possible more timely application of irrigation water, application in the proper amounts, and even water distribution over the farmers' fields. For the higher yields increased use of fertilizers and pesticides were generally necessary. The major point to be made here is that the improved soil and water management practices much more than paid for their costs, gave increased and much needed crop yields and eliminated the conditions conducive to mosquito production.

ANNEX 8

FOR THE NON-TECHNICAL READER

1. Kinds of Malaria

Human malaria is caused by four different species of the protozoon Plasmodium -- P. vivax, P. falciparum and less commonly, P. malariae and P. ovale. Of the two most common types of clinical malaria, vivax is the milder. It is characterized by periodic chills and fever, an enlarged spleen, anemia, severe abdominal pains and headaches, and extreme lethargy. Vivax malaria may subside spontaneously in ten to thirty days, but unless treated with certain curative drugs may recur at intervals over a period of one to three years. The fatality rate is low (1% or less), but the disease is extremely debilitating and lowers the patient's resistance to other diseases. Falciparum malaria produces these and other symptoms, including edema of the brain and lungs and blockage of kidney activity. The fatality rate for falciparum malaria is high if the disease is not treated promptly; in a non-immune population, never exposed to the disease or freed from exposure for a period of several years, death rates during an epidemic of falciparum malaria may exceed 10%, and there have been reports of mortality as high as 50% in limited areas. In totally endemic areas in Africa, mortality among children from six months to two years may average 25%.

2. The Malaria Cycle

Plasmodia species have a complex life cycle. They are transmitted to man by the bite of an infected female Anopheles mosquito. When such a mosquito bites, its saliva, which contains the parasite in the sporozoite (or motile infective) stage of its life cycle, is injected into the bloodstream of the victim. The sporozoites quickly enter the liver, where they divide and develop into multinucleated forms known as schizonts. A form known as a merozoite is generated about each nucleus and after six to twelve days, the schizonts burst, releasing the merozoites into the blood stream.

The merozoites invade the host's red blood cells, where they grow and divide to form more schizonts. These schizonts also burst, destroying the infected red blood cells and releasing more merozoites into the bloodstream to repeat the cycle. The major symptoms of malaria are associated with the rupture of the schizonts.

Some of the merozoites in the victim's bloodstream develop into male and female forms known as gametocytes. If at this stage the victim is bitten by a mosquito, the gametocytes enter the mosquito's stomach where they become free male and female gametes (mature germ cells) and fertilization ocurs. The fertilized gamete develops into an oocyst containing many sporozoites. When the sporozoites mature, they migrate to the mosquito's salivary glands, where the complete cycle is begun again.

(adapted from Maugh: Science,
Vol. 196, 1977)