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Environmental Assessment

Insecticide Use in the Malaria Control Component of the Health Systems Support Project (APSISA 519-0308)

El Salvador, October 1989

by

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and

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AR-126-4

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Resumen Ejecutivo

El Proyecto Apoyo a los Sistemas de Salud (APSISA 519-0308) proporciona además de otros componentes, ayuda al Gobierno de El Salvador (GOES) para reducir la incidencia de malaria, a través de "un programa de control de malaria sensible, eficiente y efectivo a nivel nacional." Los elementos de apoyo incluyen asistencia técnica, capacitaciôn y de mercaderías para insecticidas y equipo.

El programa integrado del GOES ha tenido como resultado una reducción continuada de la morbilidad de malaria de 2,000 casos/100,000 en 1980 a un promedio de 600 casos a partir de la ayuda de la A.I.D. que fué implementada en 1986. La disminución ha continuado a un nivel menor de 200 casos/100,000 (9,215 casos) en 1988. De 1980 a 1988 el Indice Parasitario Anual (IPA = número de láminas positivas/1000 examinadas) ha disminuido de 20.0 a 1.8. El número de casos de P. falciparum, la forma más severa de malaria, ha sido reducida de 15,782 a 120 casos en el mismo período. Esta reducción ha sido lograda a través del desarrollo organizado de un programa de control bien organizado que incluye rociado intradomiciliar de insecticida en áreas de alta transmisiôn, larvacimiento en las proximidades de las áreas de criadero del anófeles, fumigación peridomiciliar periódica a ultra bajo volumen con insecticida pyretroide, control físico de larvas a través de actividades de reducción de fuentes de criaderos, distribución profiláctica y terapéutica de medicicamentos antipalúdicos. Las diferentes opciones en el esquema integrado son activadas por una apropiada información entomológica, parasitológica y de vigilancia epidemiológica. Ambos, vigilancia y medidas de control son fuertemente apoyadas por esfuerzos de participaciôn comunitaria.

A la fecha, el insecticida carbamato, propoxur, ha sido utilizado en las actividades de rociado intradomiciliar. Su uso ha sido aprobado en el Examen Ambiental Inicial EAI (1986) y ha sido usado en forma efectiva y segura. Sin embargo, el costo actual del propoxur permitiría proteger con rociado sólamente a la mitad de las 30,000 casas que constituyen la meta a rociarse para el proximo año. Por lo tanto, el GOES ha solicitado reemplazar el propoxur por el bendiocarb (otro compuestos del tipo carbamato), el cual tiene un nivel de precio que permitiría la cobertura total de las areas con necesidad de rociarse (30,000 casas, aproximadamente 150,000 habitantes equivalente a menos del 2.5% de la población nacional).

El bendiocarb es un insecticida moderadamente tóxico, de la misma clase y nivel toxicológico que el propoxur. El cual fué identificado en el Examen Ambiental Inicial EAI como un insecticida sustituto potencial, y ha sido investigado en su eficacia y eficiencia por el GOES desde 1986. Los resultados obtenidos de estas pruebas, como de pruebas similares

realizadas en los países vecinos, han demostrado que éste es comparablemente eficaz al propoxur.

Adicionalmente, han habido problemas en cuanto al abastecimiento inconsistente y a la calidad del propoxur, que no sería lo esperado con el propuesto producto bendiocarb (Ficam 80 W), debido principalmente a la formulación de éste último en bolsas de papel aluminio de 100 g premedidas y pre-empacadas, al contrario de las bolsas de plástico más voluminosas de la formulación de 800 g del propoxur, permitiendo considerablemente un mayor potencial de error en el mezclado, en la determinación de la dosificación, la suspensibilidad, etc.

El bendiocarb ha sido registrado por la Agencia de Protección al Medio Ambiente de los Estados Unidos para el control del mosquito (EPA, Reg. No. 45639-1), aunque no ha sido comprado anteriormente por la USAID para uso en los programas de control de malaria, éste es recomendado por la OMS y está siendo actualmente utilizado con áxito en un gran número de países en América, Asia y Africa. Los procedimientos de seguridad requeridos para el uso del bendiocarb son los mismos que los usados por el GOES para el propoxur. Los detalles técnicos del bendiocarb y sus especificaciones de formulación, seguridad y procedimientos de primeros auxilios, estân incluidos en el Apendice de este reporte.

El uso que se propone del bendiocarb no posee peligro al medioambiente. Las 30,000 casas a cubrir (aproximadamente 100 comunidades) están distribuidas a lo largo de la costa, mayormente en las zonas oriental y occidental del país. El área es una zona rural de naturaleza agrícola. El rociado del insecticida será solamente en las casas y aplicado por los rociadores del programa de malaria entrenados para ello. La eliminación de las bolsas vacías de insecticida se facilita por el tipo de empaque en bolsas de papel aluminio, las cuales pueden ser fácilmente quemadas o enterradas.

No existe en El Salvador al presente una lista de especies en peligro de extinción y la única área de reserva natural (Monte Cristo) no está en la zona malarica y por lo tanto no se hará ningún rociado de insecticida en el área.

De las acciones alternativas, el reemplazo del propoxur por el bendiocarb es la más razonable. El continuar con el propoxur como insecticida de escoge, podría resultar en una inadecuada cobertura en las áreas de alto riesgo poniendo en peligro el programa. Abandonar el rociado intradomiciliar podría aún ser una amenaza más seria para todo el programa de control integrado, el cual ha sido muy exitoso a la fecha. Ninguna de las dos últimas alternativas es por lo tanto viable.

En términos generales, parecería ser que la sustitución por bendiocarb en el proyecto, podría significar la supervivencia de una actividad anti-malaria integrada exitosa durante lo que falta del proyecto, en contraposición a una seria interrupciôn de la tendencia descendente observada, si no fuese incorporado dicho insecticida. Para el proyecto, el uso del bendiocarb y podría ser esperado biolôgicamente tan eficaz como el uso del propoxur, y podría probablemente preservar el progreso hasta ahora alcanzado dentro de lo presupuestado, sin el sacrificio del propoxur como una alternativa viable en el caso de ser nuevamente necesario.

En resumen las recomendaciones del equipo evaluador son las siguientes.

1) Aprobación del uso del bendiocarb para reemplazar al propoxur, reteniendo este último como una alternativa.

2) Urgencia de la capacitación y monitoreo continuado para el personal en la seguridad del uso del insecticida.

3) Recomendar que la etiquetación y las instrucciones en la seguridad de uso y su eliminaciôn, tendrán que ser en español.

4) Apoyar el continuado desarrollo de pruebas de suceptibilidad de vectores para el bendiocarb.

5) Recomendar decididamente el apoyo continuado de la USAID y el MSPAS/GOES para el programa de control integrado, como actualmente se lleva a cabo.

Una revista del uso apropiado de las insecticidas mencionadas en este asesoria ambiental es obligatorio en el próxima evalución del Projecto.

1. Executive Summary

The Health Systems Support Project (APSISA 519-0308) provides, among other components, support for the Government of El Salvador (GOES) to reduce the incidence of malaria through a "responsive, efficient and effective nationwide malaria control program." Support elements include technical assistance, training and commodity support for insecticides and equipment.

The integrated GOES program resulted in a steady reduction of malaria morbidity from 2,000 cases per 100,000 in 1980 to about 600 cases in 1986, when the current A.I.D. support was implemented. The decline continued to a level below 200 cases per 100,000 (9,215 cases) in 1988. From 1980 through 1988, the annual parasitic index (API = number of positive slides/1,000 examined) fell from 20.0 to 1.8. The number of cases of P. falciparum, the most severe form of malaria, was reduced from 15,782 to 120 during the same period.

This reduction was achieved through the development of a well-organized control program that includes indoor house spraying in areas of highest transmission, larviciding of proximal anopheline breeding areas, timely peridomiciliary ULV spraying with pyrethroid insecticides, physical larval control through source reduction activities and prophylactic and therapeutic distribution of medication. The various approaches in the integrated scheme are guided by appropriate entomological, parasitological and medical surveillance data. Both surveillance and control efforts are strongly supported by community participation efforts.

To date, the carbamate insecticide propoxur has been employed in the indoor house spraying activities. Its use was approved in the initial IEE (1986) and it has been used effectively and safely. However, the cost of propoxur will permit protective spraying of only one-half of the 30,000 houses targeted for the coming year. Therefore, the GOES has requested replacement of propoxur with bendiocarb (also a carbamate compound), which is priced at a level that will allow full coverage of the targeted areas (30,000 houses with approximately 150,000 inhabitants, or less than 2.5 percent of the national population).

Bendiocarb is a moderately toxic insecticide of the same class and toxicological level as propoxur. It was identified in the initial IEE as a potential back-up insecticide, and has been tested for efficacy and efficiency by the GOES since 1986. Results of these trials and similar trials in neighboring countries have demonstrated that bendiocarb is as efficacious as propoxur. In addition, there have been problems with inconsistent

supplies and quality of propoxur that would not be expected with the proposed bendiocarb product (Ficam[R] 80 W) because of its formulation in pre-packaged, pre-measured units of 100 g sachets. Propoxur is available in bulk (800 g) formulations, which provide considerably more potential for error in mixing, dosage determination and suspensibility.

Bendiocarb is registered by the U.S. Environmental Protection Agency (USEPA) for mosquito control (EPA Reg. No. 45639-1). Although not previously purchased by A.I.D. for use in malaria control programs, it is recommended by WHO and is currently being used successfully in a number of countries in the Americas, Asia, and Africa. The safety procedures required for use of bendiocarb are the same as those that the GOES has used for propoxur. Technical details for bendiocarb, specifications for formulations, and safety and first-aid procedures are included in appendixes to this report.

The proposed use of bendiocarb poses no environmental hazard. The 30,000 targeted houses are scattered along the coastal area in approximately 100 communities, largely in the western and eastern departments. The area is of a rural agriculture nature. Spraying will be done only in houses by trained malaria program spraymen. Disposal of the containers is facilitated by the sachet packaging, which can be burned and buried easily.

There is no endangered species list in El Salvador. The only nature reserve, Monte Cristo, is not in the malarious zone and no spraying will occur in that area.

Replacement of propoxur by bendiocarb is the most reasonable of the alternative actions. Retention of propoxur as the insecticide of choice would result in inadequate coverage of high risk areas and endanger the program. Abandonment of intradomiciliary spraying would even more seriously threaten the whole integrated control program, which has been very successful to date. Neither of these alternatives is viable.

It appears that the substitution of bendiocarb in the project would mean the very survival of an exceptionally successful integrated anti-malaria activity for the remainder of the project, as opposed to a serious interruption of a downward trend in malaria transmission if it were not incorporated. Bendiocarb would be expected to be as biologically efficacious as propoxur for the project. It also would be likely to preserve the progress already made within budget and without the sacrifice of propoxur as a viable alternative should it be needed in the future.

A summary of the Evaluation Team's recommendations are as follows:

1) Endorse the use of bendiocarb to replace propoxur, the latter to be retained as an alternative.

2) Urge the continued training and monitoring of personnel in safe use.

3) Recommend that labels, instructions for safe use and disposal be made in Spanish.

4) Support continued susceptibility testing of vectors to bendiocarb.

5) Strongly recommend continued USAID and MOH/GOES support for the integrated control program as it is currently being conducted.

A review of the appropriate use of the insecticides mentioned in this environmental assessment must be included in the next evaluation of the Project.

2. Purpose, Scoping Process, Scope of Work, Project Description, Need for an Environmental Assessment

2.1 Purpose

The purpose of this activity is to conduct an Environmental Assessment for the Health Systems Support Project (APSISA 519-0308) in El Salvador with specific reference to the proposed use of bendiocarb (Ficam) in place of propoxur (both carbamate compounds) as a residual wall spray in the malaria control component of this project.

2.2 Objectives

The objective of this work is to prepare an Environmental Assessment document to determine whether the proposed change of insecticide in the project conforms to A.I.D. Regulation 22 CFR Part 2, 216.

2.3 Scoping process and Scope of Work (SOW)

According to A.I.D. Environmental Procedures (22 CFR Part 2, 216.3 (4)), a written statement of the Scope of an Environmental Assessment (EA) that identifies potentially significant issues is prepared and cleared through the Bureau Environmental Officer and the Mission. The SOW for this activity is presented as Appendix 1.

2.4 Project description (adapted from IEE of Project Paper)

The purpose of the Health Systems Support Project is to support and strengthen the capabilities of the Ministry of Public Health (MOH) to deliver basic health care services, particularly those that extend the access of the Salvadoran population to preventive and primary health care services such as immunization, oral rehydration therapy, and health/ nutrition education. The Project is composed of three components: (1) supplies and equipment acquisition and management, including support to strengthen the capacity of the MOH to select, acquire, distribute and manage such commodities based on needs and priorities; (2) strengthening basic health services delivery (including child survival and malaria control activities), particularly by improving the functioning of basic care and outreach programs; and (3) strengthening the planning and management capabilities of the MOH, particularly those systems essential to basic health services (e.g., drugs and supply management, transport, and equipment and facility maintenance). The approach will focus on increasing the utilization of existing facilities by improving service programs and outreach activities. The Project also will emphasize improving the flow of informa-

tion necessary to ensure the availability of drugs and supplies at all facility levels and to facilitate decision making and rational allocation and use of resources.

Malaria control activities included in the Health Services Support component will assist the GOES to contain or further reduce the incidence of malaria through support for a responsive, efficient and effective nation-wide malaria control program. Project support will help the MOH's Malaria Department to implement targeted anti-malaria activities in areas that historically have experienced or are experiencing high rates of malaria transmission. The malaria control program will emphasize a selective mix of vector control measures coupled with a better balance between the passive case detection and treatment by volunteer collaborators and treatment and diagnosis by the nation's private and public health facilities. Vector control efforts and radical drug treatment are expected to result in continued declines in malaria transmission and progressive reduction of the geographical area requiring active intensive control measures, thereby reducing the administrative and financial costs of the program.

Malaria control activities supported by project funds will consist of three elements:

1) Technical assistance for program monitoring, upgrading control methodologies currently in use (and/or developing alternatives to these methodologies) and training of personnel in operation and maintenance of US-supplied equipment and commodities;

2) Participant and/or in-country, in-service training in antimalarial operational research and entomological and epidemiological surveillance; and

3) Commodity support for insecticides, spraying equipment, vehicles, and various other laboratory and entomological equipment and supplies.

The implementing agency will be the Malaria Division of the MOH. During project implementation, the Malaria Division will continue to monitor malaria parasite susceptibility, as well as the efficacy of the insecticides being used to control larvae and adult forms of the malaria mosquito vector.

2.5 IEE findings

The IEE for the Health Systems Support Project resulted in a Negative Determination for the malaria control components. Propoxur was reviewed and approved as the insecticide of choice for residual house spraying. It was noted in the IEE that bendiocarb (to be purchased with MOH fun-

ding) was scheduled to be field tested in 1986 as a possible back up insecticide. The IEE recommended that "if new chemical, biological or physical vector control methodologies are introduced into the program after the approval of this Project, the environmental impact will be reviewed, and, if necessary, environmental studies or assessment will be carried out" (Aug. 4, 1986).

2.6 Need for the EA

The EA is mandated both by the recommendation of the Project IEE (quoted above) and by Reg. 216 as a "substantive amendment or extension of an ongoing project." The preparation of an EA is required in that this would constitute the first authorization for purchase of bendiocarb (Ficam) in an A.I.D.-supported project for vector control. It should be noted (Section 5.6) that bendiocarb has been used successfully in other malaria control projects for some time without endangering humans or the environment.

3. Alternatives -- Including the Proposed Action

Alternative: The continued use of propoxur (no action)

Superficially, this option would appear viable because propoxur is currently meeting project needs and there is a strong "data bank" for its use. However, because of cost factors, the continued use of propoxur in the current project (as detailed in section 5.9) would result in only half the coverage needed to ensure continuing progress through 1990. In addition to these cost considerations, there also have been technical problems with propoxur resulting from inconsistent supplies and quality of the material.

Alternative: The use of bendiocarb as a replacement for propoxur

Substitution of bendiocarb for propoxur would permit full programmed coverage through 1990 within budget. Bendiocarb is not only economically more feasible than propoxur, but it is also technically efficacious, offers safer application and handling factors and has been operationally proven in seven countries (Nepal, Mexico, Philippines, S. Africa, Ethiopia, Turkey and Zambia). Bendiocarb is under evaluation in Syria and Iraq and has been evaluated under operational conditions in Guatemala, Honduras and El Salvador. It has been recommended for use in Vector Control by WHO after Stage V trials in several countries.

Favorable evaluations of bendiocarb's cost, safety, efficacy and appropriateness to the project combine to make its substitution for propoxur the preferred alternative.

Alternative: Exclusion of intradomiciliary spraying with residual insecticide, requiring neither propoxur nor bendiocarb

The absence of a carbamate insecticide for intradomiciliary spraying as a component of the integrated vector control program would deny approximately 150,000 people in ca. 30,000 houses in several malariogenic areas of El Salvador ongoing protection and would be likely to result in disruption of the steady downward trend in malaria morbidity in the areas now under protection. Moreover, other more costly components of the integrated program would have to be enhanced at a personnel and materials cost beyond the capability of GOES and involving technology beyond its existing capacity.

4. Affected Environment

Residual house spraying is employed currently in about 100 localities ("caserios") in the country based on the recorded presence of malaria (Annual Parasitic Index (API) >15). The majority of these localities are in the lowlands, along the Pacific coast and in the western departments of Ahuachapán, Santa Ana, Sonsonate and La Libertad and the eastern departments of San Miguel and La Unión (Appendix 5). There is no single environmental area treated, and individual localities are treated only if warranted by the epidemiological surveillance.

In general, the areas treated are rural zones where agriculture, including subsistence farming and commercial activities (sugar cane, coffee and livestock), is predominant. Because of the high population density, the tropical lowland vegetation is highly modified to the agricultural pursuits of the inhabitants.

Approximately 30,000 houses with a maximum of 150,000 inhabitants, or less than 2.5% of the national population, are targeted for spraying.

Houses are made of cement, brick, mud, and less frequently of wood. Trials of the residual action of bendiocarb on each of these surfaces have been conducted and the action demonstrated as suitable (Appendix 6.5). Biodegradability is rapid and complete in a matter of several months (see Appendix 2) so that no contamination of the general environment is anticipated.

There are numerous rivers and streams throughout the areas to be sprayed, but introduction of the insecticide into these aquatic systems is unlikely. Water is sufficiently abundant that it is <u>not</u> necessary to clean tanks and workers' clothing in or near natural bodies of water.

5. Environmental Consequences: Issues, Analysis and Mitigation Measures

This section addresses the list of questions pertaining to the use of insecticides under A.I.D. Regulation 216.3 (b)(1) specifically adapted to the proposed utilization of bendiocarb in place of propoxur by the Division of Malaria (MOH/GOES). The primary focus is on the use of bendiocarb (Ficam) as a residual house spray aimed at interrupting transmission of malaria by selectively killing infective Anopheles vectors of malaria.

Bendiocarb (Ficam)

5.1 The USEPA registration status of the requested pesticide

Ficam is registered with the USEPA with various registration numbers, depending upon the formulation. The active ingredient is 2,2-dimethyl-1,3 benzodioxol-4-methylcarbamate and it belongs to the general class of insecticides referred to as carbamate compounds. A copy of the Ficam W (80%) wettable powder formulation label is included in Appendix 3 of this report. Technical characteristics of the active ingredient (bendiocarb) are presented in Appendix 2. WHO specifications and analytical procedures for bendiocarb are presented in Appendix 7. Instructions for safe use, symptoms diagnosis and treatment of carbamate intoxication are included in Appendix 8.

Ficam is manufactured by NOR-AM Chemical Company (Wilmington, Delaware, USA). The Ficam W (80%) formulation is packaged in 100 g aluminum foil and plastic sachets premeasured for adding directly to individual pump charges (8 liters). Application on walls is at 400 mg/m^2. This formulation is registered as EPA Reg. No. 45639-1.

5.2 The basis for selection of the requested pesticide

Malaria control activities under the APSISA Project in El Salvador are currently in the fourth year (1989) of a five-year strategy. The anti-malaria strategy includes the use of integrated measures aimed at reducing malaria morbidity among the inhabitants of approximately 35,000 houses in several caserios in malariogenic areas of El Salvador.

The targeted areas were selected on the basis of high rates of endemic malaria (A.P.I. >15.0) and anopheline vector susceptibility to propoxur, the residual insecticide used as an intradomiciliary residual spray. This

method is only one aspect of the integrated approach. The others are larviciding of proximal breeding areas to reduce production of anophelines prior to the initiation of three spraying cycles of 120 days each; the use of special peridomiciliary space sprays with pyrethroids when ongoing surveillance indicates a surge in malaria cases; the construction and maintenance of source reduction structures to promote drainage of breeding areas; distribution of prophylactic and therapeutic medication along with entomological and parasitological surveillance through the voluntary collaborator and appropriate medical systems; and community participation and training programs designed to increase personnel capacity in the program.

This integrated program resulted in a steady reduction of malaria morbidity from 2,000 cases per 100,000 inhabitants in 1980 to about 600 cases in 1986, when the current activity was implemented. The decline continued to a level below 200 cases per 100,000 in 1988. To a large measure, this success can be attributed to the inclusion of intradomiciliary spraying with the residual carbamate insecticide, propoxur.

In 1989, it was necessary to supplement the annual budget for insecticides ($420,000) by $192,000 to a level of $612,000 in order to maintain the decline in malaria morbidity. The success of the program has resulted in the need to spray only 30,000 of the original 35,000 houses in 1989. In spite of this reduction, the economics of the project are such that the $420,000 allotment of funds will cover only about half, i.e., ca. 15,000 houses, with propoxur. Supplemental money will not be available for the 1990 work. Therefore, budget constraints alone weigh heavily against the continued use of propoxur in the project. It has been calculated that the substitution of bendiocarb (Ficam 80 W) would allow the continuation of full coverage of 30,000 houses within the $420,000 budget.

Although the rationale for replacing propoxur with bendiocarb in the integrated program is largely economic, there are other persuasive reasons for proposing bendiocarb. It is in the same chemical class as propoxur, allowing a smooth transition in terms of anopheline susceptibility, method of application, and field and laboratory assessments of efficacy. In addition, there have been problems with inconsistent supplies and quality of propoxur that would not be expected with bendiocarb because of its formulation in prepackaged, premeasured units in 100 g sachets. Propoxur is supplied in bulk formulations, which provide considerably more potential for error in mixing, dosage determination and suspensibility.

5.3 The extent to which the proposed pesticide use is part of an integrated pest management program

The proposed use of bendiocarb (Ficam 80 W) as a replacement for propoxur in an existing integrated program for the intradomiciliary spray-

ing of dwellings would be one entity, albeit an important one, among several in the project. Other approaches include larviciding of proximal anopheline breeding areas, timely peridomiciliary ULV spraying with pyrethroids, physical larval control through source reduction activities, prophylactic and therapeutic medication distribution and community participation in anti-malaria efforts. The various approaches in the integrated scheme are guided by appropriate entomological, parasitological, and medical surveillance data and employed as indicated. The components of the integrated system are graphically illustrated in Appendix 4.

5.4 The proposed method or methods of application, including availability of appropriate application and safety equipment

The method of application does not differ markedly from the one currently employed to apply propoxur, which, in turn, derives from a long-established protocol used in anti-malaria programs in El Salvador going back to the 1950s. Bendiocarb 80% wettable powder (Ficam 80 W) will be supplied in 100 g packs made of laminated paper/foil/plastic film. The contents of a sachet will be emptied into a standard 8-liter hand sprayer containing water, with the appropriate nozzle and pressure to deliver a 1.0 percent suspension of the spray in an application pattern designed to treat interior surfaces of dwellings at the rate of 400 mg/M^2 in the same manner as in current and antecedent programs. All application equipment needed to implement operational spraying with bendiocarb is in place.

The safety equipment for bendiocarb is the same as for propoxur. The spray teams are equipped with protective clothing, face masks and appropriate head gear and foot wear and are instructed in their use. They also are given periodic safety training and admonished to strictly adhere to safety requirements of the specific pesticide labeling. Safety measures and spraying efficiency are monitored by supervisory personnel at all levels.

The instructions for the safe use of bendiocarb are provided in Appendix 8.

It appears that the substitution of bendiocarb would mean the very survival of an exceptionally successful integrated anti-malaria activity for the remainder of the project, as opposed to a serious interruption of a downward trend in malaria transmissions if it were not incorporated. Bendiocarb would be expected to be as biologically efficacious as propoxur for this project. It also would be likely to preserve the progress already made within budget and without the sacrifice of propoxur as a viable alternative should it be needed again.

5.5 Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use and measures available to minimize such hazards

The proposed use of bendiocarb as a residual house spray in a manner consistent with the replaced pesticide and established practices in El Salvador is not expected to present acute or long-term toxicological hazards to either humans or the environment. Because the material specifically targets only the interior surfaces and eaves of dwellings and neither the contents nor interior or exterior space areas of dwellings are affected, the highest risk of exposure would be to spraymen or occupants of the dwellings during application. Such risk is minimized by removing occupants from the dwellings and either removing or covering vulnerable household materials (pots, pans, dishes, glasses, food containers, etc.) prior to the spraying process. Spraymen are protected by using proper precautions and personal protection measures as required by the product label (Appendix 3).

Pertinent safety studies on bendiocarb during this decade include: safety as a component of WHO Stage V village scale field trials in Iran (16) and Indonesia (2); safety as a component of field trials in Nepal (30); a number of laboratory and field studies aimed at specific hazards such as dermal exposure, absorption, excretion of metabolites, whole blood cholinesterase inhibition and clinical signs and symptoms (4,14); and an extensive safety evaluation of bendiocarb by Bonsall and Goose in 1986 covering essentially all safety aspects of the material specifically as a residual insecticide for vector control (15). A critical review of pertinent literature reflects a collective agreement summed up by a statement by Bonsall and Goose (15) that "it is concluded from these studies that bendiocarb is a safe insecticide for vector control when used with normal safety precautions and this has been confirmed in subsequent large-scale operational programmes."

The WHO Expert Committee on the safe use of pesticides has stated that "no cholinesterase monitoring is indicated when carbamate pesticides are applied because the inhibited enzyme reactivates rapidly, causing marked symptomless daily fluctuation in cholinesterase activity, thus rendering the monitoring of little practical value" (14).

The principal measures to minimize risk are the same as those now in place for propoxur, with the exception that cholinesterase testing is not applicable for bendiocarb and packaging in sachets will require specific disposal practices in strict adherence to label requirements. Manuals and data sheets on bendiocarb (22,23,24) are available to the malaria control program and the administration is well-equipped to deal with potential hazards, precautions and necessary actions for monitoring and emergency treatment contingencies.

5.6 The effectiveness of the requested insecticide for the proposed use

Although not previously used for vector control in El Salvador, bendiocarb, a carbamate insecticide, shares many of the properties, characteristics, handling and safety features of propoxur, which is also a carbamate. The WHO has completed several stage V evaluations of the material and recommends it for use in vector control programs. Once an insecticide has cleared WHO stage V trials and has been recommended for a specific use, it is usually sufficient to evaluate local vector populations under local conditions to confirm its efficacy and applicability.

In 1987, the MOH in El Salvador completed biological evaluations of bendiocarb (Ficam 80 W) in three cantons in the Department of Sonsonate to determine the duration of effectiveness of the material against An. albimanus, the local anopheline vector of malaria, on different types of wall surfaces to which the insecticide would be applied as a residual spray (31). These evaluations were followed in 1989 by susceptibility and bioassay studies conducted under more controlled conditions using treated panels and insectary-reared mosquito specimens (32). The 1989 evaluations were done in conjunction with a more representative field trial in the Santa Ana region with an operational spray scheme involving both propoxur and bendiocarb in a total of 292 caserios (11 bendiocarb) with 30,858 dwellings (1,274 bendiocarb), and 119,080 inhabitants (5,597 bendiocarb). Susceptibility testing was done before, during and after spraying. Results showed bendiocarb to be efficacious as a replacement for propoxur with the added advantages of a lower cost and improved application protocols.

In addition to evaluations already discussed, bendiocarb has been used operationally in the malaria control programs in Nepal (5 yrs., provided by U.K.), Mexico (5 yrs.), the Philippines (3 yrs.), S. Africa (3-4 yrs.), Ethiopia (2 yrs., provided by the U.N. High Commission on Refugees), Turkey (1 year) and Zambia (1 year). Syria and Iraq have begun using a suspension formulation of bendiocarb during the past year.

No reports of problems in the application or adverse effects associated with the use of bendiocarb in these countries have come to our attention.

Favorable evaluations of bendiocarb for similar applications have been reported from the neighboring countries of Honduras (26) and Guatemala (25) against the same vector species, An. albimanus, under conditions similar to those in El Salvador.

5.7 Compatibility of the proposed pesticide with target and non-target ecosystems

Because bendiocarb is used only on inside walls of dwellings, is sprayed under monitored conditions, remains a dry substance after spraying, is biodegradable to an ineffective level, even on the target species, after a period of several months, and is not used in the natural environment, it would be expected to have an impact only on the target ecosystem and only in terms of tarsal contact on the vector, An. albimanus. A possible incompatibility with the non-target ecosystem would seem to be associated only with the handling, application and disposal of insecticidal residues, including the paper/foil/plastic package, each containing 100 g of wettable powder (Ficam 80 W).

Opening a sachet containing a small (100 g), premeasured dose for a hand sprayer containing 8 liters of water, introducing the contents into the sprayer and immediately applying them to a flat surface represents an essentially "closed" system with little chance for error or accident. The most likely environmental impact would be expected during the clean up of the spray tanks or in packet disposal. This contingency can be mitigated appropriately by strictly following label instructions for tank clean up. Spray foreman also should issue each sprayman insecticide sachets only in return for empties, which can then be burned and buried according to label instructions.

In terms of environmental compatibility, the formulation of bendiocarb would seem to allow an even safer and more easily monitored system than now exists for the current insecticide, propoxur.

5.8 The conditions under which the insecticide is used, including climate, flora, fauna, geography, hydrology and soils

Bendiocarb is used sparingly and only for intradomiciliary applications, targeting only the infective portion of the malaria mosquito population in malariogenic areas of the country with high rates of endemicity or epidemicity, and under conditions representing negligible contact with the natural environment.

5.9 The availability and effectiveness of other pesticides or non-chemical control measures

The project's purpose has been well-served by propoxur. However, for reasons stated under Section 5.1, its continued use would jeopardize the downward trend in malaria morbidity in the treated area. Cost factors would necessitate a 50 percent reduction in coverage (ca. 30,000 houses to 15,000) in 1990, which, in a real sense, affects the availability of propoxur.

However, it would be well to consider propoxur as a back-up to bendiocarb should conditions warrant. In effect, changing conditions have resulted in the need to switch from propoxur as the insecticide of choice with bendiocarb as a backup, to bendiocarb as the insecticide of choice with propoxur as a backup. Residual pyrethroids offer some possibility for the future, but currently they are not a viable alternative. Although the absence of residual insecticides would severely diminish the effectiveness of the program, it would be possible, under extreme conditions such as their discontinuance for financial, resistance, unavailability, or other reasons, to compensate in this area by using such an option as insecticide-treated bed nets.

In the complete absence of a residual component, the project could perhaps augment or modify the use of the remaining components of the current integrated control program by putting more emphasis on various combinations now being used (Appendix 4). However, without a residual insecticide in the program, the human resource requirements for greatly increased surveillance and more expensive non-chemical approaches might become economically unfeasible.

5.10 The requesting country's ability to regulate or control the distribution, storage, use and disposal of the requested pesticide

The malaria program in El Salvador is well-organized at all administrative and operational levels and is currently conducting functions under this section both safely and efficiently with propoxur. The improved packaging of the requested pesticide, bendiocarb, detailed in section 5.4, will only enhance most of these activities through cleaner and more controllable transport and storage of a dry material and easier mixing with no measuring required to obtain the exact spray formulation. There are essentially no changes in the actual application of insecticide from the methods that have been used since the 1950s. The only factor that represents a departure from current handling practices is disposal of the sachet in which the operational dose of bendiocarb is packaged. A system is already in place to cover this potentially negative aspect through strict tracking and accountability for the disposal of each empty packet, as detailed in section 5.7.

The disposal procedure also appears as a recommendation in this report. Other assurances of proper handling should include a "first in, first out" storage and an exclusive (pesticide only) transport policy. It is important that Spanish version labeling is made available to users and applicators at all levels.

5.11 The provisions made for training users and applicators

The malaria program provides ongoing training in all aspects of the application of pesticides through its national, regional department and health system network. Applicator training is generally provided by well-trained supervisors through an apprentice learning system at the field level i.e., on-the-job training. The system, which includes frequent monitoring by supervisory staff, is quite adequate for the proposed use of bendiocarb. The program administration is exceptionally cognizant of outside training resources offered by various groups including PAHO, USAID and VBC.

5.12 The provisions made for monitoring the use and effectiveness of the insecticide

The integrated program for which bendiocarb is proposed is based on a combination of data on the epidemiology of the disease and vector susceptibility to the pesticide. The program has training facilities and testing programs that go hand-in-hand with these requirements. The national laboratory in San Salvador is an outstanding example of appropriate staffing, facilities and operational efficiency. This laboratory is supplemented by field facilities in the region of the proposed bendiocarb spraying activities, where insecticide susceptibility and bioassay studies are conducted in support of the project. The system allows frequent field contact between supervisory personnel and applicators, providing a means of early detection of efficacy changes and early implementation of possible modifications in application procedures.

In addition, an effective voluntary collaborator network that reports malaria case information and regional epidemiological centers associated with the medical network provide the means to measure the impact of vector control activities on malaria incidence in the program.

5.13 Will the pesticide affect endangered or threshold species?

Because bendiocarb is used in a manner that does not involve contact with the natural environment, targeting only the infective portion of the mosquito vector population as detailed under Sections 5.5 and 5.7, it is extremely unlikely that it could have an impact on threatened species. El Salvador apparently has no list of endangered species and there are no animal preserves in the area targeted for spraying with bendiocarb.

6. Recommendations

Following its analysis of documentation, interviews and field visits, the Evaluation Team:

1. Recommends that A.I.D. concur with the use of bendiocarb (Ficam) to replace propoxur as a residual house spray in the El Salvador malaria control program.

2. Recommends that USAID and the MOH/GOES continue to support the efforts of the malaria control program to develop a fully integrated control program through improved surveillance and stratification that will continue to reduce the number of communities needing protection through indoor house spraying.

3. Recommends that the Division of Malaria (MOH/GOES) continue and strengthen the network and frequency of susceptibility/ resistance trials while bendiocarb is being used as a residual house spray.

4. Recommends that the MOH continue to train its personnel in safe use of insecticides and provide required safety equipment and clothing, because bendiocarb (Ficam) must be used with the same precautions previously employed for propoxur.

5. Recommends that A.I.D. procurement procedures for the purchase of bendiocarb (Ficam) clearly specify that labels on bulk packaging and sachets be in the Spanish language and that the vendor provide an adequate number of safety and first-aid instruction pamphlets in the same language.

6. Recommends that the MOH/GOES prepare a booklet of instructions on the appropriate disposal procedures for bulk packaging and sachets and monitor the implementation of these instructions in the field.

7. Notes that although the recommendation to replace propoxur with bendiocarb (Ficam) is based on their equal efficacy and the greater ease and economy in use and enhanced safety of bendiocarb, propoxur remains an effective insecticide for Anopheles control in El Salvador. This EA does not preclude its use in the future, if warranted.

7. Approval of EA by LAC Environmental Office

The findings of this EA have been approved by the Chief Environmental Officer of the Bureau for Latin America and the Caribbean, A.I.D./Washington. A condition of this approval is that the Mission must include in the SOW for the next evaluation of the Health Systems Support Project (APSISA 519-0308) an item instructing the evaluation team to check on the appropriate us of the insecticides covered in this EA.

8. List of Persons and Places Visited

A. Persons

Dr. Angel Guerra Sandoval	Director, Department of Malaria/ MOH
Sr. Jacobo O. Solôrzano	Chief, Entomology Section, Department of Malaria/MOH
Sr. Estrada	Chief, Malaria Health Region (Western), Department of Santa Ana
Dr. Mauricio Sauerbrey	USAID Long-Term Advisor to the Department of Malaria
Mr. Richard Thornton	Director, HPN Division, USAID/San Salvador
Ms. Sandy Del Prado	Project Manager, USAID/San Salvador
Dr. Josê Laquarussû Fiuza Lima	IDB/PAHO Malaria Commission
Dr. Herna Perdomo	IDB/PAHO Malaria Commission (Team Leader)
Dr. Ricardo Mierhoff	IDB/PAHO Malaria Commission
Ing. Oscar Larrea	IDB/PAHO Malaria Commission
Dr. Agustin Lago	PAHO Malaria Advisor, San Salvador

B. Places

Department of Malaria/MOH, San Salvador	Hematology Laboratory Entomology Laboratory Central Warehouse (El Matazano)
Environmental Vector Control Project	Rio San Antonio, Estero Ticuiziapa, Departament of La Libertad

Western Health Region	Department of Malaria, Santa Ana and environs
Western Health Region Spraying Operations	Caserios Cutumay Camones, Ayutia, Department of Santa Ana
Western Health Region	Health Unit of Texistepeque (Malaria Microscopist)

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Appendix 1

Scope of Work

Proposed Statement of Work (SOW) for an

Environmental Assessment Requested by USAID/San Salvador.

A. The purpose of the proposed EA is to consider the environmental and human safety implications of utilizing bendiocarb in place of propoxur (both carbamate compounds) as a residual wall spray in the USAID-supported Malaria Control Program in El Salvador.

B. 1. The factors that must be considered under 22 CFR 216.3(b)(i) are as follows:

- The USEPA registration status of the requested pesticide.

  The basis for selection of the requested pesticide.

- The extend to which the proposed pesticide use is part of an integrated pest management program.

- The proposed method or methods of application, including availability of appropriate application and safety equipment

- Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use measures available to minimize such hazards.

- The effectiveness of the requested pesticide for the proposed use.

- Compatibility of the proposed pesticide with target and non-target ecosystems.

- The conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils.

- The availability and effectiveness of other pesticides or nonchemical control methods.

- The requesting country's ability to regulate or control the distribution, storage, use and disposal of the requested pesticide in strict adherence to the label.

- The provisions made for training of users and applicators.

- The provisions made for monitoring the use and effectiveness of the pesticide.

- Will the use of the pesticide impact on an endangered or threshold species?

2. The evaluation team will review results of trials made in El Salvador by the MOH on the effectiveness and resistance status of bendiocarb for the known malaria vectors.

3. It is expected that the VBC Project will provide evaluation team suitable background information on the use of bendiocarb in other malaria control programs, especially in Central America, including information on human and environmental safety.

4. The evaluation team will visit the proposed sites for bendiocarb application in El Salvador and evaluate transport and storage and disposal facilities and procedures in effect.

5. The evaluation team will review, in the field, the safety procedures in use and training received by the workers handling insecticides in the malaria control program.

6. The team leader will provide regular updates to USAID/San Salvador while team is working on the project.

7. Any suggested mitigation action that will be required with the use of bendiocarb in the malaria control program should be included in the draft report which will be filed with the mission before the team leaves the country. Final EA report will be submitted to USAID/San Salvador within 21 days following completion of field work.

C. The content and form of the assessment should be prepared according to the requirements of A.I.D. environmental regulations, as outlined under 22 CFR 216.6. Accordingly, the assessment should contain the following sections: 1) summary - highlighting issues, findings, impacts and mitigations. 2) purpose - a concise description of the project and relevant regulations, explaining why an EA is needed. 3) alternatives - this section should outline project alternatives; i.e., use of bendiocarb vs. continued use of propoxur, briefly discuss their potential impacts (without repeating analyses contained in Section 5), and identify the preferred alternative. Inclusion of the mandatory no action alternative provides a basis with which to judge the comparative merits of the proposed actions. 4) affected environment - this section should succinctly describe the environment of the project area. 5) environmental consequences - this section should provide a detailed, comparative discussion of impacts, addressing all the factors identified under 22 CFR 216.3(b), "Pesticide procedures", identify impacts that cannot be avoided, and detail remedial measures and mitigations, and their approximate costs, that need to be included in the project to minimize negative impacts.

Appendix 2

Technical Information on Bendiocarb
(Abstracted from WHO Data Sheet, VBC 82/52)

A. Characteristics

1. **Common Name:** Bendiocarb

2. **Chemical Name:** 2,2-dimethyl-1,3 benzodioxol-4 methylcarbamate

3. **Molecular Formula:** $C_{11}H_{13}NO_4$ :: **Molecular Weight:** 223.25

4. **Synopsis:** Bendiocarb is a broad spectrum, carbamate pesticide; a fast acting anticholinesterase agent with effective contact and stomach action. It does not emit toxic vapors at normal working temperatures. Moderately toxic to mammals, it is rapidly metabolized with immediate loss of toxicity. Bendiocarb is a weak plant systemic with excellent residual and knockdown properties.

5. **Selected Properties**

   a) **Physical properties:** The pure compound is a white crystalline solid with a melting point of 132°C. Bendiocarb is an odorless and non-corrosive compound.

   b) **Stability:** Formulated material (80%) is stable at temperatures below 40°C. In aqueous solution at 25°C, the half-life is 48 days at ph 5; 81 hours at ph 7; and 45 minutes at ph 9. Under ph 5, bendiocarb slowly degrades to pyrogallol and acetone. On non-absorptive surfaces and at low humidity, it resists oxidation. It undergoes photo-oxidation in direct sunlight.

   c) **Vapor pressure:** 0.667 x KPA ($5x10^{-6}$ mmHg) at 25°C.

B. Public Health Programmes

1. **Pests mainly controlled:** Bendiocarb is effective against a wide range of nuisance and disease vector pests: ants, bed bugs, mosquitos, cockroaches, domestic flies, fleas, lice (with ovicidal effects), millipedes, scorpions, spiders, wasps, and other arthropods, mollusks and nematodes.

2. **Use pattern:** The 80% WP should be applied by professional applicators and it should not be directly applied to humans or food stuffs. It may be used safely in houses, public buildings (restaurants, hotels, hospitals and schools); in industrial buildings; and in aircraft and other craft. Provided the manufacturer's instructions are followed and high pressure sprays are avoided, there is little risk of contaminating people, food, or food utensils.

C. Toxicology and Risks

1. Toxicology - Mammals

a) **Absorption route:** Bendiocarb may be absorbed from the gastrointestinal tract or to a limited extent through the intact skin. Low vapor pressure makes inhalation unlikely except from airborne spray mist.

b) **Mode of action:** Bendiocarb acts through inhibition of cholinesterase activity, which is rapidly reversible. The half-life of the inhibited enzyme is approximately 30 minutes.

c) **Excretion products:** Bendiocarb is readily conjugated and metabolized by liver microsome enzymes. It is rapidly excreted (16 hrs.) mainly as sulfate and beta-glucuronide conjugates of the phenol derivative.

<u>Toxicity, single dose</u>

d)	**Oral LD_{50}:**	Rat (M)	40-156 mg/kg b.w. (unformulated compound) (403 mg. on label) 143-179 mg/kg b.w. (80% a.i. water dispersable powder)
e)	**Dermal LD_{50}:**	Rat (M)	566 mg/kg b.w. (unformulated compound) 1000 mg/kg b.w. (80% a.i. liquid formulation)

<u>Toxicity, repeated doses</u>

f) **Oral:** There was no evidence of any treatment-related effect in hamsters fed diets containing up to 500 ppm bendiocarb for at least 30 days.

g) **Dermal:** In a 21-day dermal toxicity study in rats treated with a 40% aqueous suspension of the 80% wettable powder formulation at up to 800 mg a.i./kg, no macroscopic pathology or histological evidence of dermal irritation was detected and no treatment-related mortality occurred.

h) **Inhalation:** No signs of toxicity nor cholinesterase inhibition were observed in cats exposed for 33 days in a room treated with bendiocarb (200 mg/m^2).

i) **Cumulation of compound:** Bendiocarb is non-cumulative in mammalian tissues.

j) **Cumulation of effect:** No evidence of cumulative toxicity was found in rat and dog 90-day dietary studies.

Dietary studies

k) **Short-term:** See B-K above. No lasting signs of toxicity were reported in the above mentioned 90-day studies.

l) **Long-term:** Two-year feeding studies with bendiocarb in rats and dogs indicate that the principal treatment-related effects resulted from inhibition of cholinesterase activity. In the dog comprehensive histopathological examination showed no abnormality associated with the treatment and a no-effect level of 20 ppm (0.6-0.7 (mg/kg b.w.)/day) was established. In the rat the no-effect level was 10 ppm (0.34-0.42 (mg/kg b.w./day). This information was supplied by the manufacturing company.

Supplementary studies of toxicity:

m) **Carcinogenicity:** In a two-year chronic oral and carcinogenicity study in rats, dietary levels of up to 200 ppm were without effects on the tumor profile. A carcinogenicity study in mice at levels of up to 1250 ppm indicated no treatment-related histopathological alterations in any tissues.

n) **Teratogenicity:** Bendiocarb was not found to be teratogenic in either the rat or the rabbit.

o) **Mutagenicity:** No evidence of mutagenic potential was found in a mitotic non-disjunction study on Aspergillus nidulous nor in two microbial assay studies using Bacillus subtilis and Salmonella typhimurium strains. In a dominant lethal study in rats there was no indication that bendiocarb produced any dominant lethal mutations in the male germ cells.

p) **Reproduction:** Various reproduction studies indicated that bendiocarb has no adverse effects upon fertility or reproductive function.

q) **Neurotoxicity:** Bendiocarb shows no irreversible or delayed neurotoxic effects.

r) **Other:** Technical bendiocarb and its commercial formulations are not skin irritants. Contamination of the eye with technical or formulated bendiocarb may cause temporary miosis and no more than mild, temporary irritation.

2. Toxicology --Man

a) **Absorption:** The dermal route is the main route of absorption, and inhalation of dust or fine spray mist may also be possible routes.

b) **Dangerous doses:** The threshold dose for blood cholinesterase inhibition and mild symptoms lies between 0.15 and 0 20 mg a.i./kg, for the oral route, the latter dosage having been rapidly followed by mild vertigo, nausea and sweating. Regression of these effects was advanced 0.5 hours after dosing and complete within 4 hours. Repeated ingestion of 0.1 mg a.i./kg at hourly intervals was without symptoms.

c) **Observations on occupationally exposed workers:** The safety of bendiocarb when used as a residual mosquito adulticide has been evaluated in both Iran and Indonesia -- the latter trial being undertaken in conjunction with the WHO Vector Biology and Control Research Unit. Both studies were organized along the lines of a WHO expanded Stage V evaluation programme. Very few spraymen reported any adverse effects and where such effects were reported the symptoms were both mild and transient. No complaints were made by the villagers.

d) **Observations on volunteers:** Oral administration of bendiocarb to human volunteers showed that man and the rat are equisensitive to the pesticide. The onset of signs of cholinesterase inhibition and the recovery from the toxic effects were both very rapid.

3. Toxicity --Non-Mammalian Species

a) **Fish:** Bendiocarb is toxic to fish. The range of LC_{50} for several species is 0.7-1.76 mg a.i./l.

b) **Birds:** Bendiocarb is toxic to birds. It does not affect the reproductive performance of avian species.

c) **Oral LD_{50}:**
Mallard duck, 3.1 mg a.i./kg b.w.
Bobwhite quail, 19.0 mg a.i./kg b.w.
Japanese quail, 16.0 mg a.i./kg b.w.
Domestic hen, 137.0 mg a.i./kg b.w.

d) **Other Species:** Bendiocarb is very toxic to bees.

D. Other Information

Instructions for safe use of Bendiocarb for residual indoor application in vector control programs are provided in Appendix 8.

Appendix 3

Ficam[R] 80 W Label

SPECIMEN LABEL

ACCEPTED

JUN - 2 1989

Under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, for the pesticide registered under EPA Reg. No. 45639-1

TYPICAL LABEL

Ficam® W

76% WETTABLE POWDER INSECTICIDE

RECOMMENDED FOR USE ONLY BY PEST CONTROL OPERATORS

ACTIVE INGREDIENT:	Percent by Weight
Bendiocarb: (2,2-dimethyl-1,3-benzodioxol-4-yl methylcarbamate*)	76%
INERT INGREDIENTS:	24%
Total	100%

EPA Reg. No. 45639-1

PRECAUCION AL USUARIO: Si usted no lee ingles, no usé este producto hasta que el etiqueta haya sido explicado ampliamente.

KEEP OUT OF REACH OF CHILDREN

WARNING—AVISO

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED [illegible] 2 GLASSES OF WATER AND INDUCE VOMITING BY TOUCHING BACK OF THROAT WITH FINGER DO NOT INDUCE VOMITIN[illegible] ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON GET MEDICAL ATTENTION

IF INHALED KEEP PATIENT STRICTLY AT REST AND TRANSFER TO HOSPITAL IMMEDIATELY TO GET MEDICAL ATTENTION

IF ON SKIN WASH WITH SOAP AND WARM WATER

IF IN EYES RINSE THOROUGHLY WITH CLEAN WATER

NOTE TO PHYSICIAN: CONTAINS ANTICHOLINESTERASE CARBAMATE INSECTICIDE IN CASES OF OVER EXPOSURE, ATROPINE SULFATE 2 MG (EQUIVALENT TO 1/30 GRAIN ADULT DOSE) SHOULD BE GIVEN AND REPEATED AS NECESSARY UNTIL FULLY ATROPINIZED.

NOR-AM
NOR AM CHEMICAL COMPANY
3509 Silverside Road P.O. Box 7495
Wilmington DE 19803

NET CONTENTS

Protected by U.S. Patent No. 3,736,338

USEPA Registration No. 45639-1
Issued June 2, 1989

FICAM VC

80% w/w bendiocarb water dispersible powder

Polvo de bendiocarb para suspension acuosa al 80% en peso.

Para empleo exclusivo de operarios especializados en fumigaciones, en programas de vector de control supervisados por el Gobierno.

Al emplear FICAM, use ropa protectora limpia. Para usarlo, vierta un saquito de FICAM en 8 litros de agua en el fumigador, cierrelo y mezcle agitandolo.

Evite el contacto en la piel con FICAM o su suspension fumigante, asi como trabajar en su atmosfera. Si hubiese contacto, lavese la piel inmediatamente con agua y jabon. Banese tras la jornada laboral.

Net contents: 100g
Contenido neto: 100g

Appendix 4

Chronograma de Actividades 1989
Departamento de Malaria

DEPARTAMENTO DE MALARIA

CRONOGRAMA DE ACTIVIDADES 1989

MEDIDAS DE CONTROL	MESES											
	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIEMBRE	OCTUBRE	NOVIEMBRE	DICIEMBRE
ROCIADO INTRADOMICILIAR RESIDUAL (PROPOXUR)												
APLICACION DE LARVICIDA (ABATE)												
ROCIADO ESPACIAL A ULTRA BAJO VOLUMEN (PIRETROIDE)												
CONSTRUCCION Y MANTENIMIENTO DE OBRAS FISICAS Y DRENAJE DE ESTEROS, RIOS ETC.												
DISTRIBUCION DE MEDICAMENTOS A TRAVEZ DE COLABORADORES VOLUNTARIOS, SERVIC. GRALES DE SALU TRATAM. MASIVO Y TRATAM. RADICAL												
TOMA DE MUESTRAS HEMATICAS												
DIAGNOSTICO MICROSCOPICO DE MUESTRAS HEMATICAS												
MEDICION DE PARAMETROS ENTOMOLOGICOS												
ENCUESTAS PARASITOLOGICAS			1a ENCUESTA			2a ENCUESTA				3a ENCUESTA		
PROMOCION Y PARTICIPACION DE LA COMUNIDAD												
CAPACITACION DE PERSONAL												
TRIMESTRES	PRIMERO			SEGUNDO			TERCERO			CUARTO		

Appendix 5

Areas Epidemiologicas en el Pais

REPUBLICA DE EL SALVADOR

MINISTERIO DE SALUD PUBLICA Y ASISTENCIA SOCIAL

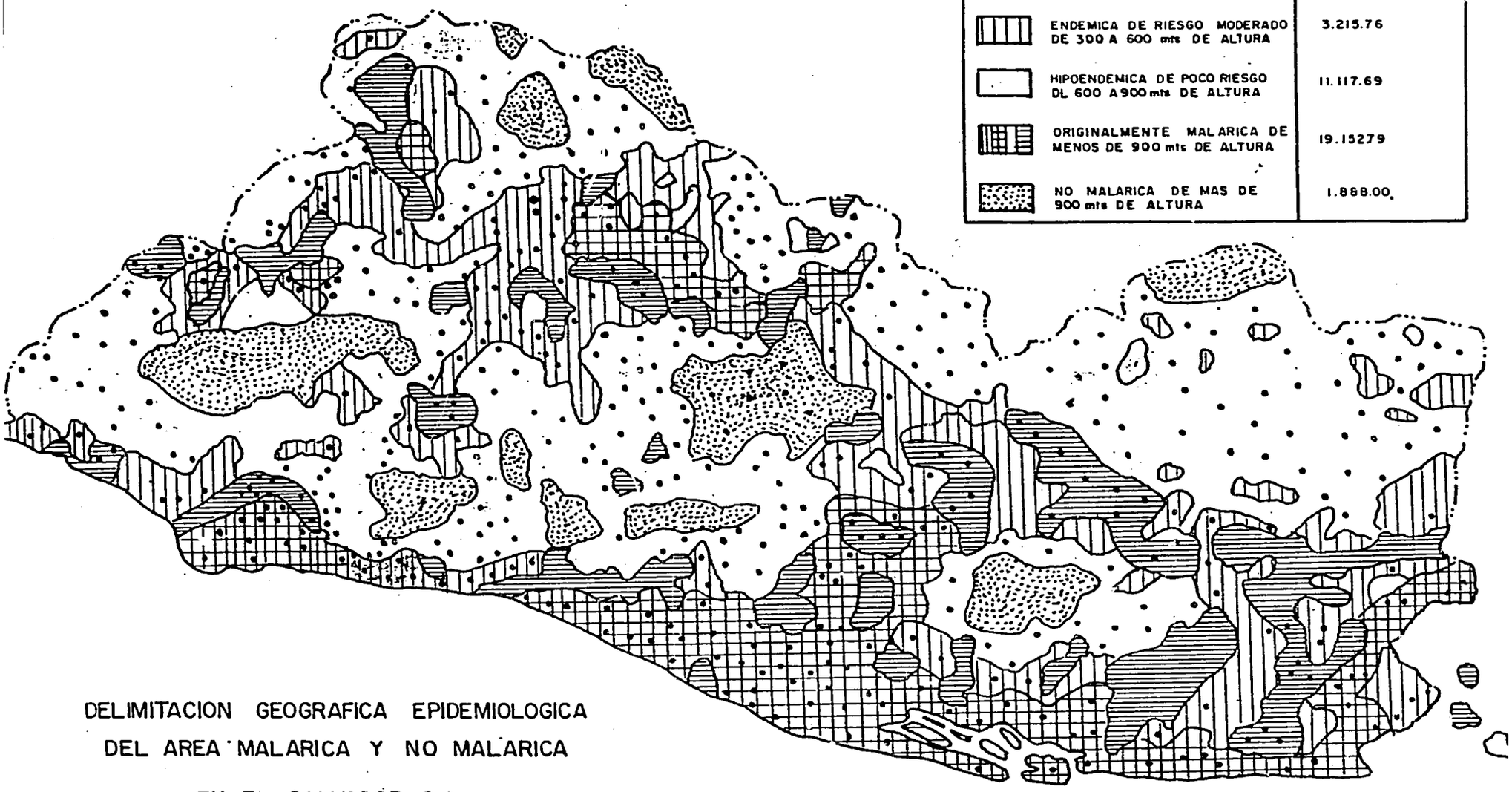
DEPARTAMENTO DE MALARIA

1 9 8 8

TOTAL AREA DEL PAIS 21.040.79 km²

AREAS EPIDEMIOLOGICAS Y ● DISTRIBUCION DE LOS COLABORADORES VOLUNTARIOS EN EL PAIS

AREA EPIDEMIOLOGICA	AREA Km²
HIPERENDEMICA DE 1ª PRIORIDAD DE 0 A 100 mts DE ALTURA	590.97
HIPERENDEMICA DE 2ª PRIORIDAD DE 100 A 300mts DE ALTURA	2.228.37
ENDEMICA DE RIESGO MODERADO DE 300 A 600 mts DE ALTURA	3.215.76
HIPOENDEMICA DE POCO RIESGO DL 600 A 900 mts DE ALTURA	11.117.69
ORIGINALMENTE MALARICA DE MENOS DE 900 mts DE ALTURA	19.15279
NO MALARICA DE MAS DE 900 mts DE ALTURA	1.888.00



DELIMITACION GEOGRAFICA EPIDEMIOLOGICA DEL AREA MALARICA Y NO MALARICA EN EL SALVADOR C.A.