OCP/78.2

(2)

ONCHOCERCIASIS CONTROL PROGRAMME IN THE VOLTA RIVER BASIN AREA

EVALUATION REPORT

PART I

presented by the

WORLD HEALTH ORGANIZATION

ONCHOCERCIASIS CONTROL PROGRAMME IN THE VOLTA RIVER BASIN AREA

EVALUATION REPORT
1974-1979

PART I

presented by the
WORLD HEALTH ORGANIZATION

CONTENTS

SUMMARY AND CONCLUSIONS

This report reviews what has been achieved in the Onchocerciasis Control Programme over the last four years.

The initial funding was pledged for six years, 1974-1979. To form the basis for the second period of financing, 1980-1985, it was recommended by the Steering Committee in 1977, and endorsed by the Joint Coordinating Committee in Kuwait, that an assessment should be presented to the fifth session of the Joint Coordinating Committee (JCC). The report which follows incorporates comments received from the sponsoring agencies, the Scientific and Technical Advisory Committee (STAC) and the National Onchocerciasis Committees.

The Programme started in 1974 with the organization of the administrative structure and the recruitment and training of the essential technical personnel. In 1975 control operations got underway in Phase I. In accordance with the timetable established by the PAG Mission, Phase II followed in 1976 spreading into Phase III in 1977.

Vector control has been highly successful over the whole area and the results obtained so far are in line with those predicted by the PAG Mission. Only at a few sites, with peculiar hydrological configuration, has larviciding not resulted in total kill at certain times of the year. These sites are quickly identified by the surveillance teams and corrective action taken. Improvement of application techniques progressively reduces the number of such failures.

The second round of surveys for epidemiological evaluation is already indicating that the level of vector control established in those parts where larviciding has been continuous for three years is resulting in a noticeable decline in the prevalence of the disease among young children, and a stabilizing of the symptoms amongst those previously affected.

The reinvasion phenomenon continues to affect the peripheral zone of the OCP area. Research has shown that most reinvading Simulium arrive in key areas in a gravid state. Many of these flies carry infective O. volvulus. Althougn the weekly riverine treatments prevent the flies from becoming established, they nevertheless pose a seasonal threat to the human population. However, the total reinvaded area represents only 20% of the total OCP area and is of a size comparable to that forecast in the PAG Mission report, although the actual pattern of distribution 'iffers. Reinvading flies emanate from sources up to 300 km away. The extended treatment of rivers in southern Ivory Coast in 1978 has had a pronounced remedial effect on some of the worst affected sites.

The entomological and epidemiological methodologies employed in the Programme have proved satisfactory. The application of larvicide to the breeding sites from aircraft is still the only effective means of controlling the vector. The entomological evaluation teams have provided useful information on the distribution of the vector, the Annual Biting Rate (ABR) and the Annual Transmission Potential (ATP). Similarly, data has been progressively collected by the Epidemiological Evaulation Unit on the clinical, ophthalmological and epidemiological aspects of the disease in over 300 sample areas. This data forms a basis for subsequent study of the evolution of the disease following the control of the vector.

Research has been planned and carried out according to operational requirements. Notable progress has been made in identifying and plotting the distribution of the different species of the S. damnosum complex, and determining the principal vectors in the Programme area. A greater understanding has been achieved of the epidemiology of the disease. Progress has been slower in the development of new insecticides and drugs but steps have been taken in 1978 to accelerate these studies. The importance of suitable chemotherapy to supplement the vector control activities is undeniable insofar as it could ease the plight of those infected, but not blind, and also help to shorten the duration of the Programme. Research in this field is closely coordinated with TDR.

Training of national personnel has been an important activity of the Programme. After training technical staff to meet its own requirements, the Programme has provided fellowships to doctors, ophthalmologists and entomologists from the participating countries in order to strengthen the national structures. In this respect 1978 has seen a significant increase in the cooperation between the governments and the Programme. The Programme has also provided in-service training in the methodologies used to scientists from other countries.

One of the main purposes of the Programme is to open up river valleys for subsequent economic development. Such development is a national responsibility. The Economic Development Unit has been following the extent of this development, which varies from country to country, and has drawn up an inventory of projects being implemented in the OCP area. The complete review of economic potential and development in the area is the subject of Part II of this Evaluation Report.

The evaluation of these first years of activity also shows that the results obtained by the Programme meet the objectives defined by STAC.

As defined by STAC, the objective of the Programme is to reduce the impact of onchocerciasis to a sufficiently low level that it no longer represents either a public health problem or an obstacle to socioeconomic development, and also to maintain and adjust control activities in order to stabilize the disease at a tolerable level.

This tolerable level results when the biting density of the vector within the control area is reduced, if not to zero, at least to a level at which transmission of O. volvulus falls below the threshold at which serious lesions of ocular onchocerciasis occur. In order to quantify the entomological criteria STAC adopted the recommendation of a Scientific Advisory Panel (SAP) Working Group that a river valley should be considered safe for resettlement when the Annual Transmission Potential (ATP) had been reduced to below 100 infective larvae of O. volvulus, and/or the Annual Biting Rate (ABR) was below 1000 flies.

These levels have been achieved over approximately 75% of the area and each year is bringing additional improvement as source areas of reinvading flies are attacked. STAC concluded that, on presently available knowledge and techniques, there would have to be continuous operational activity in the Programme area for the scheduled 20 years. It is not possible at this stage to forecast the precise nature or level of these activities, because the Programme has been operational over the whole of the originally designated area for just over one year, a period insufficient to allow the collection of the basic data essential to forecast future developments.

The Programme has been able to suspend systematic larviciding on some of the perennial rivers of the central part of the controlled zone in the dry season. The degree to which this reduction in larviciding can be extended in time and space can only be determined by careful experimentation, to avoid jeopardizing levels of ATP and ABR, and will be dependent also on the effect of treatment undertaken beyond the present boundaries. STAC considered that it should be possible to make a reasonable estimate of the extent of these cuts in the present area three years after the establishment of full control operations in all three phases of that area, i.e. at the end of 1980.

At the end of the 20-year period, the magnitude of the maintenance operation and its duration will depend on the success of the present campaign and on the introduction of possible new technology. Also, the duration of the Programme will be influenced by the results of planned supporting research. Efforts will continue to determine the longevity of the parasite in the human host, to develop suitable chemotherapy, to reduce the impact of reinvasion and to modify control through the implementation of possible alternative methods and the development of other insecticides and formulations.

The cost of the Programme for the 1974-1979 period is approximately US$ 55 000 000. The budget estimates for a continuation of this Programme at the present level of operations over the next six-year period, 1980-1985, including the extension into southern Ivory Coast, is approximately US$ 133 000 000. These figures incorporate an annual increase of 11.5% for staff, of which 3.5% is for statutory increase and 8% for inflation, 8% for all other operational costs except for aerial operations and the cost of replacing one-third of the total vehicle fleet per year.

CHAPTER I

HISTORY OF THE PROGRAMME

Onchocerciasis, or river blindness, is transmitted in West Africa by blackflies, belonging to the Simulium damnosum complex, which breed in rapidly flowing sections of many rivers. This disease, which is particularly severe in the Sudan and Guinea savanna zones, brings with it debilitation and blindness. In parts of the West African savanna onchocerciasis constitutes an important deterrent to human settlement and the subsequent economic development of many valleys which lie uninhabited and unproductive.

In 1974, at the beginning of the Onchocerciasis Control Programme (OCP) covering nearly 700 000 square kilometres in the Volta River basin, it was estimated that 10% of the population was harbouring Onchocerca volvulus, the parasite causing onchocerciasis, and that about 70 000 people were blind as a consequence of the disease. It is not possible to assess the exact number of blind in the Programme area, but it is more relevant to take into consideration the geographical concentration of blindness due to onchocerciasis in certain areas, when estimating the impact of the disease. The epidemiological pattern of ocular onchocerciasis, with extremely high blindness rates in relatively young age-groups in small rural populations, explains the important socioeconomic consequence of the disease.

Awareness of the extent of the problem had been steadily developing since the 1940s. Systematic surveys to assess the magnitude of the problem and studies to develop and evaluate potential control measures were carried out in many of the countries concerned since the early 1950s, thus providing improved background information on the epidemiology and socioeconomic importance of the disease. Control operations aiming at the destruction of the vector were carried out during the 1960s, beginning on a modest scale and culminating in a campaign involving three countries and 60 000 square kilometres, under the aegis of the Governments of Ivory Coast, Mali and Upper Volta in association with the European Development Fund (EDF), and the Organisation de Coordination et de Coopération pour la lutte contre les Grandes Endémies (OCCGE).

In 1968 the World Health Organization (WHO), in joint sponsorship with the United States Agency for International Development (USAID), and OCCGE, convened a technical conference in Tunis to consider the problem of onchocerciasis. The conference concluded that control by means of larviciding was technically feasible and chances of success would be greatest if the operations were carried out in ecological zones sufficiently large to obviate the need for continuous control of the whole area in order to protect it against reinvasion by the onchocerciasis vectors. It was recommended that priority be given to launching a large-scale control programme in the Volta River basin area, involving adjoining parts of Benin, Ghana, Ivory Coast, Mali, Niger, Togo and Upper Volta, to protect populations severely affected by the disease and to constitute the cornerstone of future coordinated action against onchocerciasis, and in favour of associated development, in Africa south of the Sahara.

In 1969 a meeting was organized in Brazzaville by the WHO Regional Office for Africa to refine further the approach needed for preparing the proposed campaign. Representatives from the Government of Ghana, OCCGE and USAID, as well as from WHO, attended these discussions. Shortly thereafter, in 1969 and 1970, several of the interested countries submitted formal requests - emanating from the highest authorities - to international and bilateral sources of technical cooperation and funding which were thought to be interested in contributing to such an ambitious undertaking. Among those organizations were the Food and Agriculture Organization of the United Nations (FAO), the International Bank for Reconstruction and Development (IBRD), the USAID and WHO. Simultaneously, the United Nations Development Programme (UNDP) manifested its interest in broadening its existing involvement in onchocerciasis studies and control in the Volter River basin area.

The preparatory phase

On the basis of the requests received and at the suggestion of IBRD, WHO and UNDP sponsored a meeting of interested parties in Geneva in 1970 to draw up the terms of reference of a mission designed to carry out complementary investigations in the seven countries concerned, as well as to plan and cost the proposed Onchocerciasis Control Programme. This Preparatory Assistance to Governments (PAG) mission was funded by UNDP with FAO as Associate Agency.

Meanwhile, in 1972, the Director-General of FAO, the President of IBRD, the Administrator of UNDP and the Director-General of WHO, in view of the importance and complexity of the scheme envisaged, decided to set up a Steering Committee, comprising a representative of each of the four sponsoring agencies, to ensure the coordination of the action taken by these agencies in the planning and implementation of the Programme.

The findings of the PAG mission and the data originating from other preliminary investigations were combined to form a report,[1] which was presented during 1973 to the Governments of Benin, Ghana, Ivory Coast, Mali, Niger, Togo and Upper Volta. This report formulated a plan of work for onchocerciasis control in the Volta River basin area which could lead to the repopulation, settlement and economic development of the endemic zones. The report was also presented to various agencies, institutions and governments.

The Plan of Operations proposed by the PAG mission report was endorsed during a conference held at Accra in November 1973, which brought together the seven governments involved, and the four sponsoring agencies. At the conference the agreement governing the operations of the Programme (Operational Agreement) was formally signed by the participating governments and WHO. This agreement, which set out the basic arrangements for the management of the Programme, was supplemented in 1974 by individual Country Protocols defining the specific contributions of each government.

As Executing Agency, WHO was assigned the task of implementing the Programme which was formally established from 1 January 1974 with headquarters in Ouagadougou, Upper Volta. The first year of activity was devoted to setting up the structures, the recruitment and training of staff, the development of infrastructure, the purchase of equipment and supplies, complementary surveys and the intensification of research. Actual control operations began in February 1975.

The machinery established to manage the Programme included, at the country level, National Committees for Onchocerciasis (NOC), comprising representatives of the main national services concerned. The role of these committees is principally, to coordinate the action of all national services involved in the Programme and the subsequent economic development projects, and to ensure liaison between the government and Programme headquarters.

At the agency level, a Scientific Advisory Panel (SAP), made up of nearly 200 technical and scientific workers, was formed by WHO to be called upon, as necessary, for advice on all aspects of the disease and its control.

An Ecological Panel (EP), comprising a small group of specialists with wide experience in river basin ecology, the epidemiology of diseases in river basins and the ecological effects of pesticides, was set up by the Steering Committee to guarantee satisfactory protection of the environment.

---

[1] UNDP, FAO, IBRD and WHO (1973) Onchocerciasis control in the Volta River basin area. Report of the Preparatory Assistance Mission to the Governments of: Dahomey, Ghana, Ivory Coast, Mali, Niger, Togo and Upper Volta, OCP/73.1 - Annexes 0-1 to VI-5, 2400 pp.

At the Paris meeting of donor and participating governments and sponsoring agencies, in June 1974, it was agreed to amplify the management structures of the Programme. The additional structures included, in particular, a Joint Coordinating Committee (JCC) composed of representatives of the seven countries, all contributing parties and the four agencies.[1] The role of the JCC was to exercise general supervision over the policies to be adopted in the planning and execution of the Programme and to follow the development of activities. The Committee, which would be presided over by an Independent Chairman and served by a joint WHO/World Bank secretariat, would meet at least once a year for this purpose.

To provide the JCC with a continuous independent evaluation of the technical aspects of the Programme, WHO formed a Scientific and Technical Advisory Committee (STAC) composed of 12 members of the Scientific Advisory Panel. This Committee would meet twice a year to review scientific and technical aspects of the Programme and would prepare an annual report containing its findings and recommendations for submission to the JCC through WHO and the Steering Committee.

Finally, the Steering Committee established an Economic Development Advisory Panel (EDAP) to assure the continuous review of information relating to the economic development aspects of the Programme. This Panel, composed of economists and specialists in agricultural and rural development would meet twice a year and would present an annual report on its findings and recommendations to the JCC through the World Bank and the Steering Committee.

These additional structures were described in a Memorandum of Understanding which was approved by the JCC at its first session in Abidjan, Ivory Coast, in February 1975.

Following the assurances received from contributing parties at this first session of the JCC, an Onchocerciasis Fund Agreement covering the financing of the first six years of operations was signed on 7 May 1975 by nine[2] donor governments, the African Development Bank, the IBRD, IDA, UNDP and WHO.

In 1976, following the consolidation of the Programme activities in the field and within the context of the new orientation being given to the functions of the Organization as a whole, the decision was taken by the Director-General to transfer the responsibility for the Programme from WHO headquarters to the Regional Office for Africa. This transfer implied both a new approach to management and a reorganization of the supporting services. Thus, in December 1976, a new Director was appointed and the headquarters in Ouagadougou assumed full responsibility for the implementation of the Programme under the authority of the WHO Regional Director for Africa. The Office of the Programme Director in Ouagadougou was enlarged by the transfer of staff from the support unit in Geneva, and a liaison office was established in Brazzaville.

Experience so far indicates that the centralization of activities in the field has had the effect of creating a closer association with the different levels of structure, in particular with the participating countries, and a greater flexibility for the management.

The interagency Steering Committee for Onchocerciasis Control in the Volta River basin area, which had been particularly active during the preparatory and launching phases of the Programme, has proved to be a valuable tool for concerted action and rapid decision-making.

---

[1] Members of the JCC as of December 1977: Belgium, Benin, Canada, France, Federal Republic of Germany, Ghana, Iraq, Ivory Coast, Japan, Kuwait, Mali, Netherlands, Niger, Norway, Togo, United Kingdom of Great Britain and Northern Ireland, United States of America, Upper Volta, the Africa Development Bank, the United Nations Development Programme (UNDP), the Food and Agriculture Organization of the United Nations (FAO), the World Bank (IBRD) and the World Health Organization.

[2] The Kingdom of Belgium, Canada, the Republic of France, the Federal Republic of Germany, Japan, Kuwait, the Kingdom of the Netherlands, the United Kingdom of Great Britain and Northern Ireland and the United States of America.

National Onchocerciasis Committees

By mid-1974, each of the participating countries had formally established a National Onchocerciasis Committee (NOC). In particular these Committees played a major role in resolving logistical problems which arose during the first years of operations.

At the first joint meeting of the NOCs which was convened in Abidjan in June 1977 it was unanimously agreed that the Committees and the Programme should meet annually. At the invitation of the Government of Benin a second meeting took place in Cotonou in June 1978.

Advisory bodies

During the first four years of activities the Programme has benefited from the guidance and support of the advisory bodies.

In the initial stages, visits were made by members of the Ecological Panel (EP) and the Scientific and Technical Advisory Committee (STAC) to the Programme area for discussions with the field staff, and to obtain first-hand knowledge of the environment and of the operations. With the expiry of the mandate of members of STAC at the end of 1976, the composition of the Committee was reviewed and slighly modified to meet the changing needs. Following the transfer of management, a joint meeting of both groups took place in Ouagadougou in 1977, followed by a meeting of STAC at the WHO Regional Office, Brazzaville, in August 1978.

The Ecological Panel has been reviewing the data collected by the hydrobiology research workers under the aquatic monitoring programme and has drawn attention to factors which might be detrimental to the environment. The role of STAC in evaluating the technical aspects of the Programme and, notably, giving guidance in research, has been equally valuable.

Although efforts were made to minimize duplication through joint meetings and through cross-representation at meecings, some overlap between the roles of the Scientific and Technical Advisory Committee and the Ecological Panel has not been completely avoided and solutions to this continue to be sought.

As Administrator of the Onchocerciasis Fund the World Bank is responsible for mobilizing and managing the funds required to carry out the Programme. Advances from the Fund to WHO are made on a quarterly basis on receipt of a written submission of the estimated payments to be made during the following quarter. At half-yearly intervals, the Bank provides to each of the contributing parties and to the Steering Committee, a statement of contributions, receipts of and disbursements from the Fund.

As of 31 December 1977, the amount of advances by the World Bank was $ 30 200 000 of which $ 20 200 000 was for the 1974-1976 period and $ 10 000 000 for 1977.

FIG. I–1

PROGRAMME AREA AS OF 1 JANUARY 1978

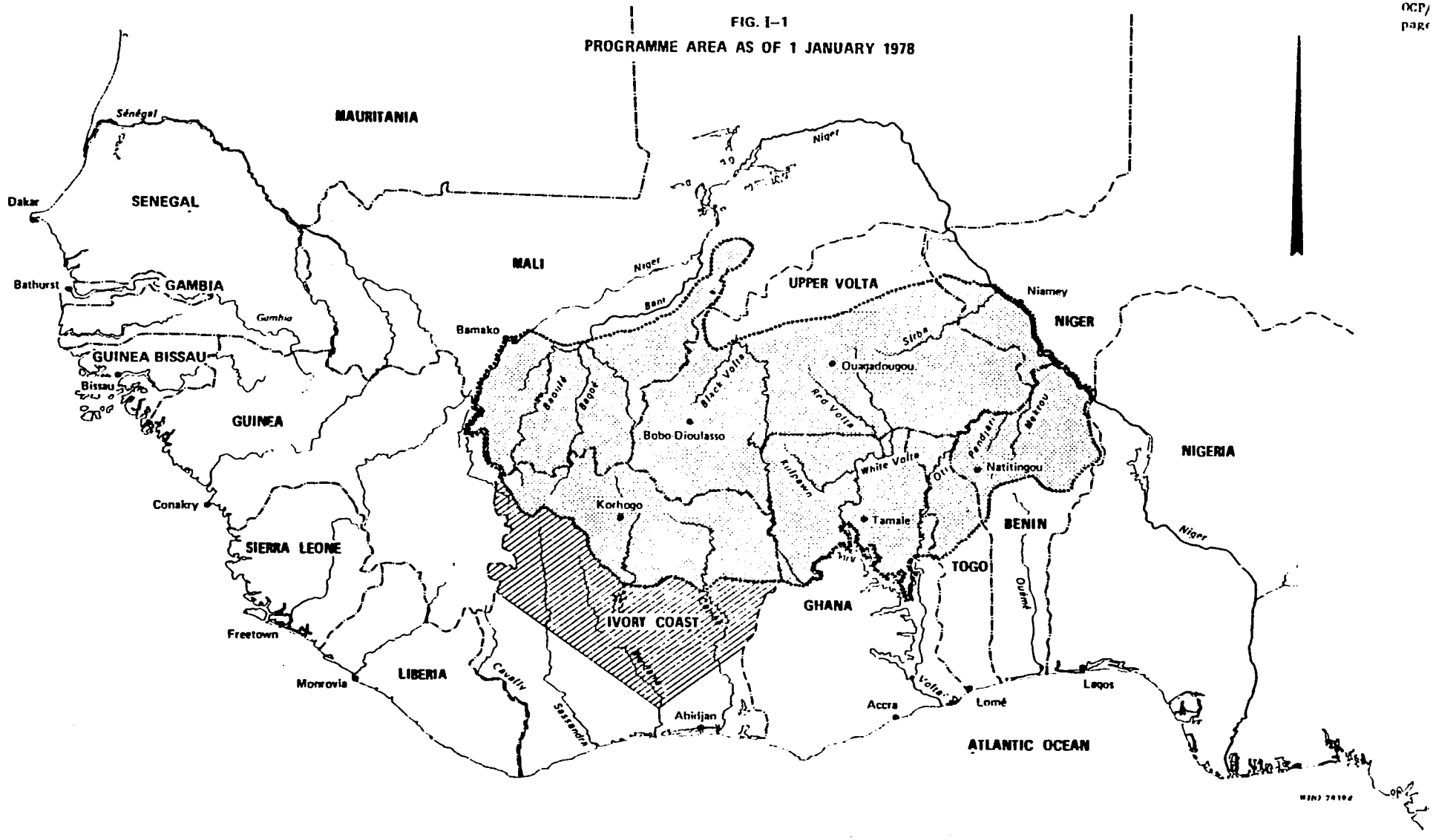
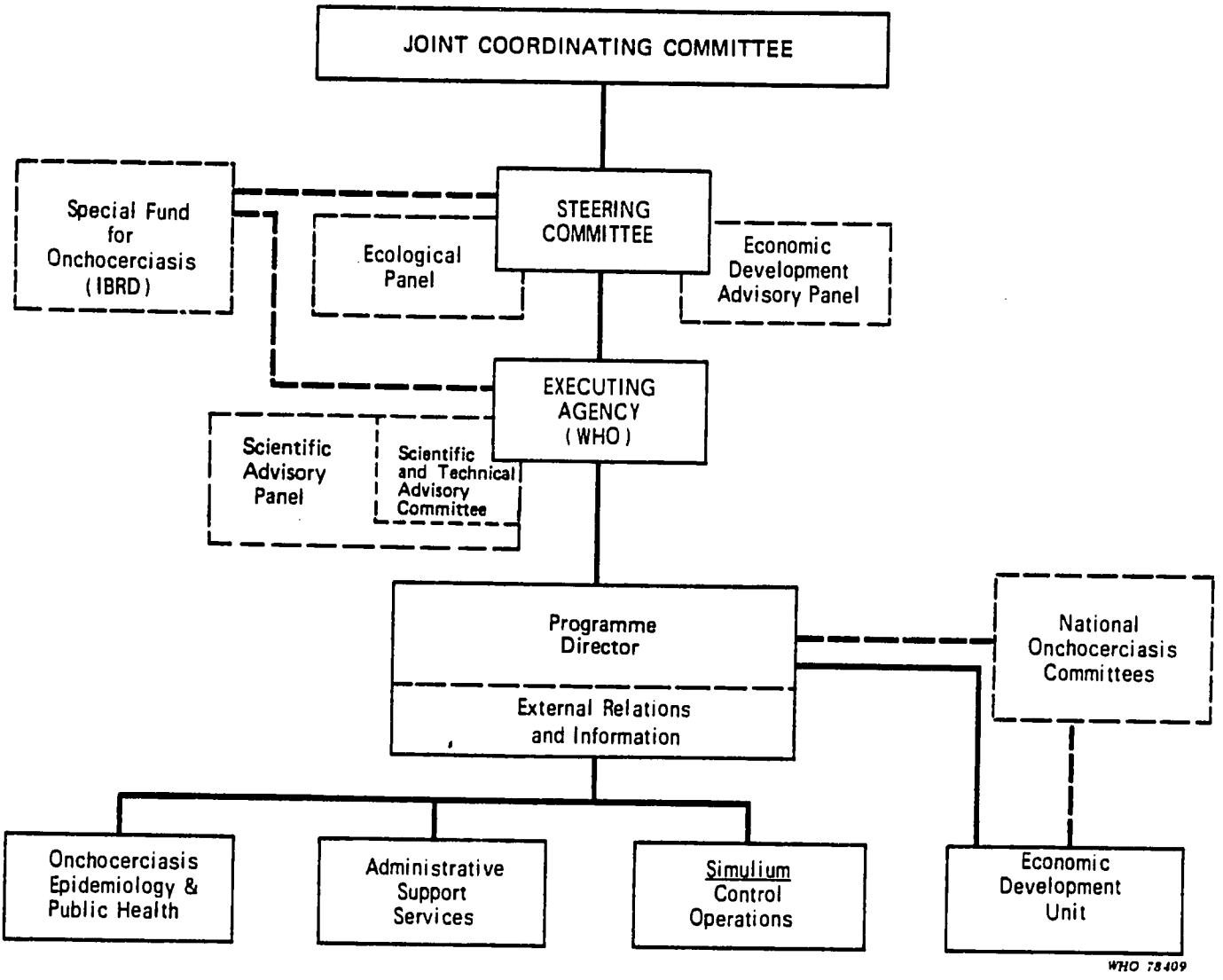


FIG. I–2

MANAGEMENT STRUCTURES [1]



[1] September 1978

CHAPTER II

THE PROBLEM OF ONCHOCERCIASIS

The disease and the parasite

Onchocerciasis is a parasitic disease caused by a nematode of the filaria group, Onchocerca volvulus. The parasite is strictly associated with man and has no known animal reservoir. It is transmitted by several dipteran flies of the Simuliidae family, which includes the West African vectors, the species complex Simulium damnosum. The Simulium or blackfly is both vector and intermediate host: a microfilaria ingested from a human has to complete a development cycle within the blackfly; in about seven days it becomes an infective larva, the only form which can infect man. There is no possibility of transmission of the disease except by forms of the parasite that have completed this obligatory intravectorial cycle.

Adult Onchocerca volvulus worms, male and female, live in human tissues either in the free state or encapsulated in fibrous formations known as onchocercomas, cysts or nodules. The free worms and deep-seated nodules are normally undetectable. The superficial nodules, which are visible and palpable, are mostly located in the subcutaneous tissues overlying bone: costal margin, iliac crests, trochanters, sacrum, knees, shins, skull. Each cyst contains one or more pairs of worms. As a rule patients have several cysts or groups of cysts, and in nodulectomy campaigns there have been cases where over 40 cysts have been removed from a single patient.

During its lifetime (estimated at 10-15 years) the female Onchocerca produces millions of embryos, microfilariae, which spread throughout the body tissues but with a particular affinity for the skin and eyes. From the skin they may be ingested by a blackfly during its blood meal. In man the microfilariae have a life expectancy of one to two years. After this time, unless they have been ingested by a blackfly and are thus able to continue their development cycle, they die in the tissues.

The main clinical manifestations of the disease are due to reactions to the presence of microfilariae, and their severity is directly related to the intensity of parasite infection. The simplest manifestations are skin lesions which are caused by scratching, and are followed by pruritic papular eruptions. Later on the skin may undergo a variety of changes: thickening and sclerosis in the form of pachyderma (elephant skin), localized or extensive cutaneous atrophy, and depigmentation.

Distribution of onchocerciasis

Onchocerciasis is essentially a disease of tropical Africa, where it is prevalent to varying extents between latitudes 15°N and 15°S. However, it also affects two other continents: America, with foci in Guatemala, Mexico, Venezuela, northern Brazil, and Colombia; and Asia, with the focus in northern Yemen.

Broadly speaking, the northern limit of the disease in Africa runs from Gambia to the south of Lake Chad; it then rises in the Sudan along the Nile as far as the Abu Hamed region (19°15'N) and drops again into Ethiopia along the tributaries of the Nile. The countries situated between this line and the Equator are the worst affected: the whole of West Africa (except Mauritania), Cameroon, southern Chad, the Central African Empire, southern Sudan, western Ethiopia, and northern Zaire.

Further south, the disease occurs in Equatorial Guinea, Gabon, Congo, Rwanda, Burundi, the central basin and southern part of Zaire, Uganda, western Kenya, Tanzania, Angola, and Malawi, where it reaches its southernmost point, 17°S.

The vector and transmission

Vector species

The known vectors of human onchocerciasis are flies which belong to the Simuliidae family. The African vectors are members of the complexes Simulium damnosum (throughout the area of distribution of the disease) and Simulium neavei (in certain parts of central and east Africa). As regards S. damnosum s.l., its area of distribution extends northwards and southwards beyond that of onchocerciasis.

The S. damnosum complex

It has been known for some years that S. damnosum, once regarded as a homogenous species, in fact constitutes a complex of different taxa. As a result of recent studies 24 separate cytological segregates have been identified throughout tropical Africa. For West Africa nine segregates have been described, six of which ("Nile", "Sirba", "Bandama", "Soubre", "Yah", "Bille") are of direct concern to the Programme because they are found in or closely associated with the Programme area. At a Scientific Advisory Panel meeting on vector complexes the decision was endorsed to consider these as species with the following names already given them in publications, S. damnosum s.s., S. sirbanum, S. sanctipauli, S. soubrense, S. yahense and S. squamosum respectively.

Table II-1 and Fig. II-1 show the distribution of these six main species for the whole of West Africa, and for the Programme area and adjacent zones respectively.

Each of the species has a characteristic distribution pattern related to the distribution of the bioclimatic zones of West Africa. Thus S. sanctipauli has never been demonstrated outside the forest zones; S. squamosum and S. yahense are more ubiquitous but mainly confined to certain types of watercourse in well wooded country; S. soubrense mainly inhabits the large rivers in the forest and Guinea savanna zones; S. damnosum s.s. is found mainly in the Guinea savanna zones; S. sirbanum has been found in forest areas but it is mainly in the Sudan savanna zone and the northern Guinea savanna that this species is widespread.

Differences in transmission potential have been demonstrated between species and as a function of the bioclimatic zones.

TABLE II-1. DISTRIBUTION OF SPECIES OF S. DAMNOSUM COMPLEX

Species	Indication of distribution	Habitat
squamosum	Cameroon, Benin, Togo, Ghana, Ivory Coast, Upper Volta	Humid forest and riverine forest in Guinea savanna
yahense	Togo, Ghana, Ivory Coast, Liberia, Guinea	Humid forest and mountain forest; extends into Guinea savanna
soubrense	Benin, Togo, Ghana, Ivory Coast, Liberia, Guinea, Upper Volta	Humid forest and riverine forest, extends into Guinea savanna
sanctipauli	Ghana, Ivory Coast, Liberia	Humid forest
damnosum s.s.	Cameroon, Nigeria, Benin, Togo, Ghana, Ivory Coast, Liberia, Guinea, Mali, Niger, Upper Volta	Humid forest and Guinea savanna; extends into Sudan savanna
sirbanum	Cameroon, Nigeria, Benin, Togo, Ghana, Ivory Coast, Guinea, Gambia, Upper Volta, Mali, Niger	Sudan savanna; extends into Guinea savanna and even forest

Bio-ecology of the vector

Like all blackflies, S. damnosum s.l. develops, during its larval and pupal stages, in running water. Pre-adult development (eggs, larvae and pupae) lasts about a fortnight under tropical running-water temperature conditions. The various species of the complex have somewhat different requirements with respect to the physicochemical conditions of the water of their breeding sites.

Among all the biological peculiarities, two fundamental characteristics stand out because they determine the strategy and tactics to be employed against S. damnosum.

(i) The demands of the larvae of the complex are relatively exacting, particularly in regard to their nutrition. This is reflected in limited spatial distribution of the breeding places and is what makes it possible, after a careful survey of those breeding places, to implement a campaign aimed at destroying, within a given area and by sufficiently specific action, all the larval populations of the species.

(ii) This factor, favourable to the execution of a coordinated campaign, is unfortunately counterbalanced by the flying power of the females; whence, on the one hand, the need to continue larviciding over a very long period to obtain only a satisfactory reduction in the parasite population harboured by man; and, on the other hand, the need to apply treatment to a sufficiently extensive protective zone so as to minimize the consequences of possible reinvasions.

Transmission

The microfilariae of O. volvulus, the pathogenic agent of human onchocerciasis, have to go through a stage in a vector in order to continue their development. These microfilariae, ingested during a blood meal, undergo several moults in the course of a cycle that lasts an average of seven days. On completion of this cycle, the infective larvae break out of the fly during a subsequent blood meal. In view of the duration of the reproductive cycle of the female S. damnosum, it is unlikely that the parasite would develop to the infective stage between two successive blood meals. Thus an infected female does not normally become capable of transmitting the disease until she takes a third blood meal.

The dynamics of transmission depend on many factors, the main ones being:

- the absolute quantity of potential vector blackflies;
- the mean age of the vector populations;
- the vector species concerned (adaptation to the parasite, degree of anthropophilly, etc.);
- the transmission season;
- the degree of contact between human and vector populations, which depends on human activities (linked to age and sex) and on the above-mentioned factors;
- the level of infection of the human populations, which are the only reservoir of the pathogen.

Epidemiology of onchocerciasis

Not all the determining factors in the spontaneous development of onchocerciasis have yet been found, but a number of general rules can be deduced from observations so far.

Parasite build-up

Onchocerciasis is a parasitic infection that progresses slowly as part of a cumulative process. There is a long period of clinical latency after infection (one year on average). Spontaneous cure is belated and is governed by the life-span of the adult worm (10-15 years). Under stable conditions of transmission, the filarial load in the individual steadily increases over the years. The severity of the lesions varies directly with the degree of parasite infection, i.e., with the number of adult worms in the body of the host and the number of microfilariae they release. Level of transmission and length of exposure to blackfly bites are the two factors in man-vector contact that govern parasite build-up.

In four villages of the Programme area it was possible to determine annual transmission potentials (ATP)[1] before the start of the campaign, over a sufficiently long period to have a good idea of the effect of annual variation. Medical examination has shown that exposure to increasing ATPs leads to increasingly severe onchocerciasis lesions among a population (Table II-2).

Geographical disparities

Onchocerciasis occurs in foci, each of which is centred on a breeding place, or succession of breeding places, in the immediate vicinity of which the disease appears in its most severe form. The distribution of foci is governed by the hydrogeographical features of the region. Depending on the density of breeding places, foci may be relatively extensive and continuous, or separate and restricted in area, in a mosaic pattern.

Endemicity in any given focus falls off with increasing distance from the centre. This stratification into levels of endemicity (first-line, second-line and third-line villages) is governed by the frequency of contact between man and vector, which decreases with distance from the larval breeding place and the distance over which the blackfly has to travel.

Endemicity levels

A study carried out in the Programme area in 364 villages has shown that there are two distinct types of endemic situation.

(a) A level of severity of the disease, corresponding to what entomologists have called the desertion level and epidemiologists call the intolerability level, at which the survival of the community as a group is at stake. This seems to occur whenever the blindness rate rises above 4-5% of the toal population. The population then starts to decline, at least relatively, as a result of a combination of health factors and social factors. The surface occupation density tends to fall below 50 inhabitants/km^2 until it reaches a critical threshold value of 35 inhabitants/km^2 at which first-line villages are doing no more than living on borrowed time. All such villages also have:

- over 60% of onchocerciasis;
- over 20% of persons with ocular onchocerciasis;
- over 10% of persons with severe ocular complications;
- mean microfilarial density of over 10-15 mf.

Not all communities with over 60% cases of onchocerciasis are in this situation and they may have different values for the other parameters. However, it seems reasonable to consider this rate as a threshold beyond which there is a major risk of the situation becoming intolerable. The existence of this risk is defined as hyperendemicity.

---

[1] For an explanation of ATPs and annual biting rates (ABRs) see footnote on pages 22 and 23.

TABLE II-2. EFFECT OF EXPOSING A POPULATION TO INCREASING ANNUAL TRANSMISSION POTENTIALS

Village	ATP	No. examined parasito-logically (1)	Prevalence of onchocerciasis (2)	Mean mf density	No. examined ophthalmo-logically	Prevalence of ocular onchocerciasis (1)	Proportion of irreversible lesions (3)	Blindness rate (4)
Nasso	200	508	54.8%	13.9	378	14.8%	8.3%	0.2%
Pendie	1 200	234	70.3%	15.6	182	33.3%	14.7%	2.1%
Dangouadougou	1 600	212	68.7%	20.0	176	55.0%	20.9%	4.2%
Fetekro	2 000	154	76.0%	26.8	128	59.0%	25.0%	7.6%

(1) rates adjusted for age and sex with reference to the OCP standard population.
(2) geometric mean of individual parasite loads per biopsy (distilled water for 30 minutes).
(3) calculated on ocular onchocerciasis cases. Iritis not included.
(4) blindness defined as less than 1/20 vision in the better eye. Calculated on total registered population.

(b) On the other hand, when infection is below a certain level, the disease is socially inapparent. In such communities, however:

- onchocerciasis is not a causative factor of blindness, or is an unimportant one, and the blindness rate is generally less than 1% (except in places where there is another major endemic disease, such as trachoma);
- less than 10% of the population have ocular onchocerciasis and the number of irreversible ocular lesions is in single figures (always less than 2.5% of the population);
- mean microfilarial density for all positive cases is less than 10.

This level of perfect tolerance exists in almost all villages in which less than 40% of cases were found. Above this threshold level of 40%, however, more severe symptoms soon begin to appear. Thus, hypoendemicity, the tolerable level of the disease, is defined by the existence of less than 35% of cases in a community.

(c) Between these two limits, less than 35% and over 60%, every type of situation may be found. Collective resistance factors (population density per village territory), individual susceptibility factors, and differences in exposure to risk according to sex, occupational or ethnic category, social division of labour or the mode of working the village territory, mean that no general law can be formulated to describe what is usually called mesoendemicity. The definition of mesoendemicity is thus purely a negative one: a situation is mesoendemic when the disease ceases to be socially inapparent but has not yet reached a level that is intolerable for the group affected.

Blindness

The concentrates of cases of blindness in small rural communities, with extremely high rates in relatively young age-groups (Fig. II-2) has serious repercussions on the working capacity of an important sector of the population. Recent observation of a high mortality among blind persons compared with healthy adults of the same age range, would seem to imply that the present estimate of 100 000 blind in the Programme area is not an exact view of the phenomenon. The risk of blindness incurred by populations living in a hyperendemic area can be two or three times higher than the rate of blindness observed at any given moment.

FIG. II-1
DISTRIBUTION OF SPECIES OF S. DAMNOSUM COMPLEX

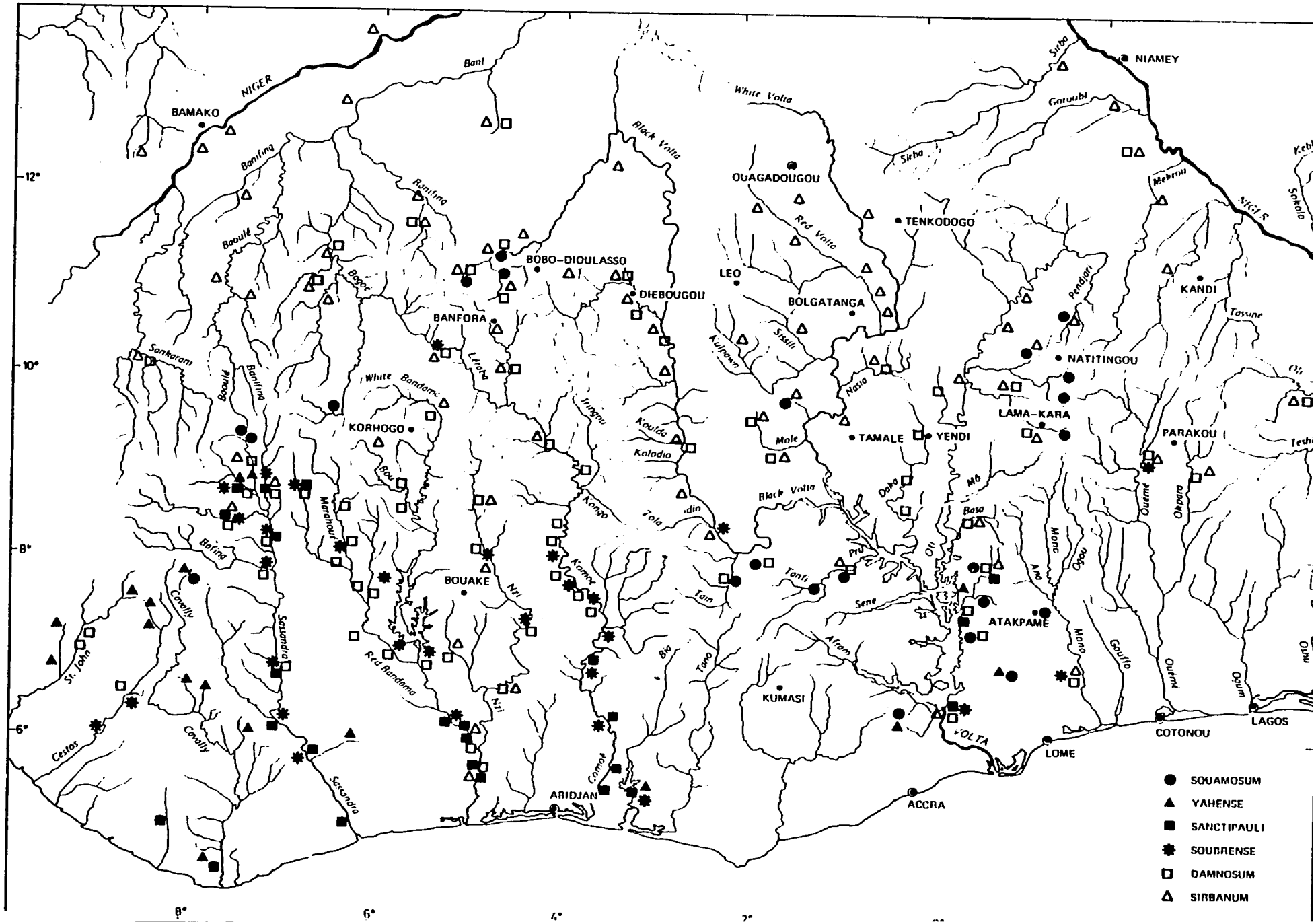
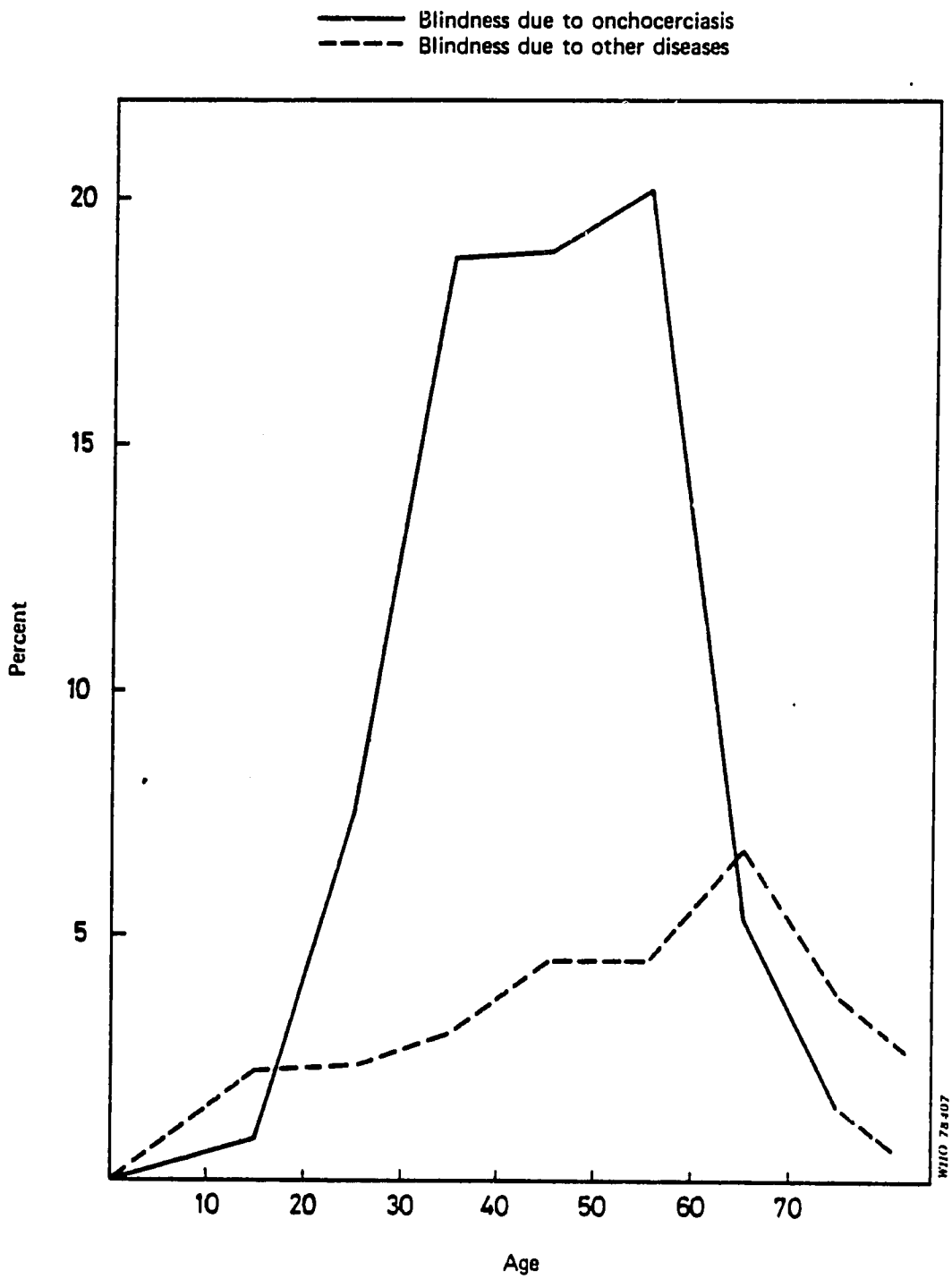


FIG. II–2
AGE DISTRIBUTION OF BLIND MEN IN 15 HYPERENDEMIC VILLAGES



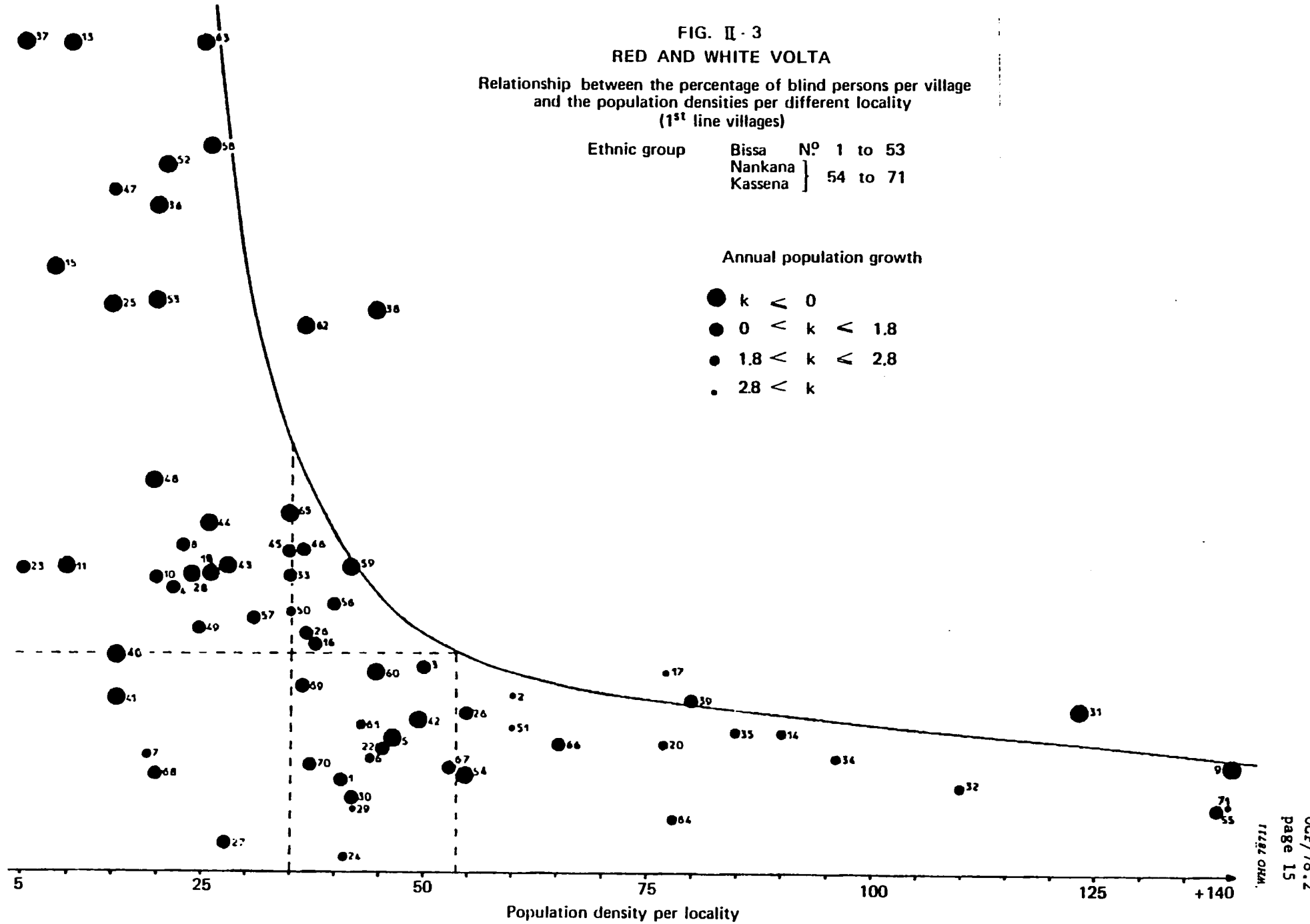
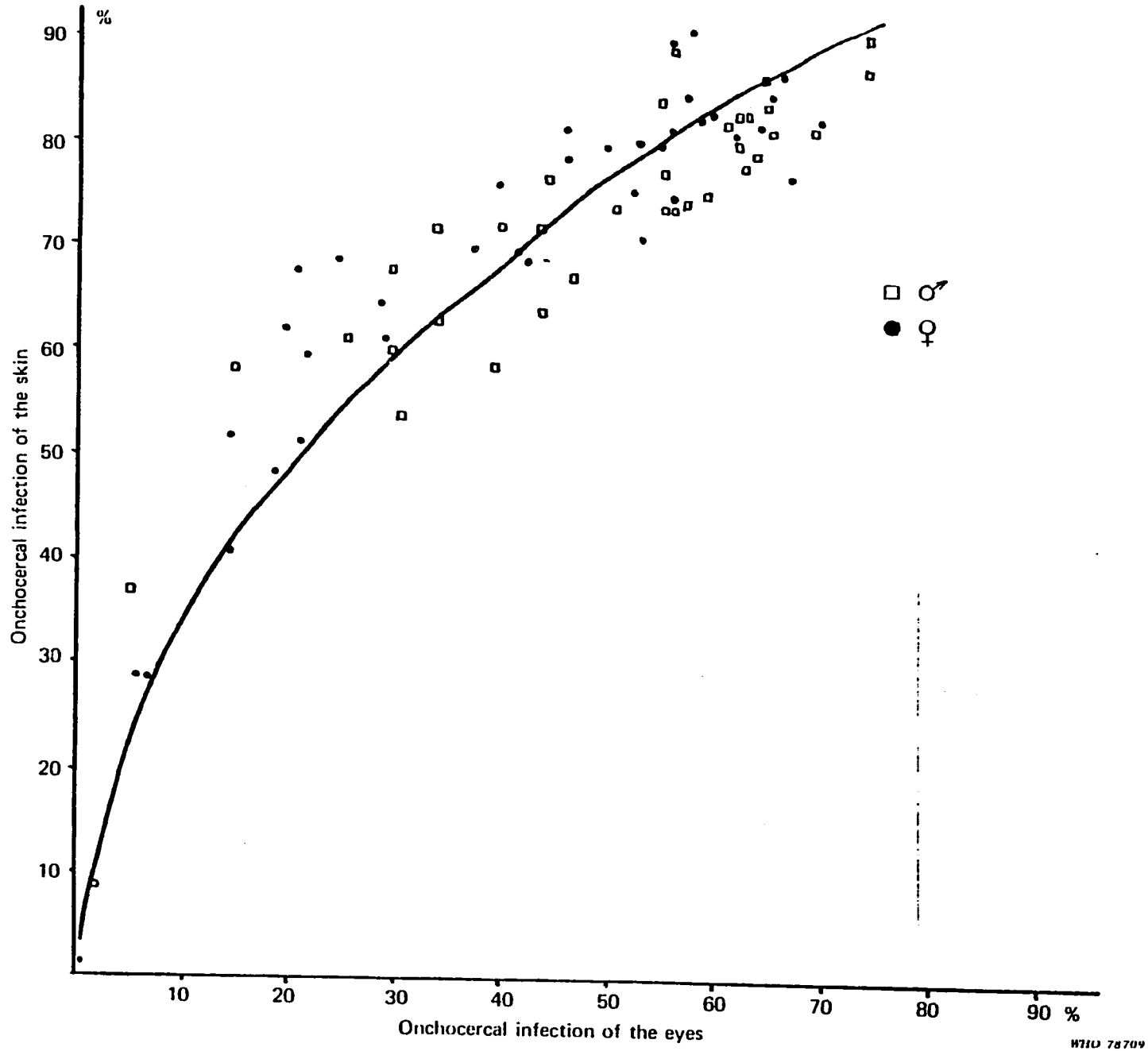


FIG. II - 3
RED AND WHITE VOLTA
Relationship between the percentage of blind persons per village and the population densities per different locality (1st line villages)
Ethnic group
Bissa N° 1 to 53
Nankana } 54 to 71
Kassena }
Annual population growth
k ≤ 0
0 < k < 1.8
1.8 < k ≤ 2.8
2.8 < k
5
25
50
75
100
125
+140
Population density per locality
TILLÉ OHM.

FIG. II - 4
ONCHOCERCAL INFECTION OF THE EYES AND SKIN IN THE OCP AREA



CHAPTER III

THE CONTROL CAMPAIGN AND ITS RESULTS

Basic data - methods of control and techniques

In default of any therapeutic weapon at present utilizable in a mass campaign, the only feasible method of controlling onchocerciasis is still by control of the vector.

Taking into account the genetic, biological and ecological characteristics of S. damnosum s.l., the control of the vector can be approached, in theory, from many angles.

Ecological control

The elimination of rapids, which are where the vector reproduces and develops, would be a final and, therefore, ideal solution to the problem of onchocerciasis. Thus in Africa the great dams built (Aswan, Akosombo, Kainji, Kossou), being built or planned (Selingué, Manantali, Noumbiel, Jebba, Bui), by eliminating any possibility of S. damnosum breeding up-river, have had or will have an extremely beneficial effect on the onchocerciasis situation. A study undertaken by OCP has established that the construction of just the one hydroelectric dam at Noumbiel, on the Black Volta between Upper Volta and Ghana, will result, apart from the final elimination of local vector populations along considerable reaches (120 km) of this river and its tributaries, in a saving of $ 150 000 a year in the cost of conventional vector control operations.

However, to construct such engineering works for the sole purpose of controlling a disease, important though it may be from an economic point of view, is out of the question. The topography of the African savanna zones would not permit it in all places where it would be desirable, and the cost of such dams is generally very high.

On the other hand, the proliferation of small dams to provide reserve water supplies near rural population centres has often resulted in an aggravation of the onchocerciasis problem because of the favourable conditions for the development of S. damnosum created by their spillways.

Genetic control

The introduction of sterile males into natural vector populations has been the theme of many experiments, and has been successfully utilized in campaigns against certain insects.

The fact that females of S. damnosum mate only at the start of their adult lives and then, having been fertilized, are able to migrate over long distances, rules out the application of this method. There are also currently insuperable problems concerning mass colonization of S. damnosum in the laboratory. The flies cannot be mated in captivity and have difficulty in taking blood and ovipositing.

Biological control

Many parasites infest S. damnosum in nature and research efforts are at present being concentrated on the possibilities of utilizing them with a view to reducing or eliminating vector populations. It is still too early to say whether this technique could be applicable in mass campaigns.

Chemical control

This method can be approached in two ways: control measures directed against the adult, and control of the aquatic development stages (eggs, larvae and pupae).

Adult control

One of the earliest campaigns against S. damnosum employed this principle, though it was not possible to determine the part played by larvicide action (part of the insecticide falling directly into the rapids) in the successful results obtained.

In fact, because of the possibilities of dispersal of S. damnosum females around their sites of reproduction, particularly during the rainy season, it would not be feasible to conduct an adulticide campaign covering a wide area. However, research is in progress with a view to developing a control technique that would allow protection of localized sites, particularly in reinvaded areas.

Control of pre-adult development stages

Eggs and pupae of blackflies are securely fixed to their supports and partly protected from their surroundings by the adhesive jelly, in the case of the egg mass, and by the cocoon, in the case of the pupae. As neither of these stages ingests food particles from its surroundings they could only be destroyed by fairly strong contact poisons. They are not effectively destroyed by any insecticide currently in operational use.

On the other hand the larvae, because of their relative concentration and their mode of obtaining nourishment by filtration of particles in suspension in the water, are the forms most susceptible to insecticides that act mainly through ingestion. In default of any alternative, larval control is therefore the principle upon which most campaigns against blackfly vectors of onchocerciasis have been conducted in Africa.

Widely utilized in prior campaigns, and again adopted for the Programme, larval control is governed by the following principles:

- the larvicide solution must be released upstream from each breeding site, or set of breeding sites, so as to destroy the larvae of all stages; the range of action of the insecticide wave transported by the current depends essentially on the hydrological and topographical characteristics of the watercourse treated;

- applications must be made periodically, at intervals shorter than the larval life-span of the species; the periodicity has been fixed at seven days, which satisfies both biological and logistical exigencies;

- these applications must continue, in a given area, for as long as the capacity for reproduction of the residual blackfly population poses a threat from the epidemiological viewpoint (transmission rate too high) or in entomological terms (re-establishment of local blackfly populations too rapid).

Techniques

Until 1971 the insecticide used was DDT, which is very effective but whose residual properties and effects on the environment were not appropriate to the present ecological requirements. As a result of studies undertaken since 1967, investigators have been able to select several compounds belonging to the organophosphorus group, one of which, temephos (Abate ®, OMS 786), combines in a specific formulation the essential properties of high effectiveness against S. damnosum larvae of all stages, and, because of its relatively specific action, its low persistence and the very small doses applied, low toxicity for the environment.

This insecticide has been used since the start of operations by the Programme, but investigations continue with a view to developing new compounds in different formulations.

Most of the campaigns prior to the Programme, which were based on the principle of larval control by chemical means, used treatment techniques suited to the small geographical areas covered. However, the treatment appliances, both static (drums with holes to release

the insecticide over a given period), or mobile (floating craft of various sizes), very soon proved unsuitable for the treatment of large areas because of the impossibility of utilizing them in all situations.

Access to the rivers in all seasons constitutes the major, often insoluble, problem that the treatment teams have to face when working on the ground, especially during the rainy season which is generally the period of high transmission in most onchocerciasis-infested valleys. The treatment rounds are therefore done incompletely, not always at regular intervals and at the cost of unremitting efforts. Moreover, for these less than ideal results the resources that have to be deployed are considerable. To take one example, the treatment of the Comoé-Léraba River in the Banfora region (25 000 km^2) required from 1969 to 1972 the presence, five days a week, of four strong ground teams, each consisting of one qualified technician, two labourers and one driver, with cross-country vehicles and equipment for larviciding (boat, out-board motor, etc.).

These teams were able to reach all the treatment points only in the dry season, despite the constant maintenance of 300 km of tracks specially built for the purpose.

The results showed the effects of these constraints and the level of transmission in the largely inaccessible southern part of this zone remained too high for the maintenance, or return, of human populations.

In view of the strategic exigencies, largely determined by the biology of the vector and necessitating the treatment of extensive areas, these land-based methods could no longer be considered, so in 1967 spraying from the air was started on a trial basis. Later, a type of aeroplane used for agricultural spraying, then the helicopter, first small and then medium-sized, were tried out.

The aeroplane proved very efficient for medium-sized and large watercourses, where gallery forest vegetation does not hamper navigation and treatment. It proved less so for the smaller rivers obscured by forest canopy, where it is replaced with great advantage by the helicopter, whose manoeuvrability is practically unlimited.

The first five years of operations

Vector control operations

After analysis of the various principles, methods and techniques, and in the light of experience with prior campaigns, the Onchocerciasis Control Programme was planned and put into operation according to the following criteria:

- control measures directed against the larvae of the vector, which are its most concentrated and most susceptible development stages;

- utilization of insecticide with little residual action, effective at low concentrations and producing little pollution under the conditions of application;

- treatment from the air, the only method at present applicable which has proved, for practically 100% effectiveness, the least costly.

Aerial operations

An invitation to bid for a contract to carry out aerial operations gave details of the requirements. This included specifications for the development of equipment for the release of accurately measured quantities of insecticides for both helicopter and fixed-wing machines. The type of machine considered suitable for the work requested as well as the flying hours required were also specified. It was anticipated that it would be possible to treat the large rivers by fixed-wing aircraft and that the smaller rivers would require helicopters.

At the end of July 1974, the contract was awarded to Evergreen Helicopters Inc. from McMinnville, United States of America, who operated Bell 206 helicopters and a Pilatus Porter aircraft.

Work commenced in 1975 in Phase I only, operating from one base in Bobo-Dioulasso, and during that season the following hours of fixed-wing and helicopter were flown to dispense 75 630 litres of Abate:

Phase I 1975

	Larviciding	Prospection	Administration	Total hours	Abate
Helicopter	1 911	782	89	2 782	47 369
Fixed-wing	366	80	94	540	28 261
				Total	75 630

In January 1976 Phase II began with the treatment of the lower White Volta by helicopter while treatment continued in Phase I. This machine flew across from the Bobo-Dioulasso base each Tuesday and when the rains began in May, all the other rivers which started flowing in Phase II were treated by the same helicopter, assisted by the fixed-wing on the White Volta once the flow of water was sufficient for fixed-wing treatment.

At the end of 1976, with the treatment of Phases I and II, the following hours had been flown:

Phases I and II 1976

	Larviciding	Prospection	Administration	Total hours	Abate
Helicopter	3 011	1 192	155	4 358	79 862
Fixed-wing	488	95	41	624	50 085
				Total	129 947

During these initial two years of operation a system evolved which is flexible enough to deal with the constant adjustments that have to be made.

At the end of 1976, the initial aerial contract with Evergreen Helicopters Inc. came to an end. International bidding for the next contract took place in mid-June 1976. The contract was awarded to Viking Helicopters Ltd, an Ottawa based firm, on 6 August 1976. The change of contractor provided an ideal opportunity to improve equipment and techniques, based on the knowledge acquired in the first two years of operation. With the helicopter equipment, the previous contractor had developed a gravity-fed system and although very effective in the wet season, problems had been experienced in distributing insecticide at difficult breeding sites in the dry season. Consequently, the incoming contractor was asked to develop a "dual" system where, by operating a switch in the aircraft, the pilot could elect for the insecticide to be emitted either by the gravity-fed system or through a pressure-fed single nozzle. This newly developed "restrictor" system proved highly successful, particularly in the dry season.

Modifications were also made to the fixed-wing equipment. The previous contractor used an underslung cylinder into which the required quantity of insecticide was fed and emitted by the action of a floating piston. With the newly developed equipment, all parts are internal within the aircraft and the only external part is the emission tube. The system is activated by air pressure and has proved accurate and reliable.

In the first year of operation with the new aerial contractor, the whole designated Programme area was under treatment for the first time and at the end of 1977 the following hours had been flown:

	Phases I, II and III 1977				
	Larviciding	Prospection	Administration	Total hours	Abate
Helicopter	4 424	685	249	5 350	84 318
Fixed-wing	854	57	114	1 025	71 297
				Total	155 615

The treatment flying was done with six helicopters in spraying configuration and two fixed-wing aircraft operating from Tamale and Bobo-Dioulasso. Fifty-four per cent. of insecticide released was by helicopter and 46% by the two fixed-wing aircraft. The average release of insecticide per hour (80 litres per hour) is four times that of a helicopter (20 litres per hour). Also, the fixed-wing aircraft can be operated for approximately half the cost of a helicopter.

As river levels alter, the breeding sites of S. damnosum change and aircraft circuits have to be modified accordingly. It is unlikely that a river treated with a particular quantity of insecticide one week would require the same dosage the following week, and as rivers start to flow, or dry up, they are constantly being added to or removed from a circuit. Hence, it is necessary to produce new treatment maps each week at the two bases of Bobo-Dioulasso and Tamale. Following this the pilots are briefed on the circuit to be flown that particular week. The pilots carry with them the 1:500 000 treatment maps, which indicate the rivers to be treated and the dosages required, and 1:200 000 maps which show the release points of the breeding sites to treat. Circuits normally take three to four days (Figs III-1 and III-2).

There are eight major fuel distribution points in the Programme area from where the subsidiary caches are supplied. At six of these points bulk fuel is available from airport pumps, but at the other two fuel has to be brought in from elsewhere. There are 80 subsidiary caches of fuel and insecticide in the Programme area (Fig. III-3). Both fuel and insecticide have to be made available in drums. Maintenance of adequate stocks at these caches and the keeping of accurate records are large-scale logistical exercises.

Entomological surveillance

The original plan for entomological evaluation (PAG mission report, Annex V-3) envisaged a network of seven sectors and 24 subsectors, from each of which would operate about two teams of vector collectors. Additional teams were to be attached to each of the sectors to give a total of 58 teams. Each team would consist of three vector collectors, a driver and vehicle; 141 regular catching points were to be visited at fortnightly intervals. At each visit two consecutive days (11 hours) catching would be undertaken. In addition shorter catches would be made at other less important sites and larval searches made at known and suspected breeding places.

This basic plan has been modified in several respects:

(a) the vector collecting team has been reduced from three to two collectors;

(b) the collections at regular catching points have been made at weekly instead of fortnightly intervals;

(c) the number of catching points has been considerably increased, and almost all catches are for the 11-hour period.

These alterations to the original plan were considered necessary to provide satisfactory operational information. As the control operation is based on a weekly cycle, hydrological data collected by the surveillance teams must be transmitted by radio from the subsectors each week. Most of the hydrological stations are important catching points which must be visited weekly regardless of whether a catch is made. Similarly, each team must return to base each week in order to pass on its vital hydrological information. Thus the utility of operating the surveillance network on a weekly cycle is obvious. In addition, the entomological data concerning both larval searches and adult collections is invaluable in planning the aerial control operations. A fortnight's delay in acting on this information is too great when dealing with a vector whose immature stages are completed in less than that time.

In addition to this operational role the entomological evaluation, at this stage, is designed to provide (i) a measure of the effectiveness of the Programme in the period before reliable epidemiological changes can be demonstrated; (ii) statistically valid data to compare biting and transmission rates with the human parasitological and ophthalmological findings; and (iii) data for use in research into the reinvasion phenomenon.

In order to fulfil these requirements 50 vector collecting teams were employed during 1975 and 86 during 1976 and 1977, falling to 78 in 1978. In addition another 20 teams were employed on a temporary basis for an intensive programme designed to study reinvasion problems in 1977 and 1978.

In setting up the entomological evaluation network, 525 catching points were studied in varying degrees of detail, and the catching results stored in the headquarter's computer. These catching points are distributed as follows:

Phase I	227
Phase II	108
Phase III W	70
Phase III E	120

Increasing knowledge has indicated that more intensive catching at fewer sites is likely to yield the most valuable results, especially when reinvasion problems are being studied.

Thus, during 1977, an average of 270 (range 213-302) catching points was visited each month, and over 1400 days catching undertaken per month, to give an average of 5.3 days catching per site per month.

Establishment of criteria

Interpretation of the entomological data presents a number of problems. Clearly, in the complete absence of the vector no further transmission will take place. However, with a vector such as S. damnosum, which under certain circumstances may migrate (page 24), this situation is unlikely to be achieved, or maintained, for long periods over wide areas. It has thus become necessary to determine the level of biting fly populations and potential transmission of O. volvulus which is considered acceptable from the medical and economic viewpoints. In order to make a judgement concerning the success or otherwise of the Programme, and to provide criteria for assessing the advisability of settling populations in zones of severe onchocerciasis, OCP convened a Scientific Advisory Panel Working Group in June 1977. The group considered the available entomological data concerning the transmission situation before vector control activities, together with the known resultant degrees of the disease. The group decided that an Annual Transmission Potential (ATP)[1] of 100 was extremely

[1] This is the annual total of the estimated individual monthly transmission potentials obtained from the formula:

$$\frac{\text{No. of days in month} \times \text{No. of infective larvae}}{\text{No. of days worked}} \times \frac{\text{No. of flies caught}}{\text{No. of flies dissected}}$$

Calculations for the ATP in the Programme area are based solely on the numbers of infective larvae indistinguishable from O. volvulus in the flies' heads. Where Simulium biting densities are low, as in the Programme area, ATPs calculated in this way are liable to wide fluctuation resulting from the numbers of infective larvae in single flies.

unlikely to result in any untoward medical or socioeconomic effects. Available data also suggested that an ATP of 800+ was likely to be accompanied by severe onchocerciasis. In order to cover the situation where previously uninhabited areas are to be subjected to human settlement, it was also necessary to determine what level of biting fly populations might give rise to unacceptable levels of ATP. The Panel concluded that an Annual Biting Rate (ABR)[1] of less than 1000 was most unlikely to give rise to an ATP of over 100 and this could be considered safe, and that with an ABR of above 8000 a hyperendemic onchocerciasis situation was likely to develop should a human population containing some onchocerciasis carriers be settled. The group clearly appreciated that with knowledge which should become available after the second or third passage of the epidemiological evaluation teams, it might be possible to safely increase the acceptable levels of ATPs and ABRs.

An analysis of the results during three years for the Phase I and II area shows a steadily improving situation.

	% of ATPs below 100		% of ABRs below 1000	
	Phase I	Phase II	Phase I	Phase II
1975	68	70	61	50
1976	81	85	72	80
1977	86	92	79	85

In 1975 Phase I was under insecticidal control whilst Phase II was not. However, it seems most likely that the control activities in Phase I influenced the results in Phase II where, at the new catching points from which several years' data were available, the lowest ever ATPs and ABRs were recorded. The superior results of Phase II in subsequent years arises from the fact that this area is little subjected to reinvasion by epidemiologically significant numbers of flies from outside the control area, whereas about 40% of Phase I is so reinvaded.

In many cases results in the heart of the Programme area are excellent. For example, at Wayen (point 0407) situated on the White Volta river just east of Ougadougou, no vector flies have been caught since the start of the control campaign, yet, in the pre-control times the ABR exceeded 8000 and the ATP exceeded 200. In most of the Black, White and Red Volta, and Sissili valleys in Upper Volta, transmission of onchocerciasis has almost certainly ceased since the start of the control campaign. Further south, in the Black Volta valley, control has improved markedly each year, e.g. at Chache (point 1303)[2] the situation for the three years of control is as follows:

	ABR	ATP
1973-74	34 000	N.A.
1975	12 015	825
1976	1 957	80
1977	657	15

The 1977 data concerning ABRs and ATPs at 157 well-studied points have been analysed and plotted on Figs III-4 and III-5. Similarly all usable pre-control data have been plotted on Figs III-6 and III-7. The ABR data has been plotted for 114 points and ATP data for 96 points.

---

[1] This is the annual total of the estimated individual monthly biting rates that have been obtained from the formula:

$$\frac{\text{No. of flies caught} \times \text{No. of days in month}}{\text{No. of days worked}}$$

[2] See Fig. III-8.

Control in Phase III West was implemented only in March 1977, and for parts of Phase III East only in August 1977 (not at all in the easternmost valley - the Sota valley). Therefore, the data for 1977 in Figs III-4 and III-5 include three or more months of pre-control in these areas. Analysis of the pre-control and 1977 ATPs shows the following breakdown:

ATP	1977		Pre-control	
	No. of points	% of points	No. of points	% of points
0-99	91	58	12	13
100-199	20	13	6	6
200-399	19	12	19	20
400-799	16	10	12	12
800+	11	7	47	49
	157	100	96	100

The pattern of results when ABRs are considered is very similar with a few more points registering results which do not fall below the critical level (1000).

The reinvasion phenomenon

Shortly after the commencement of control in the Phase I area, fly populations dropped sharply and in most cases became zero within three or four weeks. However, with the onset of the rainy season large numbers of flies reappeared at certain sites in the south-west of the Programme area. Detailed investigations showed (a) that there was no active breeding in the area; (b) that virtually all the flies were parous (were in fact several days old and had already taken at least one blood meal before they were caught by the vector collector); (c) flies in many cases were carrying infective stages of the parasite Onchocerca volvulus. The flies appeared to be a reinvading population moving in the same direction as the prevailing monsoon winds. Each year a similar reinvasion has occurred in the same areas which are indicated on Fig. III-9. These are areas where there is an epidemiologically significant influx of infective flies. Flies probably penetrate to all parts of the Programme area but generally in numbers which are epidemiologically insignificant. The results of the reinvasion study are shown in Annex I.

Sources of reinvading flies are probably located to the south-west of the reinvaded zones. Experimental control in the Marahoué and Sassandra valleys in June-July 1977 seemed to greatly curtail the reinvasion of the Upper Bandama and Léraba rivers. Control operations carried out on the Marahoué and Sassandra rivers in Ivory Coast during 1978 have confirmed this observation.

The reinvading flies have proved to be only savanna cytospecies. Extension activity in Ivory Coast to cover all savanna regions should result in an improved situation in the Bandama valley, as already mentioned, and in the Bui region of the Black Volta.

A comparison of the reinvasion map (Fig. III-9) with the map of ATPs in 1977 (Fig. III-4) shows that most of the catching points registering unsatisfactory ATPs fall within the reinvasion zone.

The actual zone affected by reinvasion is less than 30% of the total original Programme area, and with alterations to the southern extension of the Programme area in Ivory Coast this is likely to be considerably reduced.

Epidemiological evaluation

Aim and methods

The outline in the PAG report for the epidemiological work to be done by the OCP was as follows:

(a) surveillance of 0.33% of the population of the Programme area, i.e. 33 000 persons distributed in the seven participating countries of which the population concerned is estimated at about 10 million;

(b) stratification according to endemicity levels of the localities, or regions if these are known, in such a way that two-thirds of the sample are situated in zones of meso- or hyper-endemicity because "the primary aim of the surveys is to determine the effects of the control operations in areas with high levels of endemicity";

(c) initial selection, on the basis of data previously collected, of a random sample composed of N clusters of 300 persons until the required number in each country is obtained;

(d) longitudinal follow-up during the implementation of the Programme, at three-year intervals, of each of the individuals forming the evaluation clusters;

(e) annual detailed examination of 8-10% of the sample; complete ophthalmological examination, complementary laboratory tests.

Sample design

It soon became evident that the focal distribution of the disease would not allow for a valuable random selection.

It was considered that in endemic situations which were far from being homogeneous, and where one could see a distinct pattern of foci in relation to the profile of watercourses, a careful choice was necessary, and in 1975 it was decided to utilize the following criteria, agreed upon by STAC:

(a) The "villages" must be representative of all the ecological, hydrological and geographical zones of the basins and watercourses where breeding places occur. The The villages selected must be representative of all the known foci. As a result they are scattered throughout the 14 000 km of watercourses covered by the Programme.

(b) They should be interdependent with the entomological evaluation programme, i.e. they should be selected close to the permanent collecting points, particularly when entomological considerations so require.

(c) Full attention should be paid to sociological factors, longitudinal studies being incompatible with a high drop-out rate and presupposing social homogeneity and an adequate level of population stability. Accordingly, administrative and commercial centres (which have too high a proportion of foreigners, temporary residents and non-residents), agricultural (including processing) businesses and projects dependent on migrant and seasonal labour, and nomadic communities were all excluded.

(d) The different levels of prevalence need to be represented in the samples. Bearing in mind the PAG mission's recommendation that two-thirds of the villages in the sample should have a prevalence of more than 33%, it was found preferable to select 75% of the sample from hyperendemic villages (prevalence >60%) and the other 25% from villages where prevalence is lower.

(e) As a result, of the total of 300 subjects recommended for the clusters, it was necessary sometimes to combine several small villages to form one cluster, sometimes to restrict the survey in excessively large villages to one or more districts.

(f) As far as possible, the selection of villages should take into account the economic development zones.

(g) Random selection was replaced by selection based on the accepted evaluation criteria.

(h) Communities from non-endemic regions who come to settle in the reclaimed areas, such as the territory of the Volta Valleys Development Authority (AVV) in Upper Volta, and who form a control population not foreseen in the PAG mission report, had to be included in the evaluation programme.

Current methodology

Since the beginning of the campaign, baseline data have been collected in the seven countries. On the basis of the criteria mentioned above, the following conclusions can be drawn:

Geographical dispersal: all river basins treated by the vector control unit are represented in the sample.

Relation with entomology: whenever possible the villages close to a permanent Simulium catching point were chosen in order to assess the degree of correlation with the entomological results. In certain cases the investigations were conducted upon the request of the entomologists. The different levels of transmission (ATP) are represented in the sample.

Migrants: in the AVV where there is a population of non-infected immigrants, 3600 individuals have been registered for a special study aimed at checking the persistence of any residual transmission.

Quantitative aspect: the basic sample established in the seven countries in the original Programme area totals 80 000 people, out of a population of 11 million inhabitants. This represents a sample of 0.75% of the population, which is considerably greater than the number originally envisaged (0.33%). This decision was taken in consideration of:

- the need to retain a sufficiently large sample in order to obtain significant results in the longitudinal surveys of villages over a period of 10 years or more, in view of the high absentee rate of 20% at each examination; also, the larger sample initially chosen now contains a sufficient number of villages from which valid conclusions can be drawn on the transmission resulting from infected flies imported from outside the OCP area;

- the need to ensure adequate geographical coverage as required by the entomological control;

- the need for mapping of foci and chemotherapeutic trials.

For operational reasons, the epidemiological evaluation has been carried out at two different levels, simple and detailed. The simple survey consists of a parasitological assessment of prevalence and intensity of onchocerciasis by means of examining two skin snips, plus a screening procedure for visual impairment and blindness. In the detailed survey a careful clinical and ophthalmological examination is also included. Because of the time-consuming technique, the detailed examinations have been carried out on only approximately 15% of the total sample, allowing for certain special studies concerning ocular lesions.

Data concerning the activities of the Epidemiological Evaluation Unit is given in Annex II.

Medical results of entomological operations

(a) Results of preliminary campaigns 1962-1974 in the Programme area

The Sikasso region (Mali)

The basin of the Farako, a small secondary tributary of the Banifing in eastern Mali, was a large and serious focus of onchocerciasis. Its treatment began in 1952. As it covers only 2000 km^2 and has no biological or natural boundaries, the treated area could never be completely protected and was constantly reinvaded by blackflies migrating from nearby basins.

In the central area of this focus, the best-protected part, the theoretical number of bites per man per year (ABR) was kept within the region of 1000 during the control period (extreme values 350 and 2500), whereas during the interruption in 1965 it was 12 000. Medical observations in four villages kept under surveillance for 10 years show that this partial control of the vector was enough to reduce the level of endemicity from over 50% to 10% and less. The maintenance of residual transmission is confirmed by the presence of an infected nine-year-old child; however, the very low level of such transmission is confirmed by the fact that onchocerciasis prevalence in children under 15 years of age fell from 15% to 0.4% between 1968 and 1976.

After 13 years of partial control of the vector in this area, even though the blackfly was not eradicated anywhere, it was found to be impossible for the disease to persist in places where the ABR had been reduced to 1000 or less for 10 years. These villages now contain only residual cases, bearing witness to parasite infection that is dying out, and sporadic cases indicating the persistence of low residual transmission.

The Banfora region

This region in the south-west of Upper Volta along the frontiers with Mali and Ivory Coast was subjected to Simulium control in 1969 because it formed a natural extension of the neighbouring campaigns in Mali (Farako since 1962) and Ivory Coast (Upper Bandama, 1969). Unfortunately, the operations had to be halted for financial reasons from October 1973. During the six years of the campaign protection was never complete. The ABR during the interruption of operations is not precisely known, but no doubt fluctuated around 15 000 bites annually.

Compared with the pre-campaign situation (1967-1969), the surveys carried out in 1973 and early 1974 showed that in six years the level of endemicity had dropped by 15-20% in all the villages, falling from 70-80% to 55-60% in hyperendemic regions and from 60-65% to 35-40% in mesoendemic regions. The fall in prevalence was marked in subjects under 30 years of age and almost imperceptible above that age, confirming that the reduction of transmission was the cause.

In late 1975 a further series of surveys showed that endemicity had almost returned to its original level. The deterioration was particularly marked in males between the ages of 10 and 30, and the infection rate in children under 10 years had increased slightly instead of continuing its rapid fall. A one-year break in entomological control, which brought a massive quantity of blackflies into contact with a parasite reservoir that had not been reduced sufficiently, was enough to wipe out the benefits of six years of work almost completely.

(b) Preliminary results of OCP

The first check of the results of operations in Phase I began in 1978. Sixteen Upper Volta villages were re-examined and the reliability of survey and diagnostic methods confirmed: the disease was found again in more than 99% of the people where it had been observed three years earlier; the few negative cases can be accounted for either by an error of identification or by mishandling, or by carriers with a very low parasitic load that randomizes the demonstration of microfilariae (the diagnostic error risk is lower than 1%).

Eight hyperendemic villages were re-examined along the Bougouriba and Black Volta rivers, in an area where vector control was not completely successful in 1975 (ATP = 183 in 1975 in Mabere village), but where as early as 1976 ATPs were below the threshold of 100 larvae/man/year.

In the 0-4 years age-group, the prevalence of onchocerciasis had decreased from 5.3% to 1.6% within three years and among the 140 children born since the beginning of operations, only two were found infected (they were born in early 1975). A slight decrease even tends to appear in the 5-9 years age-group.

Seven other villages were visited again in late 1977 in the Upper Comoé basin where the control is reported to be excellent since January 1975, that is for almost three years. No positive cases were found among children born during that period. Of the 277 children examined in the under five age-group, none had onchocerciasis whereas three out of 267 (1.1%) were infected before the campaign began. In the meantime, the prevalence had dropped from 9% to 6% in the 5-9 years age-group.

Finally, in Dangouadougou, a village located on the route of the reinvasion phenomenon, the ATP is still higher than 1000. The disease in the village is becoming more severe: the overall prevalence is increasing slightly, but the individual microfilarial loads are growing on an average of one-third (32 mf. instead of 20), two children under four were found infected and the prevalence has increased from 3.5% to 7% in this age-group.

These medical results clearly confirm the validity of the findings of the entomological evaluation. The tendency to a setback of the disease is still more significant if one considers that the transmission has been reduced to a lower level. The ATP values established in 1976 allow an optimistic view of the overall epidemiological results which will be observed after a five or six-year period of control. The aging of adult worms will then lead to a significant decrease of the parasitic load to which will be added the effects of the renewal of generations among the population.

In terms of ophthalmology, four villages in Upper Volta have been re-examined (Mouvielo, Kimpeo, Pendie and Dangouadougou) after a three-year period. Preliminary results do not show any significant difference as regards the prevalence of ocular onchocerciasis or the number of severe cases, but, generally speaking, overall rates have diminished slightly. However, in three of these villages (Mouvielo, Kimpeo and Pendie) where entomological results are satisfactory, there is a tendency to a decrease of ocular microfilarial loads in data for 1978, as compared to 1975 data. Also, the number of patients with aggravated ocular impairment is remarkably low. This might explain why the blindness rate has decreased from 12.3% to 8.2% in one hyperendemic village (Dangouadougou): the number of new cases of blindness was low and the blind of the village had been subjected to high mortality.

All these results, and especially the assumption that the interruption of the transmission of onchocerciasis might already have had a favourable stabilizing impact on the ocular lesions, must be checked on a statistically reliable sample. This will be done in 1979. A study of the risk factors of blindness among onchocerciasis patients in a protected area will be undertaken. Such a study will be most valuable for the future assessment of the number of blind people in the OCP area.

In order to evaluate the effects of the vector control operations in the Programme area, a subsample of 150 to 200 villages was chosen, according to criteria defined by STAC, and will form the reference sample for longitudinal evaluation. These villages will be re-examined at fixed intervals independent of any other possible factors likely to alter their representative character.

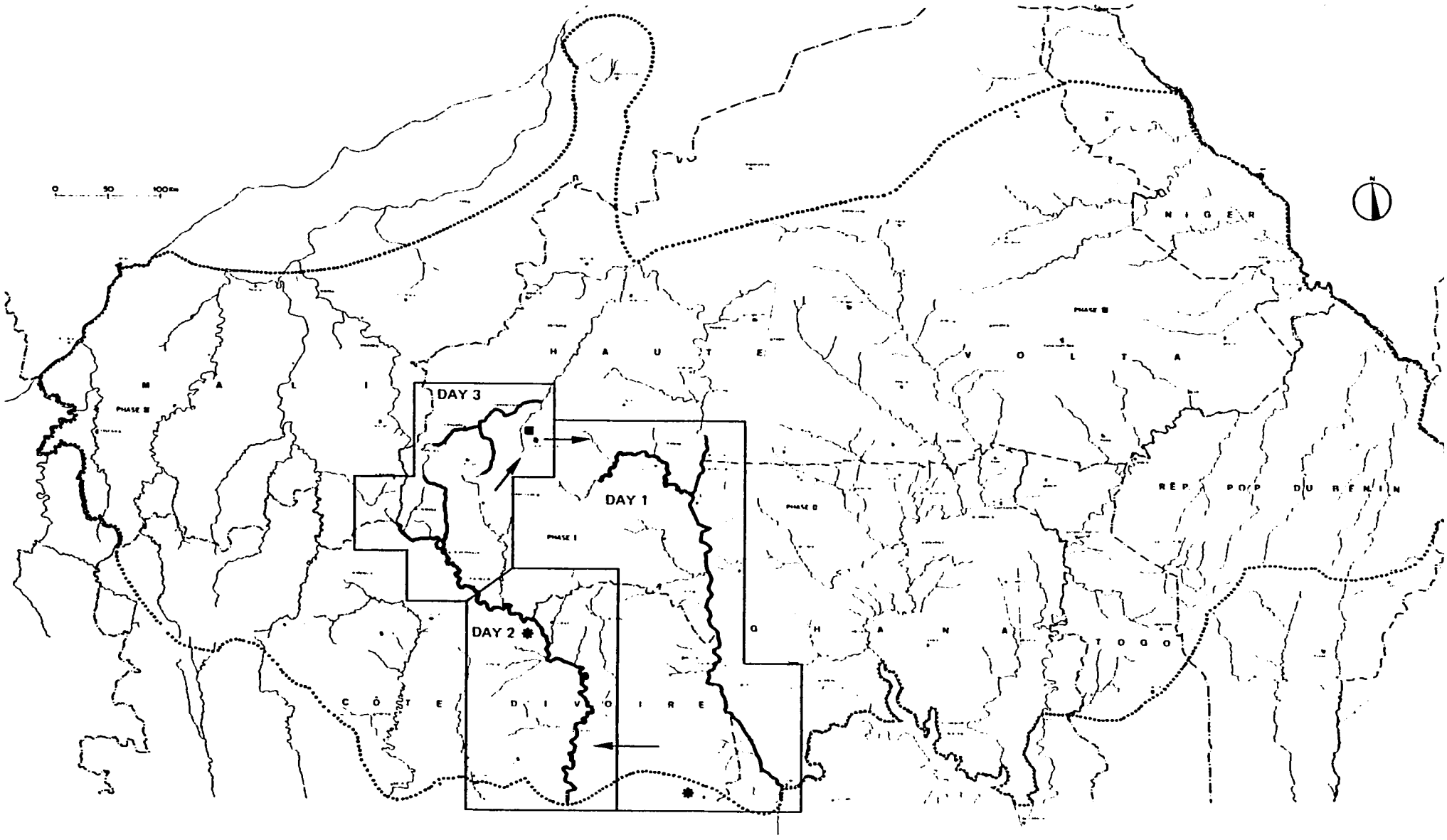
The other villages will form a data bank which can serve either for special evaluations (need for a greater number in certain areas, local residual transmission, reinvasion, agricultural development, etc.) or for certain specific studies (therapeutic trials, mono-vectorial transmission).

Finally, other villages could be included in the future sample if the boundaries of OCP are modified.

As a first approach, the sample selected for regular evaluation of the Programme will be made up as follows:

Upper Volta	56 villages out of	117 visited
Mali	36	65
Ivory Coast	39	57
Niger	8	17
Togo	15	27
Benin	23	27
Ghana	30	54
Total	207	364

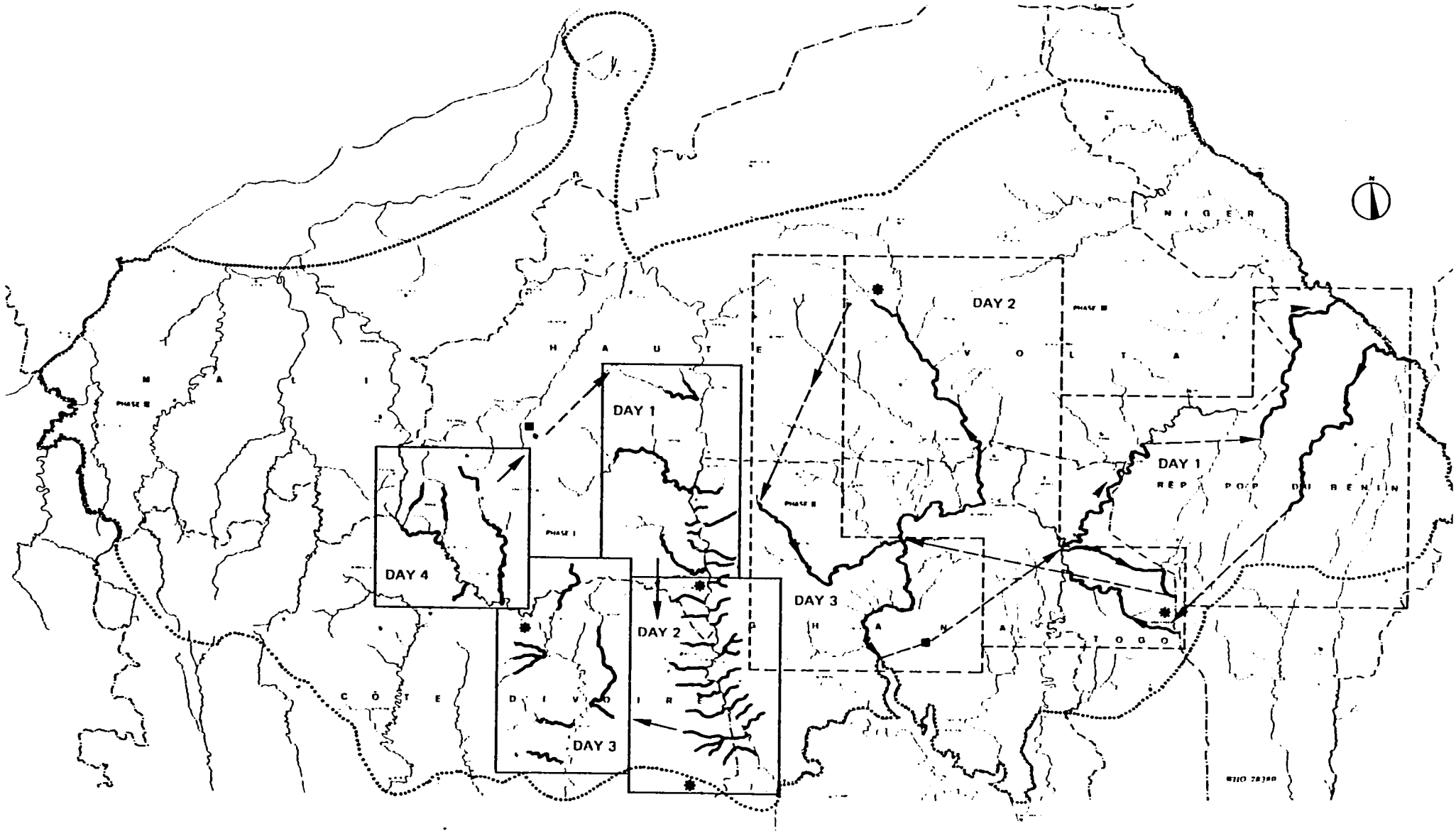
FIG. III–1
AIRCRAFT TREATMENT CIRCUITS



2 1/2 DAY DRY SEASON HELICOPTER TREATMENT.
ABATE DISPENSED USUALLY 400 LITRES.
THESE RIVERS ARE DONE BY FIXED WING IN WET SEASON.

✸ NIGHT STOP
■ BASE

FIG. III–2
AIRCRAFT TREATMENT CIRCUITS



4 DAY WET SEASON HELICOPTER TREATMENT.
ABATE DISPENSED USUALLY 1000 LITRES.
LARGE RIVERS DONE BY FIXED WING IN WET SEASON.

3 DAY FIXED WING TREATMENT IN WET SEASON.
FIXED WING NOT USED IN DRY SEASON WHEN THESE RIVERS ARE DONE BY HELICOPTER.

NIGHT STOP
BASE

FIG. III–3
REFUELLING POINTS IN THE PROGRAMME AREA

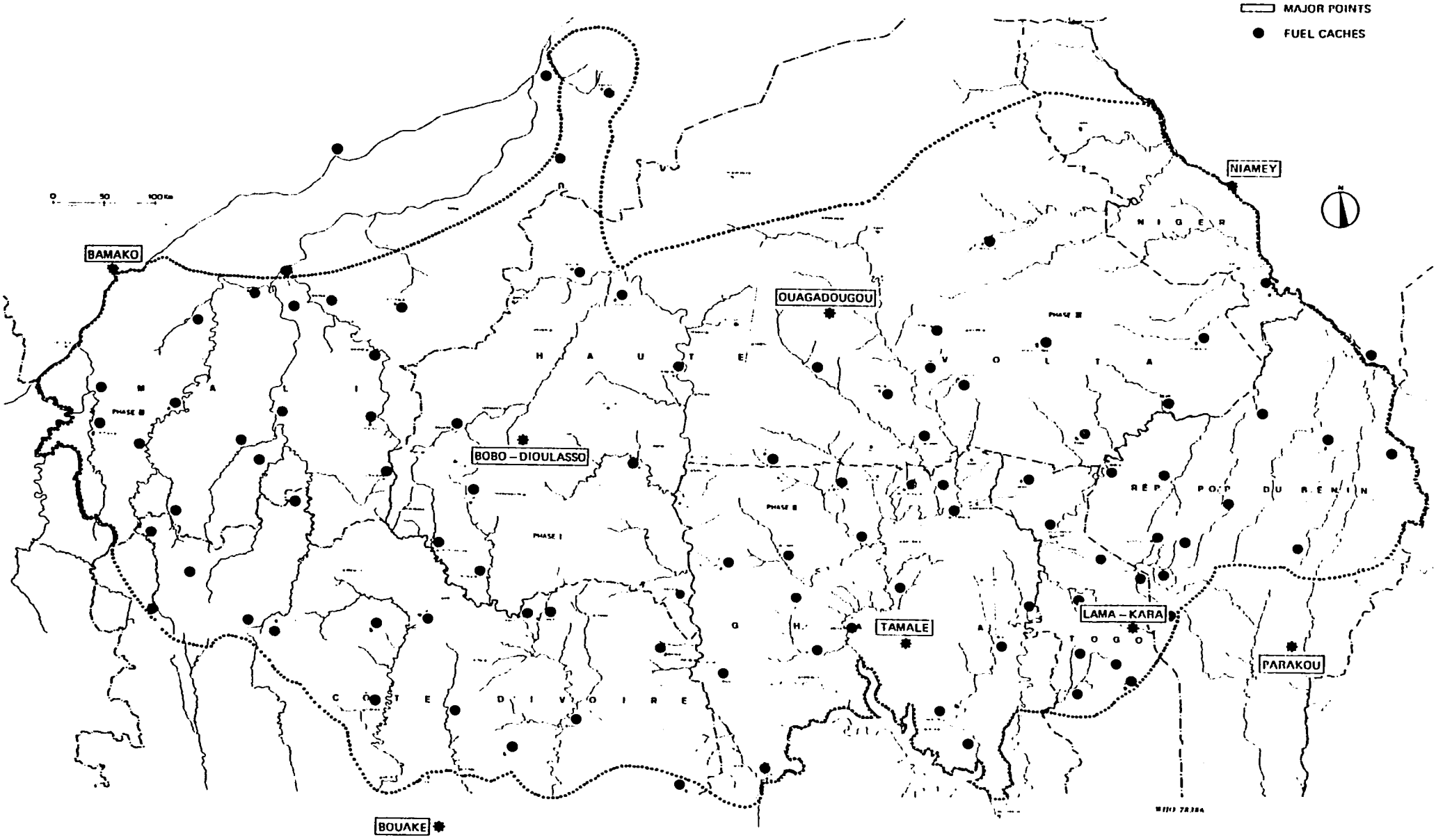


FIG. III–4

ANNUAL TRANSMISSION POTENTIALS – 1977

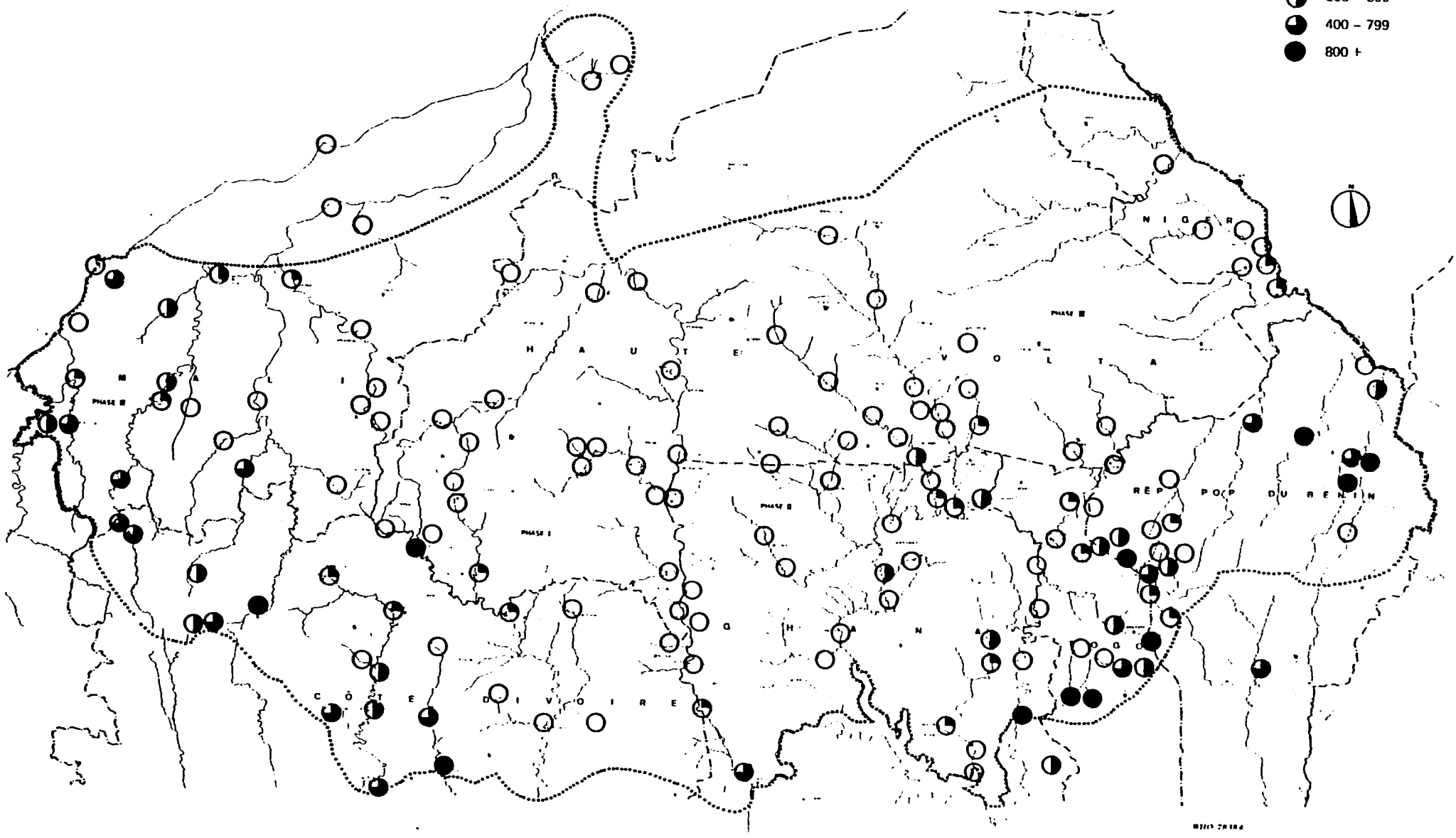


FIG. III–5
ANNUAL BITING RATES – 1977

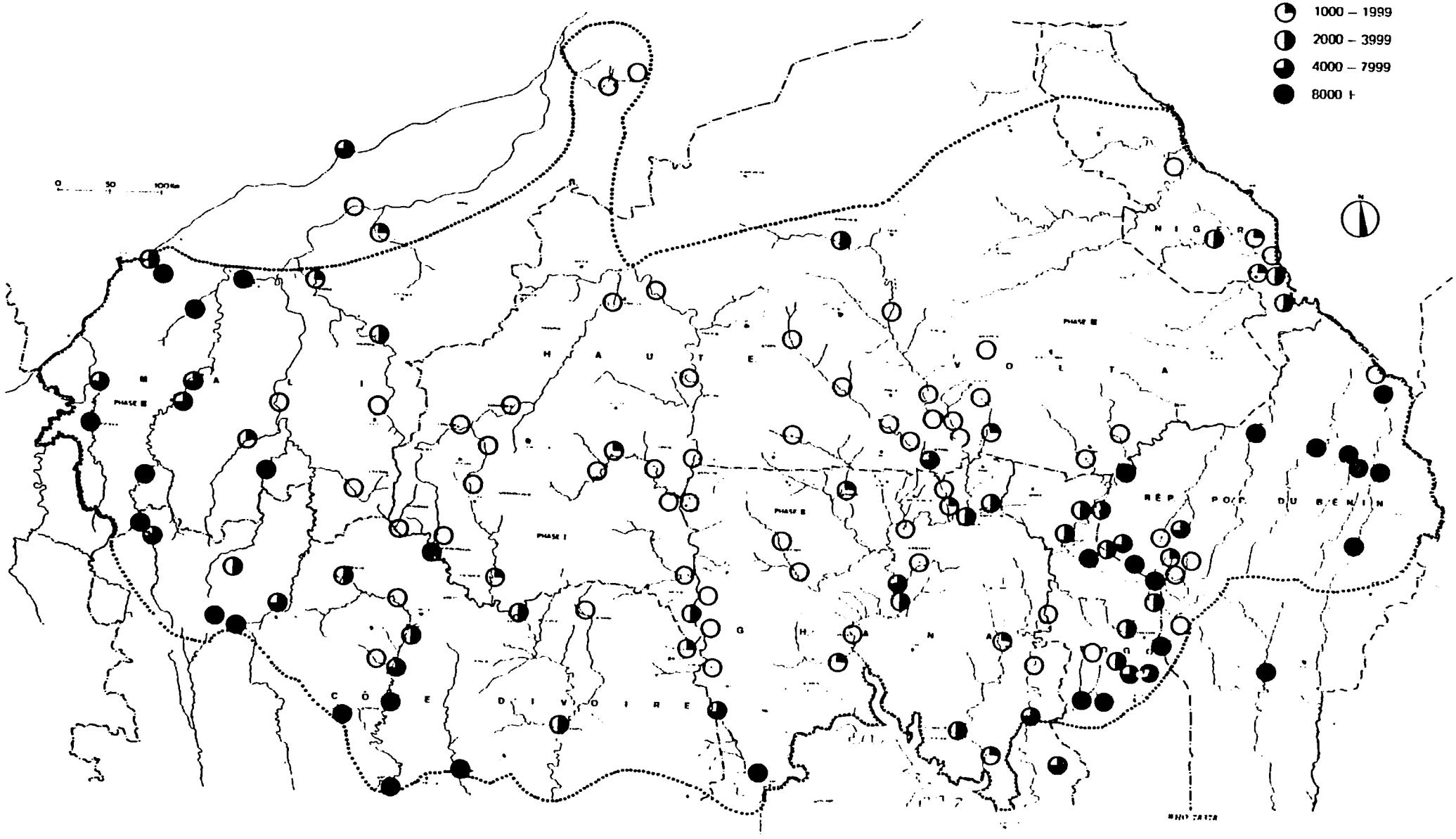


FIG. III–6
ANNUAL TRANSMISSION POTENTIALS – PRE-CONTROL

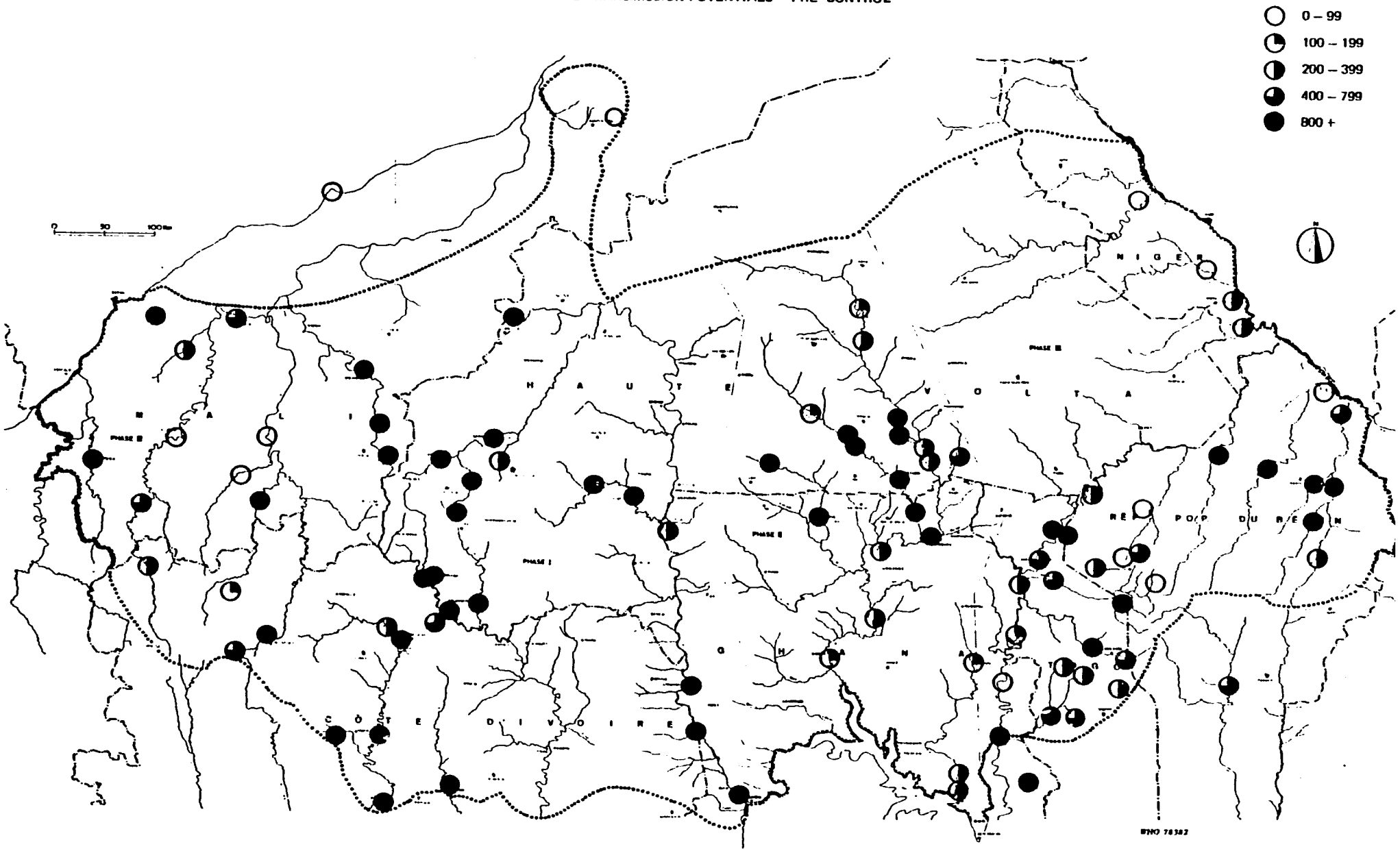


FIG. III–7
ANNUAL BITING RATES – PRE-CONTROL

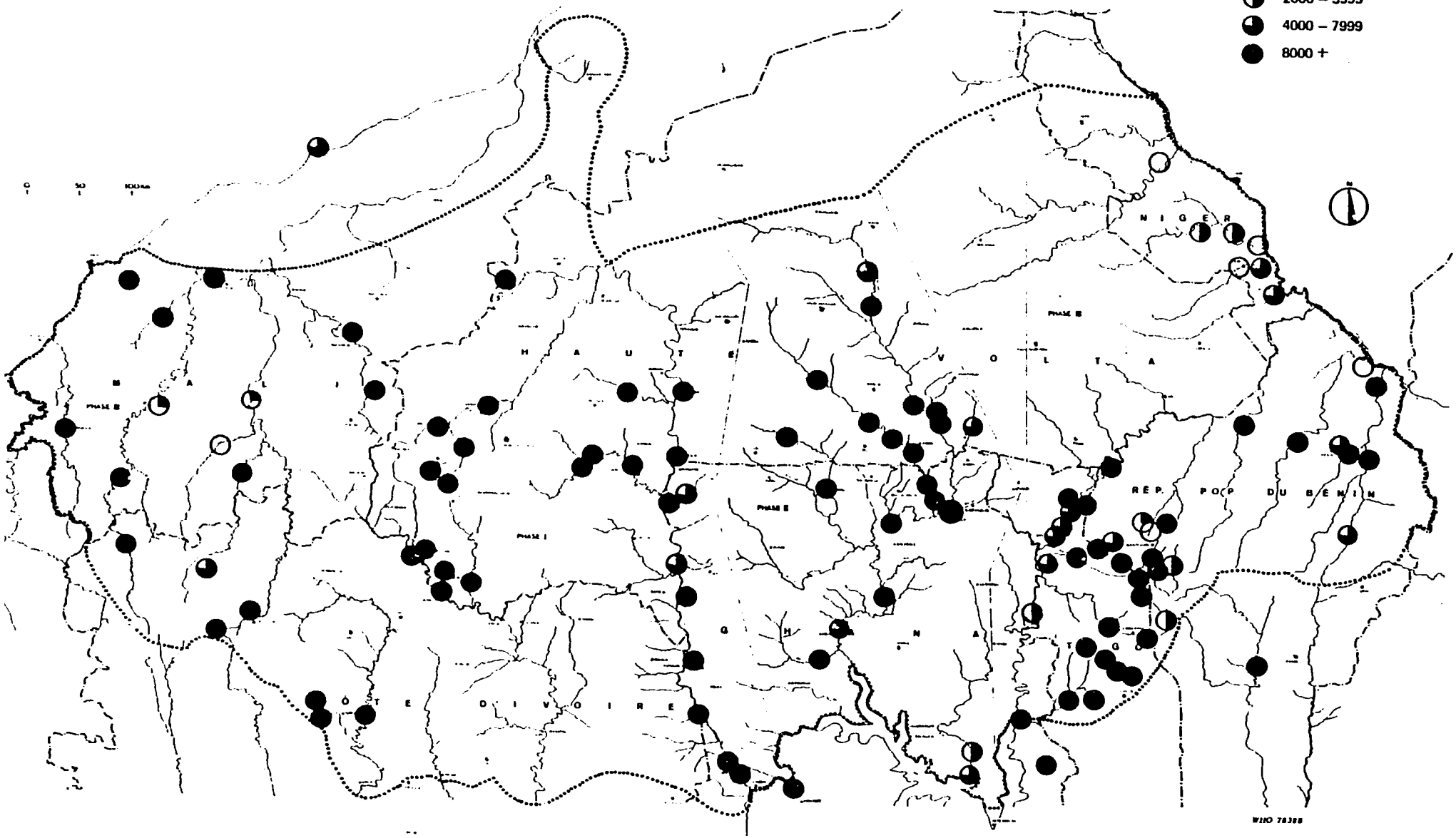


FIG. III–8
AREAS OF REINVASION, CATCHING STATIONS AND EXPERIMENTALLY TREATED RIVERS.

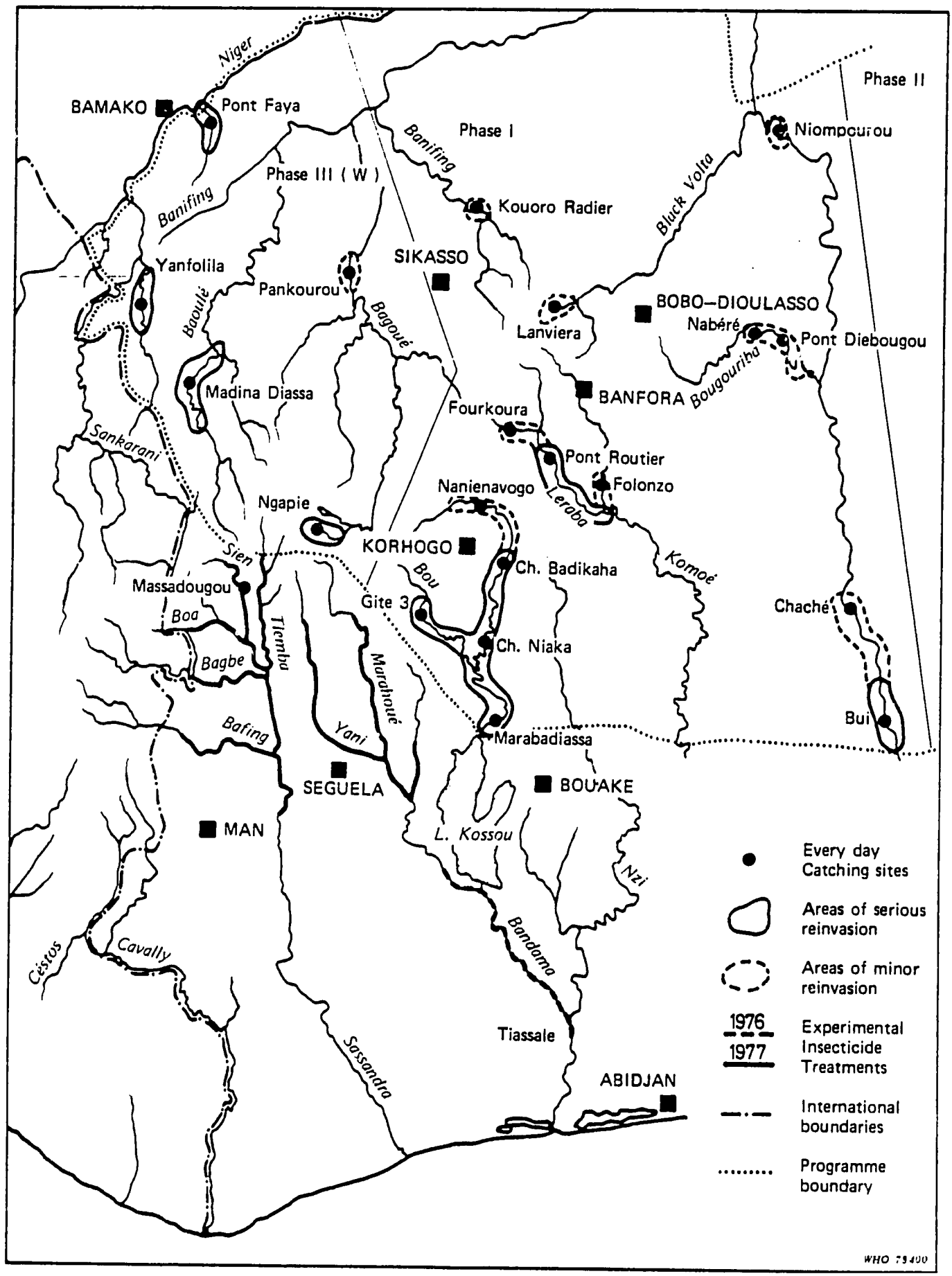


FIG. III-9
REINVASION AREAS

Zones subjected to reinvasion by significant numbers of infective flies

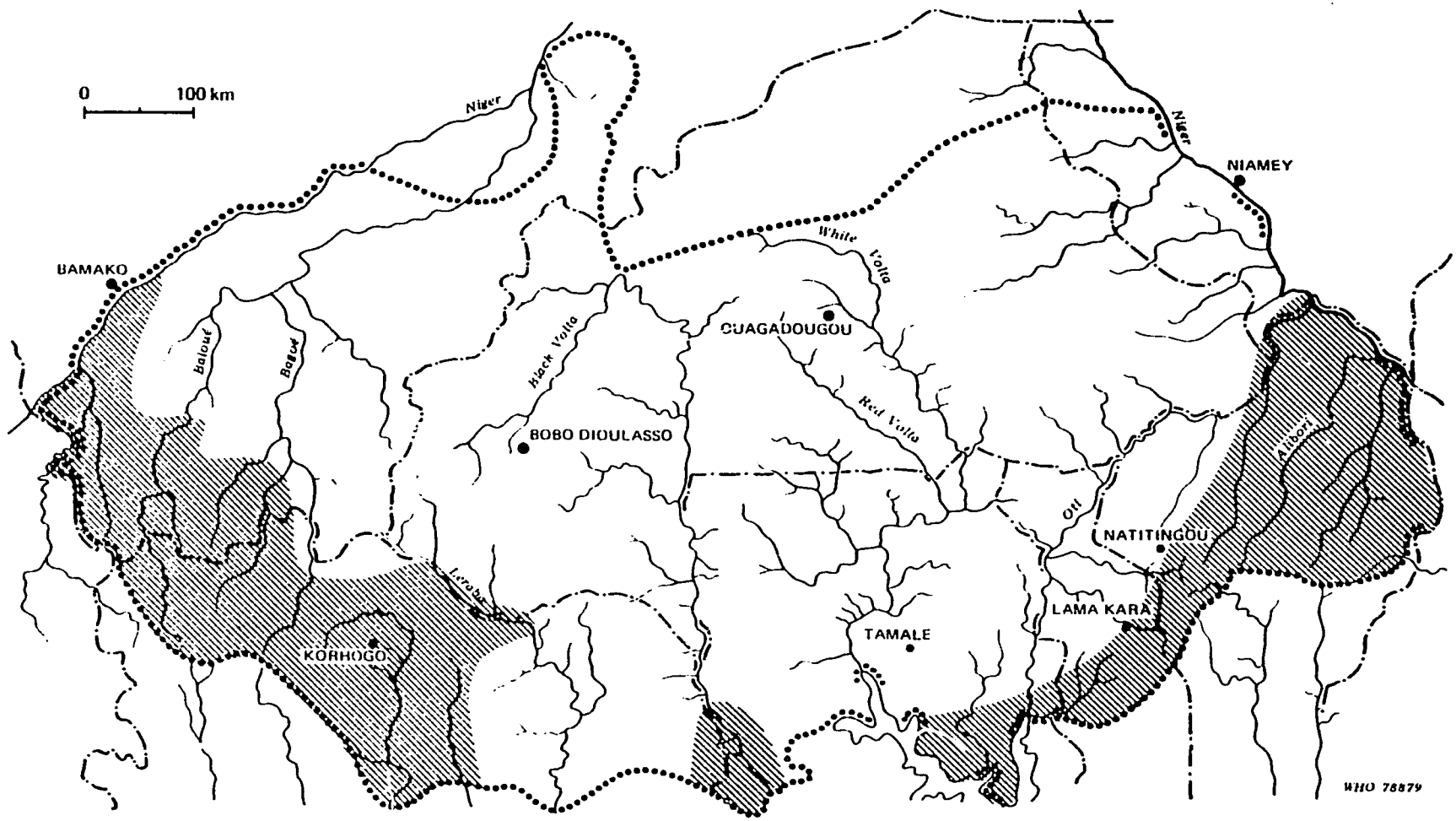


FIG. III-10
ENDEMICITY OF ONCHOCERCIASIS IN THE PROGRAMME AREA BEFORE BEGINNING OF CONTROL OPERATIONS

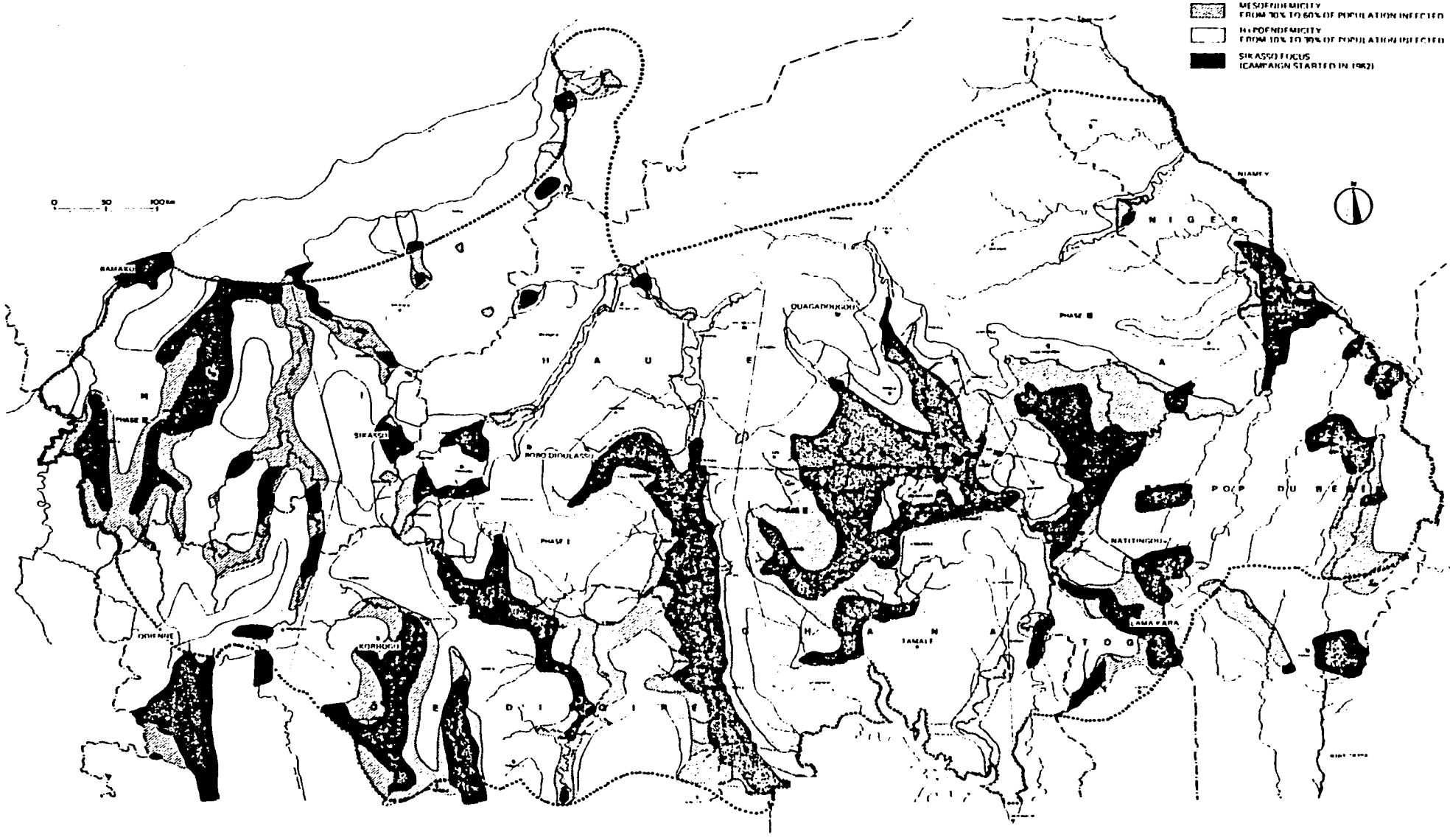
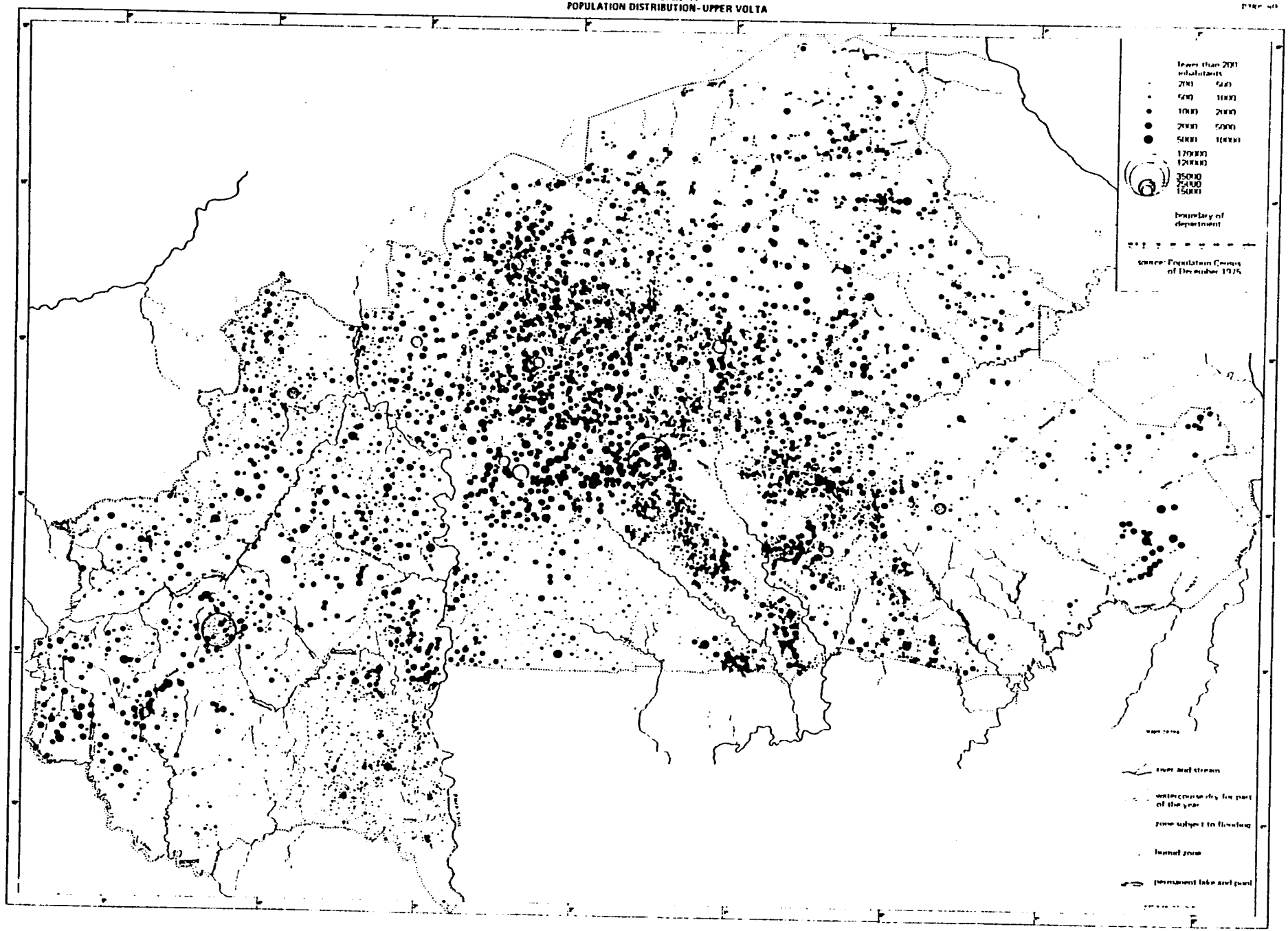


FIG. III-11
POPULATION DISTRIBUTION - UPPER VOLTA



CHAPTER IV

ECONOMIC DEVELOPMENT

The Unit started functioning in February 1976. The first few months were spent on familiarization tours within the Programme area, establishing contacts with the ministries and officials concerned with development activities and projects in the oncho zones of the respective countries, with representatives of the United Nations Development Programme, FAO, WHO and other specialized agencies of the United Nations, and with other multinational and bilateral aid agencies.

Close association was established with the regional development organizations in the Programme area, in particular those based in Ouagadougou, and also with the Comité Inter-Etats pour la lutte contre la Sécheresse (CILSS), and the Inter-African Centre for Hydraulic Studies.

During the course of the year the functions of the Unit were more specifically defined to be information and liaison, namely to:

- collect and disseminate basic socioeconomic data which may be useful for planning and development actions by both beneficiary and donor countries;
- on the basis of the socioeconomic data collected, assist in the establishment of a socioeconomic data bank for the Programme area;
- at the request of the countries, study and advise on development projects being executed or planned for the oncho zone;
- maintain contacts with all parties to the Programme and interested agencies (beneficiaries, sponsoring agencies, bilateral and multinational aid and financing agencies).

Following this definition a standard questionnaire for collection and transmission of information to the Programme on a regular basis was devised and circulated to the Programme countries.

In 1976 the responsibility for preparing an annual report on socioeconomic developments in the Programme area, which had hitherto been assumed by the United Nations Development Programme, passed to the Unit. With the assumption of this responsibility, the staffing of the Unit was effected on a multidisciplinary basis (sociology, agroeconomics, development economics and public health) in order to ensure the proper integration of the various aspects of development. By combined use of the questionnaire and personal visits by members of the Unit, information was assembled for compilation of the annual socioeconomic reports for 1977 and 1978.

CHAPTER V

RESEARCH AND ENVIRONMENTAL PROTECTION

Research

The greater part of the research carried out by the Onchocerciasis Control Programme falls under the following main headings:

(i) Vector ecology;

(ii) Vector control;

(iii) Epidemiological, clinical and parasitological research;

(iv) Chemotherapy.

This research has had a strong operational bias. While most of the work has been entrusted to institutions and universities under contract,[1] two research scientists and numerous short-term consultants, have also been employed directly by the Programme. An amount of approximately $ 2 300 000 has been spent on research, equivalent to almost 7% of total expenditure of the Programme.

Vector ecology

It was appreciated at the beginning of the Programme that the vector, S. damnosum, was not a single species but rather a complex of several very closely related species. Initially the species could only be identified in the larval form by examination of the giant chromosomes in the salivary glands; therefore emphasis has been placed on finding morphological characteristics which would enable the field entomologist to classify the adults, pupae and larvae using a light microscope. Keys have been developed for the identification of adults and a working group was convened to consider their field application and adoption by the Programme.

Research has also been carried out on the enzyme polymorphisms in the adults of the S. damnosum complex. This method has enabled S. squamosum and S. yahense to be differentiated but it does not have the same field potential as morphological keys.

Techniques were devised for the rearing of single generations of flies in the laboratory from eggs obtained from wild-caught blood-fed females. Until adult identification became possible, these methods were utilized during the study of the reinvasion phenomenon to obtain larvae for cytotaxonomic identification. The rearing technique was passed on to a few technical personnel for field implementation.

Attempts were made to develop a laboratory colony of S. damnosum. Unfortunately, most efforts to transport live material, mainly eggs, to laboratories outside West Africa failed, except when the material was handcarried. However, some progress was made in developing blood-feeding and certain mating procedures which provide a foundation for the continuation of these studies.

The variations in behaviour and vectorial capacity of the different species have been studied. Information was derived coincidentally from a variety of research experiments and also directly from the control operations. An X-ray fluorescent spectroscopy technique was used in an attempt to identify the sources from which migrating flies emanated. A prolonged study was undertaken of the movement of adults in relation to major wind patterns.

---

[1] A list of research agreements financed by OCP is given in Annex III.

Studies have been carried out to determine the epidemiological importance of each of the cyto-species of the S. damnosum complex. This work has tended to confirm the earlier findings that the savanna species of the complex, S. damnosum and S. sirbanum, are unable to transmit effectively the forest variety of O. volvulus, and vice versa.

As the Programme relies entirely on vector collection to assess the S. damnosum s.l. present in an area and to evaluate the effectiveness of control, research has been aimed at developing an operationally acceptable, alternative method of catching the blackflies, and at finding an artificial substrate as a suitable means of determining the larval population. Two adult traps have been successfully tried. The first, a window-pane trap, intercepts the insects in flight; though useful as a research tool, it has not caught adults consistently in numbers in any way comparable with vector collectors. It has shown, however, that flies tend to move upstream along, and just above, the river bed. The second, the aluminium sheet trap, has proved more efficient than vector collectors particularly in reinvasion areas, but its effectiveness is influenced greatly by its location. It has the advantage of catching adults of physiological stages different from those seeking a blood meal, especially gravid flies. However, such flies are not suitable subjects for an epidemiological evaluation of the control operations. Operationally, this trap would not only give less valuable results but would require as great, if not greater, manpower input than at present available in the entomological evaluation network.

After many trials it was found that clear plastic strips were the most effective artificial substrate for larvae, but they did not prove more attractive than the natural substrate available at any site. Nonetheless, through their use additional information was obtained on the distribution of the larvae in the water at depths of at least three metres.

Vector control

In view of the reliance of the Programme on one formulation of the larvicide, viz., Abate emulsifiable concentrate, priority has been given to finding an alternative. This research has been developed in close association with the Division of Vector Biology and Control of WHO, Geneva.

A floating-cage method has been devised for the testing of new insecticides and formulations against the larvae of S. damnosum s.l. enabling their effect on non-target organisms to be observed. The results of these small-scale tests are similar to what is obtained in riverine tests. This is a marked advance on all previous methods and enabled the rapid screening of a range of products. However, the number of compounds which meet the strict specifications laid down for the Programme and give maximum control of the vector, with minimum effect on the other aquatic organisms, is very limited.

So far, only Chlorphoxim has reached the stage of a large-scale field test. Results indicate that the formulation of Chlorphoxim supplied, used at concentrations lower than are used with Abate, is more toxic to non-target organisms although effective against S. damnosum larvae. Likewise, other insecticides have proved too toxic to the non-target organisms and more selective formulations are being sought. Research has shown that the feeding mechanism of the Simulium larvae filters from the water particles of a size mainly in the range of 5 to 15 mμ. These particles take 18 to 30 minutes to pass through the gut. Accordingly, the effectiveness of particulate formulations of different insecticides, including Abate, is being tested. Of special interest are microencapsulated formulations which may enable larvicides to be more target-positive. In this respect Methyl-Dursban, which failed in other formulations, is under trial as Reldan 10-10 presented within capsules which are intended to rupture when ingested by the larvae. The possibility of using pyrethroids in similar formulations is being explored.

Trials are also under way to determine the usefulness of insect growth regulators, Dimilin and Altozid, in the control of Simulium.

Because of the need to monitor the susceptibility of Simulium larvae to Abate and to any other insecticide which might be introduced during the period of control operations, a method was devised to enable susceptibility tests to be carried out in field conditions and give consistent results. This method is now in operational use and to date there is no evidence of the development of resistance to Abate anywhere in the Programme area. On the other hand, resistance to DDT has been observed in larvae collected from rivers where that insecticide had not been used previously for Simulium control; presumably this results from DDT leeching into the rivers after agricultural application.

Before an insecticide can be safely accepted for operational use, large-scale riverine tests are necessary. These tests cover a period of one year to take into account the variety of riverine and climatic conditions common to the area. A Scientific Advisory Panel meeting was convened in Geneva in July 1978 to assess the present knowledge on alternative insecticides. This meeting, attended by representatives of several chemical companies, made recommendations for future work aimed at finding a standby product to replace Abate, should this become necessary.

Epidemiological, clinical and parasitological research

On the medical side most of the research has been undertaken in the course of the epidemiological evaluation activities, producing a greater insight into the implications of the disease. To provide comparative data on the dynamics of onchocerciasis transmission and on the pathogenesis of the disease from a similar, uncontrolled area, a longitudinal study has been undertaken in Northern Cameroon over a period of three years.

The applied research undertaken by the Epidemiological Evaluation Unit has been mainly concerned with operational epidemiological aspects of onchocerciasis in order to improve the field survey techniques used. In the field of parasitology, several different methods for the examination of skin snips were compared to determine a suitable technique both for large-scale field surveys and for the detection of new and light onchocercal infections. Microfilaruria, which is an important sign of systemic onchocerciasis, was investigated and a simple field technique based on filtration of urine was developed.

Histological examinations of skin snips have been carried out to assist in the identification of skin lesions due to onchocerciasis.

Although it has been recognized for some time that there are apparent differences between the O. volvulus found in the forest and savanna areas, and that the parasites in infective stages found in the vector may be other than O. volvulus, until recently no technique was available to enable clarification. Recent advances in histochemical staining techniques are now beginning to provide methods which could have future operational consequences and possibly lead to a more precise entomological evaluation of transmission potentials.

Staining techniques have also been devised for the differentiation of the microfilariae of O. volvulus and D. streptocerca. This method has enabled a significant prevalence of D. streptocerca to be noted in the Volta Region of Ghana.

A study is being undertaken of the digestion of skin snips by Collagenase, a method which enables the total number of microfilaria present in a snip to be counted, as against only a percentage by the standard techniques.

In the ophthalmological field, different vision tests were explored to ensure reliable results on impaired vision in the villages examined. It was found that different figures in the shape of a hand were preferable for use in the operational conditions of the Programme.

Following reports from other onchocerciasis areas indicating a high prevalence of glaucoma, especially in young age-groups, measurements of intra-ocular tension were taken during two years. This research has shown that severe ocular onchocerciasis is strongly associated with secondary glaucoma which represents a final stage of severe ocular pathology.

Another important operational aspect of onchocerciasis is the definition of cases at high risk of blindness. For this purpose the relationship between the ocular parasite load and severe onchocercal eye lesions was investigated, as well as the importance of optic nerve involvement in onchocerciasis and its influence on the visual fields.

Following studies on the relationship between the number of microfilariae in the anterior chamber of the eye and the intensity of onchocercal infections, it has been shown that the presence of numerous microfilariae in the eye is associated with severe and irreversible lesions. A scoring system for the ocular microfilarial load has been developed.

It has also been demonstrated that visual field defects in onchocerciasis constitute an important and common visual handicap, often equivalent to blindness.

The epidemiological and ophthalmological data collected by the Programme has served as a basis, in combination with other data particularly geographic and demographic, for the redefinition of endemicity levels. Consequently the idea of "sporadic" endemicity has now been abandoned.

Chemotherapy

Within the Programme area a trial was undertaken to determine the possible advantages which might derive from nodulectomy. Initial results indicate that such practice could be beneficial in certain cases, for example, in children with head nodules.

In the absence of a suitable drug for mass treatment, a chemotherapeutic research programme has been progressively implemented. For obvious ethical reasons trials were undertaken only with drugs that are widely used and whose efficacy, side-effects and toxicity are already well-known, but whose activity and method of use with onchocerciasis patients in the Programme area needed to be specific.

The reference microfilaricide, Diethylcarbamazine (DEC) has been tested both in restricted communities and for mass treatment in whole villages. A variety of regimes was tested and the subjects followed up medically for at least several months and sometimes for several years. The results may be summarized as follows:

(i) in light to moderately infected persons the side-effects can be controlled by administering gradually increasing doses and adding antiallergic and/or anti-inflammatory drugs;

(ii) in patients with a high parasite count the side-effects are extremely troublesome, but again, the side-effects have been reduced by using low initial doses and employing antiallergic drugs;

(iii) the effects on the ocular parasite count are excellent. The ocular reactions to the drug are either not dangerous or can be controlled by corticoids;

(iv) the addition of other anthelminthics, such as levamisole, to DEC does not help;

(v) DEC eyewashes cause violent ocular reactions and so cannot be recommended in practice.

Suramin, the recognized macrofilaricide, was prescribed with the usual precautions to town outpatients and meso- and hyper-endemic village communities, some of which were followed up for three years. The following observations were made:

(i) the toxic and side-effects of suramin are most violent in subjects with high filaria counts, so strict medical surveillance is necessary;

(ii) the parasiticidal activity is more marked in moderately infected than in highly infected patients;

(iii) the effect on the ocular parasite count is excellent but there is some risk of developing irreversible lesions.

A bibliography on suramin 1970-1975 was published.

Other drug trials using metrifonate, levamisole and nifurtimox have been carried out in the Programme area and in Cameroon. Metrifonate has been administered in different regimens to a hyperendemic village but the results will not be available until late 1978.

In order to strengthen and accelerate the studies of current and potentially suitable drugs, a Chemotherapeutic Research Centre was established in Tamale in northern Ghana in 1976.

For the future, chemotherapeutic research is directed towards short-, medium- and long-term objectives.

The reduction of the risk of blindness among populations infected before the beginning of the Programme is a short-term objective.

The target group for possible action is made up of individuals who do not yet suffer from irreversible ocular lesions but have a sufficiently high level of infection for the risk to persist that such lesions may appear during the months or years to come.

In a few years this initial group will only comprise two types of individual: on the one hand those in whose case it is too late to intervene and on the other those whose condition will never evolve towards blindness. When that moment comes no preventive measures will any longer be justified.

The criteria for identifying the group at risk must not only be technically acceptable (sensitivity, specificity, reproducibility, etc.) but also usable under field conditions and by auxiliary personnel. These two latter factors represent, at the moment, a major obstacle to mass diagnosis of a possible target group.

In regard to therapy the classical filaricides administered at the usual doses perhaps precipitate ocular lesions. To use them in a mass campaign would therefore require the development of new treatment schedules, less toxic and better tolerated by the populations.

In the medium term the possible topical use of filaricides (eye drops, transcutaneous preparations, etc.) as well as operations such as cephalic nodulectomy in children under 15 years of age should be given more study.

Likewise, control of transmission through measures against the vector has created new epidemiological conditions which may change completely the indications for chemotherapeutic measures.

The evolution of ocular lesions may perhaps be spontaneously slowed down, if not stopped altogether, once a zone is protected. The need to treat the groups at risk would in that case be felt much less acutely.

Moreover, the problem of the toxicity for the eye of the filaricides used at the moment has not yet been solved. Mass treatment designed to diminish the risk of blindness in a protected zone may not therefore be clearly indicated.

Longitudinal surveys with a view to comparing the risk of blindness (1) in controlled and uncontrolled zones and (2) in the absence of and after treatment, must be carried out before a decision can be taken regarding intervention.

These medium-term objectives imply a reduction in the human parasite reservoir. Such a reduction can only be obtained by chemotherapy applied to the whole population. There is a strict time limit involved, since by definition these objectives will gradually lose their justification as the end of the entomological programme draws near.

Here again, there can scarcely be any question of banking on the discovery of new products since their development may take five to 10 years even when a "candidate" product is available, which does not seem to be the case at the moment.

Research should be directed towards the possibility of using, in mass campaigns, filaricides at present available or already undergoing clinical tests. Their action should be studied in relation to the reduction of the human parasite reservoir, which means that it must be possible to administer them to all the infected population and not merely to a restricted target group, as would be the case in a campaign to prevent blindness.

Finally, a programme of chemotherapeutic research is in line also with some long-term objectives. The most important of those objectives is the need to provide a method of controlling the disease in succession to the vector control campaign, so as to keep transmission down to an acceptable level once that campaign is completed.

Several solutions for this problem of the Programme's consolidation phase are being studied. Most of them aim at controlling the vector: biological control, use of encapsulated forms of insecticide, reorganization of the vector control campaign on the basis of local resources, new methods of conducting spraying operations, etc.

None of these solutions, however, would seem to be as satisfactory either from the scientific or from the financial and logistic point of view as the control of transmission through a chemotherapy campaign affecting the whole population.

Such a campaign, aimed at neutralizing or periodically reducing the human parasite reservoir (every five years, for example) would only be possible through the use of a macrofilaricide that was effective and could be used in mass campaigns.

On the other hand, the time needed to achieve that objective - 15 or so years - makes it possible to envisage the development by the pharmaceutical firms of a new macrofilaricide meeting the standards of efficiency and safety required.

Cooperation with the pharmaceutical industry

The ever-increasing cost of developing any new product and uncertainty regarding the profit that may be made by producing a medicament against onchocerciasis discourage the participation of the pharmaceutical industry in research on the chemotherapy of onchocerciasis.

The high cost of developing a medicament is mainly due to the following factors:

- the need to maintain on a permanent footing research facilities designed to test products that are potentially valuable for onchocerciasis control;
- the need to have available in the endemic regions adequate clinical facilities and personnel capable of carrying out clinical research;
- the existence of national standards in many countries (and standards that are becoming more and more strict) in regard to the effectiveness and safety of drugs; this is particularly true in the case of a product intended for use in a mass campaign;
- the possibility that a "candidate" product of clinical interest may be costly to synthesize at the outset and may remain costly if it is produced only in small quantities;
- the time needed to discover any product that is altogether new in this field.

The potential benefits of a new product such as a macrofilaricide may seem of a social rather than an economic nature and it would appear that financial support would be necessary to ensure the participation of industry in this type of research.

An accelerated programme of onchocerciasis chemotherapy which would aim at increasing the chances of the discovery of a new macrofilaricide by the pharmaceutical firms by encouraging certain decisive stages in the development of the new product would be justified by the combination of the three factors mentioned below:

(i) the importance of making provision for the consolidation phase of the present vector control programme;

(ii) the value of discovering a new macrofilaricide that was safe and effective and could be used as the weapon of choice during that phase;

(iii) the need to aid firms financially in order to obtain their cooperation in this type of research.

The implementation of this research programme will be carried out in close cooperation with the Special Programme for Research and Training in Tropical Diseases (TDR).

At the present time TDR activities in respect of onchocerciasis chemotherapy are along three main lines:

- encouraging the synthesis of new filaricides by the pharmaceutical firms;
- encouraging the establishment of screening centres for such products;
- encouraging clinical trials in endemic zones of products that have shown filaricidal activity and for the use of which in human medicine permission has been obtained.

For its part the medical personnel of OCP is in a unique position to carry out, under the best possible technical and material conditions, a whole series of studies directly connected with the operational objectives of the Programme:

- therapeutic trials designed to test at village community level on the one hand the the classical filaricides and on the other the various products already used in human medicine for diseases other than onchocerciasis but which have already shown filaricidal activity;
- clinical, morphological and other studies of the Mazzotti reaction; an attempt to classify this reaction also fits into this framework as does the study of methods making it possible to diminish its intensity;
- experimental epidemiological studies with the main aim of defining various population groups (target groups for certain measures, high-risk groups, etc.) or for determining the relationship between certain forms of treatment and the evolution of the disease.

Environmental Protection

The weekly application of the larvicide used to control the vector, Abate emulsifiable concentrate, could have an adverse effect on non-target organisms. Therefore, in the early stages of the operations, an aquatic monitoring programme was set in motion. Unfortunately, no data was available as a basis for future comparison; thus, studies of the rivers covered by the first phase of operations commenced almost at the same time as the larviciding. Only on two rivers not brought under treatment until the third phase was pre-control data obtained.

Despite these problems, the protocol developed for the aquatic monitoring and followed consistently on eight rivers principally in the southern section of the Programme area, has proved adequate and sufficiently sensitive to record any significant alteration in the composition of the riverine fauna. Results have indicated, as expected, a certain diminution in the overall quantity of non-target invertebrate organisms in those rivers under continual control. This generally amounts to approximately 30% but there is no indication of a similar effect on the fish population.

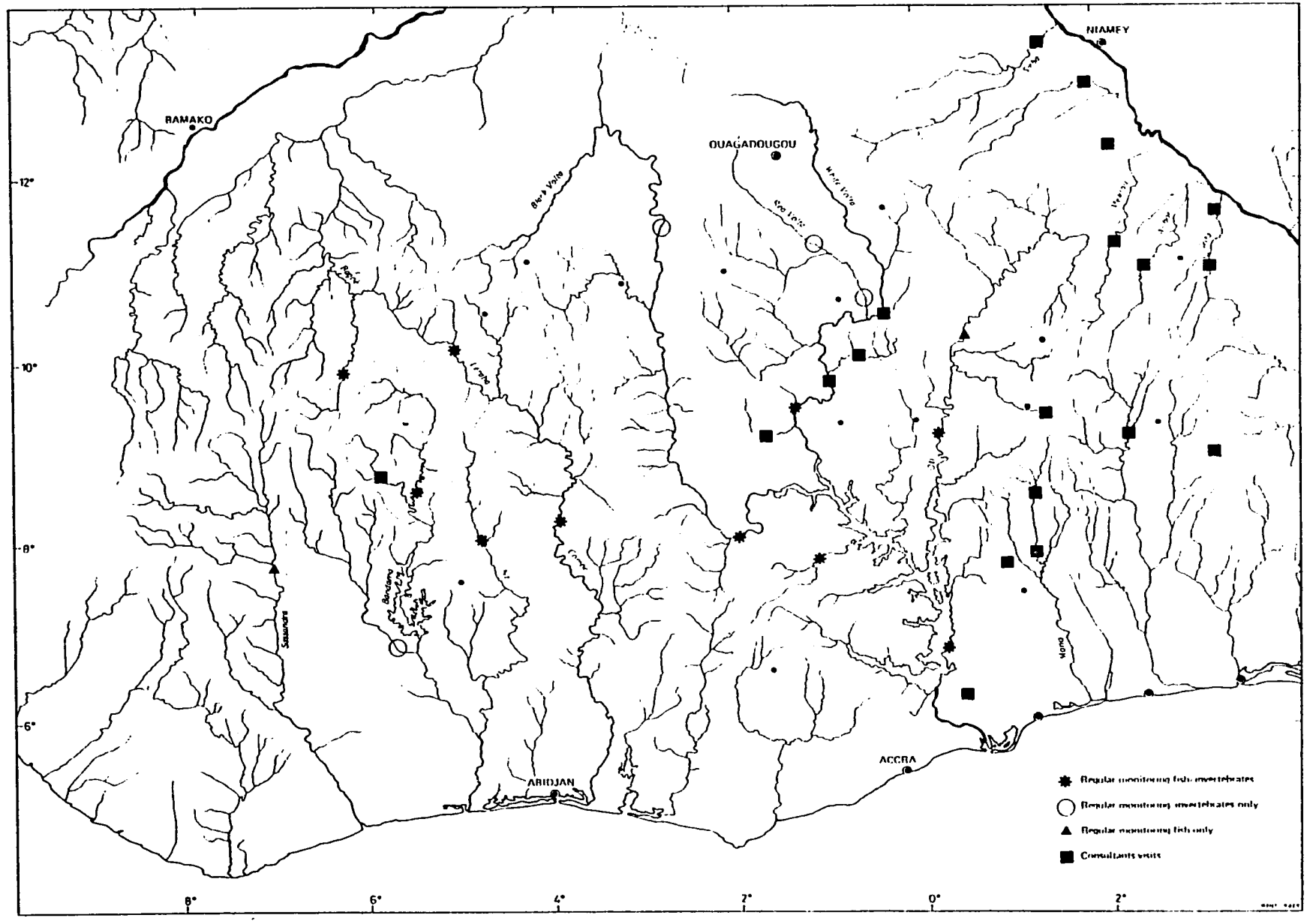
The initial impact of the insecticide on the aquatic fauna appears to be more drastic during the first treatments of a river but, even without interruption of the weekly schedule, the riverine fauna is able to recover gradually to a level comparable with other rivers in the area.

Studies on the fish population have not revealed the disappearance of any species under the regular application of larvicide, and the number of young fish remains high, suggesting that breeding is unaffected.

Data collected is recorded on specially designed forms and fed into a computer for subsequent analysis. Because of the tremendous differences in the rivers, not only seasonal but annual on account of the varying rainfall affecting flow and discharge, several years study will be necessary before firm conclusions can be drawn. However, a certain consistency in results has already been noted permitting a reduction in monitoring frequency from monthly to quarterly intervals.

In conjunction with these monitoring activities there is a back-up research programme which is leading to a greater understanding of the natural ecological balance that exists in the rivers and the interrelationships of the different organisms.

FIG. V-1
AQUATIC MONITORING SITES



CHAPTER VI

TRAINING

After adoption of the PAG Mission Report in 1973, the rapid implementation of the Onchocerciasis Control Programme and launching of operations required a large number of personnel of varied disciplines and levels. The main thrust of OCP being entomological the greatest need was, of course, for entomologists and technicians. The demands of the Programme were greater than the available supply and a contract was concluded with the Organisation de Coordination et de Coopération pour la Lutte contre les Grandes Endémies (OCCGE) for the training of these categories of personnel at the Institut de Recherches sur l'Onchocercose (IRO) at Bouaké. Under this contract four entomologists, one assistant entomologist and 26 technicians were trained between 1974 and 1977, sufficient, in fact, to fill all the posts in OCP authorized in the budget. With funds provided for fellowships, one medical officer received training in ophthalmology and another followed a course in public health.

As the Programme developed, the need for in-service or more advanced training of its personnel became evident. Training appropriate to the specialized needs of the different sections of the Programme was organized, for example, two technicians received specialized instruction in rearing single generations of flies for taxonomic identification, and several entomologists were introduced to the new techniques developed for identifying the different species of the S. damnosum complex. The opportunity was given to an assistant entomologist to receive academic training to qualify as an entomologist.

On the epidemiological side requirements were much smaller and in-service training was possible: technicians were taught to take skin snips and examine them for microfilariae, and census clerks to collate essential information on the population in villages surveyed by the epidemiological teams.

In the field of administration, emphasis was given to providing instruction, either in Ouagadougou or in WHO headquarters, Geneva, in stores management, book-keeping, cost accounting, and preparation and execution of the budget. Attention was also paid to the training of mechanics, on whom much of the success of the operations depends. English and French language course were arranged and continuous in-service-training in secretarial duties was provided.

The methods and techniques which OCP has developed to survey, control and evaluate the vector and the disease are models of value to entomologists, parasitologists and ophthalmologists studying onchocerciasis elsewhere. Accordingly, doctors and scientists participate in Programme activities for varying periods including, so far, an entomologist from Sudan, two physicians - from Mali and Brazil - and an ophthalmologist and health superintendent from Nigeria. At the request of the Ghana Government, two national entomologists were attached to the Tamale sector for four months practical training prior to their subsequent assignment by the Government to assist with preliminary studies in the proposed extension area. The Programme has also been included in the reorientation training course for WHO entomologists which had 11 participants in 1976 and 10 in 1977.

At its fourth session held in December 1977 in Kuwait, the JCC confirmed its special interest in the question of training. The participating countries strongly emphasized that they wished to avail themselves of all the possibilities that the Programme could offer in this regard. During 1978, the Programme Director visited each of the countries for an exchange of views with the authorities. The action taken so far was reviewed and the problem of training in onchocerciasis was considered within the context of the overall training programme of WHO.

The specific areas in which OCP can assist in training national personnel are:

- parasitology and ophthalmology as applied to the collection of base-line data on onchocerciasis and to the epidemiological evaluation of a control campaign against the disease;

- ecology and control of the vectors of onchocerciasis as applied to the geographical surveillance of the breeding sites, to the organization of detailed entomological investigations, and to the planning and establishment of an entomological evaluation network;

- ecology and control of the vectors of onchocerciasis as applied to the planning, costing and implementation of vector control operations (aerial logistics, equipment and ground support networks);

- cytotaxonomy of the S. damnosum complex in West Africa;

- techniques for the collection, classification and presentation of data on economic development projects in the Programme area;

- planning of the infrastructure, and financial and administrative management for an onchocerciasis control campaign.

As of September 1978 the training support within the framework of OCP was as shown in the following Table VI-1.

TABLE VI-1. TRAINING SUPPORT SINCE INCEPTION OF PROGRAMME

Name	Nationality	Title or post occupied (at time of selection)	Training institutions	Field of specialization	Duration
FELLOWSHIPS					
ABOUSSA, Dr Ayité-Folly	Togo	Médecin Chef Subdivision Sanitaire Aneho, Togo	Clinique Ophtalmologique Université de Dakar Senegal	Ophthalmology	3 years
AGOUA, Dr Hyacinthe	Benin	Docteur Vétérinaire Chef de la Région Elevage de l'Atacora, Bénin	ORSTOM, Bondy, France OCCGE, Bouaké	Entomology	2 years
AKOGBETO, Mr Codjo Martin	Benin	Professeur de Biologie-Géologie, Lycée Behanzin Porto-Novo, Bénin	ORSTOM, Bondy, France	Entomology	15 months
AMAKYE, Mr Joseph Somua	Ghana	Research Officer Council for Scientific and Industrial Research Accra, Ghana		Hydrobiology	3 years
ANTWI, Mr Leonard A. K.	Ghana	Research Officer Council for Scientific and Industrial Research Accra, Ghana	University of Miami Miami, Florida Centre for Disease Control Atlanta, Georgia	Pesticide residue analysis	5 months 1 month
ASIGRI, Mr	Ghana			Entomology	
BA, Dr Oumar	Mali	Docteur en Médecine Médecin Chef du Secteur No. 3 des Maladies Transmissibles, Bamako, Mali	Ecole Nationale, Santé Publique de Rennes, France OCP Ouagadougou	Public health	1 year 2 months
BUGRI, Dr Samuel Z.	Ghana	Medical Officer Ministry of Health Accra, Ghana		Parasitology	
GLELE, Dr Clément	Benin	Médecin Chef Circonscription Médicale Djougou, Bénin		Epidemiology	
OUSSA, Dr Germain	Benin	Chef des Services de Médecine et de Pharmacie Hôpital de Parakou, Bénin	Clinique Ophtalmologique Université de Dakar Sénégal	Ophthalmology	3 years
SAMMAN, Mr James	Ghana	Research Scientist Institute of Aquatic Biology Achimota, Ghana	University of Salford United Kingdom	Hydrobiology	3 years
SEKETELI, Dr Azodoga	Togo	Docteur Ingénieur Entomologie Agricole	OCCGE, Bouaké	Entomology	
SOME, Mr Antoine	Upper Volta	Professeur Sciences Naturelles Collège de Tounouma Bobo-Dioulasso	ORSTOM, Bondy, France OCCGE, Bobo-Dioulasso OCCGE, Bouaké	Entomology	2 years
WILSON, Mr Michael David	Ghana	Assistant Entomologist Ministry of Health Accra, Ghana	London School of Hygiene and Tropical Madicine United Kingdom	Parasitology	1 year
TRAINING 1974					
AWOTO, Mr N'Guessan	Ivory Coast	Assistant d'Assainissement Ministère de la Santé Publique, Antenna d'Hygiène Yamoussoukro, Côte d'Ivoire	IRO, Bouaké	Entomology	4 months
DEH DEH, Mr Jean	Ivory Coast	Assistant d'Assainissement Ministère de la Santé Publique, Secteur de Gagnoa, Côte d'Ivoire	IRO, Bouaké	Entomology	4 months
GBATO, Mr Bagui J. B.	Ivory Coast	Assistant d'Assainissement Ministère de la Santé Publique, Grandes Endémies Man, Côte d'Ivoire	IRO, Bouaké	Entomology	4 months

TABLE VI-1. TRAINING SUPPORT SINCE INCEPTION OF PROGRAMME (continued)

Name	Nationality	Title or post occupied (at time of selection)	Training institutions	Field of specialization	Duration
TRAINING (continued)					
1974					
GBOHO, Dr Christophe	Ivory Coast	Vétérinaire Inspecteur Ministère de la Production animale, Abidjan CÔte d'Ivoire	IRO, Bouaké	Entomology	4 months
IKPE, Mr Atse	Ivory Coast	Assistant d'Assainissement Inspection Sanitaire Ministère de la Santé Publique, Daloa CÔte d'Ivoire	IRO, Bouaké	Entomology	4 months
NION, Mr Joseph	Upper Volta	Contrôleur Phytosanitaire Inspection des Produits végétaux Ministère de l'Agriculture et de l'Elevage Ouagadougou, Haute-Volta	IRO, Bouaké	Entomology	4 months
OCRAN, Mr Michael	Ghana	Medical Entomologist Ministry of Health Epidemiology Division	OCP, Bole	Entomology	10 months
SAWADOGO, Mr Raogo O.	Upper Volta	Infirmier 1er échelon Antenne Onchocercose Banfora, Haute-Volta	IRO, Bouaké	Entomology	4 months
SOME, Mr Antoine	Upper Volta	Professeur Sciences Naturelles Collège de Tounouma Bobo-Dioulasso, Haute-Volta	IRO, Bouaké	Entomology	3-1/2 months
ZERBO, Mr Gaston	Upper Volta	Professeur de Biologie Ministère de l'Education Nationale, Ouagadougou Haute-Volta	IRO, Bouaké	Entomology	6 months
1975					
ADJONOU, Mr Christian	Togo	Technicien d'Entomologie Chef de la Section d'Entomologie Ministère de la Santé Publique, Lomé, Togo	IRO, Bouaké	Entomology	4 months
AHADZIE, Mr Daniel	Ghana	Laboratory Technician National Malaria Service Ministry of Health Ho, Volta Region, Ghana	IRO, Bouaké	Entomology	1-1/2 months
AITCHEDJI, Mr Cyrille	Benin	Infirmier d'Etat Technicien d'Entomologie Antenne Entomologique OCCGE Cotonou, Benin	IRO, Bouaké	Entomology	2 months
AMPAH, Mr Victor L.	Ghana	Laboratory Technician National Malaria Service Ministry of Health Ho, Volta Region, Ghana	IRO, Bouaké	Entomology	2 months
AVISSEY, Mr Henry S.	Ghana	Technician National Malaria Service Ministry of Health Ho, Volta Region, Ghana	IRO, Bouaké	Entomology	2 months
BAAH, Mr Akwasi A.	Ghana	Technician National Malaria Service Ministry of Health Ho, Volta Region, Ghana	IRO, Bouaké	Entomology	2 months
BARRO, Mr Télé	Upper Volta	Infirmier Adjoint 4ème echelon Ministère de la Fonction Publique et du Travail Ougadougou, Haute-Volta	IRO, Bouaké	Entomology	3 months

TABLE VI-1. TRAINING SUPPORT SINCE INCEPTION OF PROGRAMME (continued)

Name	Nationality	Title or post occupied (at time of selection)	Training institutions	Field of specialization	Duration
TRAINING (continued)					
1975					
DOFINI, Mr Jacques	Upper Volta	Infirmier Adjoint 4 ème échelon Centre Médical Houndé Ministère du Travail et de la Fonction Publique Bobo-Dioulasso, Haute-Volta	IRO Bouaké	Entomology	3 months
FIASORGBOR, Mr George K.	Ghana	Technician Ministry of Health Accra, Ghana	IRO, Bouaké	Entomology	1-1/2 months
GONE, Mr Mawutowu	Togo	Laboratory Technician Ministry of Health Lome, Togo	IRO, Bouaké	Entomology	4 months
KONATE, Mr Kati	Upper Volta	Infirmier 1er échelon Centre Médical de Houndé Haute-Volta	IRO, Bouaké	Entomology	3 months
MAHAMANE, Mr Abdoulaye	Niger	Spécialiste d'Entomologie-Parasitologie de l'OCCGE Service des Grandes Endémies, Niamey, Niger	IRO, Bouaké	Entomology	4 months
TIAHO, Mr Pierre Claver	Upper Volta	Infirmier 3ème échelon Dispensaire de Banfora	IRO, Bouaké	Entomology	3 months
1976					
COULIBALY, Mr Soungalo	Mali	Conducteur d'Agriculture 3ème classe Ministère du Travail et de la Fonction Publique Bamako, Mali	IRO, Bouaké	Entomology	4 months
DIALLO, Mr Isaac	Mali	Infirmier d'Etat 2ème classe Responsable du Poste Médical de l'OICMA Kara, Mali	IRO, Bouaké	Entomology	4 months
DIARRA, Mr Youssouf	Mali	Ingénieur des Travaux Agricoles - 3ème classe Opération Riz Ségou, Mali	IRO, Bouaké	Entomology	3-1/2 months
GBAGUIDI, Mr Kokou Pierre	Benin	Infirmier Spécialiste en Entomologie-Parasitologie OCCGE, Centre Muraz Antenne Entomologique Cotonou, Bénin	IRO, Bouaké	Entomology	3 months
KASSAMBARA, Mr Mabo	Mali	Infirmier d'Etat 2ème classe Secteur des Grandes Endémies Bandiagara, Mali	IRO, Bouaké	Entomology	4 months
OTCHOUMARE, Mr Jonas	Benin	Infirmier Spécialiste en Entomologie-Parasitologie OCCGE, Centre Muraz Antenne Entomologique Cotonou, Bénin	IRO, Bouaké	Entomology	3 months

TABLE VI-1. TRAINING SUPPORT SINCE INCEPTION OF PROGRAMME (continued)

Name	Nationality	Title or post occupied (at time of selection)	Training institutions	Field of specialization	Duration
TRAINING (continued)					
1977					
DIALLO, Mr Arba I.	Upper Volta	Infirmier 3ème échelon Centre Muraz Bobo-Dioulasso, Haute-Volta	IRO, Bouaké	Entomology	4 months
OUEDRAOGO, Mr M. Maxime	Upper Volta	Infirmier 3ème échelon Centre de Santé Kombissiri, Haute-Volta	IRO, Bouaké	Entomology	4 months
SIMAGA, Dr Bakary	Mali	OCP staff member	IRO, Bouaké	Entomology	6 weeks
1978					
ADAMOU, Mr Hamadi	Niger	Aide-Assistant de l'Action Sociale, 2ème classe Niamey, Niger	OCP, Lama-Kara IRO, Bouaké	Entomology	8 weeks 6 months
AGOUA, Dr Hyacinthe	Benin	Sector Chief, OCP Bamako, Mali	IRO, Bouaké	Cytotaxonomy	2 weeks
BALDE, Mr Mamadou S.	Guinea	Chef d'Equipe Entomologie Service National de Prévention, Projet Paludisme, Conakry, Guinée	IRO, Bouaké	Entomology	4 months
CAMARA, Dr Sekou Y.	Guinea	Médecin Inspection Médicale des Ecoles, Conakry, Guinée	OCP, Epidemiological Evaluation Unit	Parasitology	2 months
DIALLO, Mr Amadou	Guinea	Chef de la Section Parasitologie Service National de Prévention, Laboratoire National, Conakry, Guinée	OCP, Epidemiological Evaluation Unit Ouagadougou, Upper Volta	Parasitology	2 months
DORE, Mr Lah	Guinea	Chef d'Equipe Projet de Lutte contre l'Onchocercose, Conakry Guinée	IOTA, Bamako	Ophthalmology	12 months
FASSENA, Mr Ido	Upper Volta	Infirmier OCP, Epidemiological Evaluation Unit Ouagadougou, Upper Volta	Centre Muraz, OCCGE Bobo-Dioulasso	Parasitology	3 months
GBAMOU, Mr Ciba	Guinea	Parasitologiste, Projet de Lutte contre l'Onchocercose, Conakry, Guinee	OCP, Epidemiological Evaluation Unit Ouagadougou, Upper Volta	Parasitology	2 months
KAFANDO, Mr Jean Christophe	Upper Volta	Laboratory Assistant OCP, Epidemiological Evaluation Unit Ouagadougou, Upper Volta	Centre Muraz, OCCGE Bobo-Dioulasso	Microscopie	1 month
KASSE, Dr Yaya	Guinea	Médecin-Ophtalmologiste Directeur, Projet de Lutte contre l'Onchocercose Kankan, Guinee	IOTA, Bamako	Ophthalmology	12 months
KONE, Mr Koho Raymond	Guinea	Chef d'Equipe, Parasitologie, Service National de Prévention Projet Paludisme Conakry, Guinée	IRO, Bouaké	Entomology	4 months
KOUMOUVI, Mr Katevi	Togo	Assistant d'Entomologie Service des Grandes Endémies Lomé, Togo	OCP, Bobo-Dioulasso IRO, Bouaké	Entomology	3 months 4 months

TABLE VI-1. TRAINING SUPPORT SINCE INCEPTION OF PROGRAMME (continued)

Name	Nationality	Title or post occupied (at time of selection)	Training institutions	Field of specialization	Duration
TRAINING (continued) 1978					
LABO, Mr Rahiou	Niger	Assistant d'Elevage 2ème classe Laboratoire d'Elevage Niamey, Niger	OCP, Tenkodogo IRO, Bouaké	Entomology	8 weeks 6 months
LAMA, Mr Roger	Guinea	Professeur de Biologie Faculté des Sciences de la Nature Conakry, Guinée	IRO, Bouaké	Entomology	4 months
MENSAH, Mr Gilbert	Benin	Chargé de Recherches Antenne de Recherches Entomologiques, Cotonou	ORSTOM, Bouaké	Hydrobiology	6 months
SAGNO, Mr Arsène	Guinea	Biologiste, Enquêtes Palud., Service National de Prévention, Conakry Guinée	IRD, Bouaké	Entomology	4 months
KABA, Mr Kabine	Guinea	Assistant de l'Entomologiste OMS Projet de Lutte contre l'Onchocercose, Conakry Guinée	IRO, Bouaké OCP	Entomology	4 months 1 month
CAMARA, Dr Sekou Y.	Guinea	Médecin Inspection Médicale des Ecoles, Conakry Guinée	IRO, Bouaké	Entomology	4 months
KOUROUMA, Mr Souleymane	Guinea	Chef d'Equipe Section de Parasitologie Projet de Lutte contre l'Onchocercose Conakry, Guinée	IRO, Bouaké OCP	Entomology	4 months 1 month
MASAOE, Mr Nicholas J.	Tanzania	District Health Officer Regional Development Arusha, Tanzania	IRO, Bouaké	Entomology	4 months
OULARE, Mr Thaoua	Guinea	Assistant de l'Entomologiste OMS Projet de Lutte contre l'Onchocercose, Conakry Guinée	IRO, Bouaké OCP	Entomology	4 months 1 month

A list of 16 candidates for training was submitted by letter dated 20 September 1978 from the Ministry of Health, Mali.

CHAPTER VII

IMPLEMENTATION AND COSTS

Budget execution 1974-1979

Expenditures for the 1974-1979 period are expected to be approximately $ 55 360 000,[1] representing savings of some $ 7 200 000, on original estimates.

A comparison between the PAG Mission estimates by activity for 1974-1979 and total expenditure currently estimated as of May 1978 for the same period, gives the following breakdown:

Activity	PAG ($)	% of total	Current estimates ($)	% of total	Savings (overrun) ($)
Vector control	35 083 000	56	35 175 000	64	92 000
Epidemiological evaluation	3 406 000	5	2 979 000	5	427 000
Economic development	1 399 000	2	827 000	1	572 000
Director's Office, ADMIN, WHO support, meetings	13 390 000	22	11 583 000	21	1 807 000
Research/training	9 282 000	15	4 317 000	8	4 965 000
JCC	-	-	479 000	1	(479 000)[2]
Total	62 560 000	100	55 360 000	100	7 200 000

A comparison between the PAG Mission estimates by category of expenditure for 1974-1979 and anticipated expenditure for the same period, is as follows:

Category	PAG ($)	% of total	Current estimates ($)	% of total	Savings (overrun) ($)
Personnel	20 566 000	33	20 099 000	36	467 000
Aerial contract	11 236 000	18	10 509 000	19	727 000
Insecticide	7 712 000	12	5 818 000	11	1 894 000
Research/training	9 282 000	15	4 317 000	8	4 965 000
Operations/maintenance/ travel	4 611 000	7	8 067 000	15	(3 456 000)
Capital items	9 153 000	15	4 616 000	8	4 537 000
Other (JCC, meetings, consultants)	-	-	1 934 000	5	(1 934 000)[3]
Total	62 560 000	100	55 360 000	100	7 200 000

[1] Actual expenditures for 1974-1977 amount to $ 29 299 147.

[2] There was no provision for the JCC in the PAG report.

[3] No provision was made for this in the PAG report.

By the above comparisons, actual expenditures are expected to be 25% less on insecticide, 53% less on research/training, and 50% less on capital acquisitions. Over the 1975-1977 period, Programme total costs per kilometre of river decreased 32% from $ 31.48 in 1975 to $ 21.52 in 1977. Projections through 1979 also suggest decreases in total cost per kilometre beyond the 1977 rate. These reductions have occurred as a result of maintaining administrative overheads relatively constant and by carefully monitoring the most important variable items in vector control such as insecticides and evaluation teams.

From 1975-1977, minimum guaranteed flight hours were exceeded by 7.3% for fixed-wing aircraft and 3.6% for helicopter. 1977 insecticide applications in Phase I and Phase II represented decreases of 5% and 46% in litres per kilometre of river protected compared to 1975 and 1976.

As of May 1978, the number of entomological surveillance teams per kilometre of river protected in Phases I, II and III had been reduced by 16%, 28% and 11%, respectively, compared to the first years of operation (1975, 1976, 1977, respectively).

Excepting dramatic reversal of the climatic conditions experienced during the last three years, the satisfactory cost-effective ratio of our operations should continue during the 1980-1985 period since the optimal use of Programme financial resources reflects better knowledge of field conditions and improved efficiency.

CHAPTER VIII

PLAN OF ACTION AND BUDGET 1980-1985

A. PLAN OF ACTION

During the subject period, the strategy of the OCP will remain essentially as originally planned. The objective of the Programme will continue to be to reduce the impact of onchocerciasis to a sufficiently low level so that it no longer represents either a public health problem or an obstacle to socioeconomic development and also to maintain and adjust control activities so as to stabilize the disease at a tolerable level. Methods of entomological and epidemiological evaluation of the control operations will continue unchanged. These activities will be supported by a programme of applied research. The present administrative infrastructure of the OCP should remain substantially unchanged with 48 professional posts, 643 general services posts, two aerial bases and about six sectors and 22 subsectors.

Vector control operations

The plan of action for vector control over the period 1980-1985 calls for the protection of a cumulative total of 3 552 438 km of river compared to 2 095 207 km during the period 1974-1979, i.e. an increase of 70%. This is due to the gradual build-up of activities during the period 1974-1979 (larviciding beginning only in 1975) as compared to the period 1980-1985, during which it is envisaged to maintain an annual level of activities similar to that projected for 1979.

RIVER DISTANCES PROTECTED BY PHASE BY YEAR IN KILOMETRES[1]

	1974	1975	1976	1977	1978	1979	Total 1974-1979	Per year 1980-1985	Total 1980-1985
Phase I	-	191 143	191 143	191 143	191 143	191 143	955 715	191 143	1 146 838
Phase II	-		59 894	59 894	59 894	59 894	239 576	59 894	359 364
Phase III	-			258 908	258 908	258 908	776 724	258 908	1 553 448
Ivory Coast extension	-				41 064	82 128	123 192	82 128	492 768
Total	-	191 143	251 037	509 945	551 009	592 073	2 095 207	592 073	3 552 438

[1] Calculated by multiplying estimated wet season river length by 17.5 weekly treatment circuits and estimated dry season river lengths by 34.5 weekly treatment circuits.

In terms of inputs per kilometre of river protected, helicopter hours will decrease from 112 to 109 per 10 000 km (-3%), and vector collecting teams will decrease from 15 to 13 per 100 000 km (-13%). See tables on page 61.

The rate of fixed-wing hours will, however, increase from 23 to 27 per 10 000 km of river protected (17%) and the amount of insecticide used per 100 km of river treated will increase from 39 to 42 litres (8%). This is due to anticipated higher-than-average rates of consumption for these two inputs in the Ivory Coast extension area, larger rivers in the south necessitating more fixed-wing aircraft use and more insecticide than smaller rivers further north. In brief, the impact of these increases on unit costs for the period 1980-1985 is great since they affect every year.

HELICOPTER HOURS BY YEAR AND PHASE ABSOLUTE AMOUNT (Q)
AND RATE (R) PER 10 000 km OF RIVER PROTECTED

	(A) 1974		(B) 1975		(C) 1976		(D) 1977		(E) 1978		(F) 1979		(G) 1974-1979		(H) By year 1980-1985		(I) Total 1980-1985	
	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R
Phase I	-		1 912	100	2 420	127	1 907	100	1 800	94	1 800	94	9 839	102	1 800	94	10 800	94
Phase II	-		-	-	1 410	235	859	143	898	149	898	149	4 065	170	898	149	5 388	149
Phase III	-		-	-	-	-	2 369	91	2 582	100	2 582	100	7 533	97	2 582	100	15 492	100
Ivory Coast extension	-		-	-	-	-	-	-	860	209	1 150	140	2 010	163	1 150	140	6 900	140
Total	-		1 912	100	3 830	153	5 135	101	6 140	111	6 430	109	23 447	112	6 430	109	38 580	109

FIXED-WING HOURS BY YEAR AND PHASE ABSOLUTE AMOUNT (Q)
AND RATE (R) PER 10 000 km OF RIVER PROTECTED

	(A) 1974		(B) 1975		(C) 1976		(D) 1977		(E) 1978		(F) 1979		(G) 1974-1979		(H) By year 1980-1985		(I) Total 1980-1985	
	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R
Phase I	-		366	19	352	18	367	19	367	19	367	19	1 819	19	367	19	2 202	19
Phase II	-		-	-	224	37	200	33	200	33	200	33	824	34	200	33	1 200	33
Phase III	-		-	-	-	-	415	16	516	20	516	20	1 447	19	516	20	3 096	20
Ivory Coast extension	-		-	-	-	-	-	-	280	68	500	61	780	63	500	61	3 000	61
Total	-		366	19	576	23	982	19	1 363	25	1 583	27	4 870	23	1 583	27	9 498	27

INSECTICIDE BY YEAR AND PHASE ABSOLUTE AMOUNT (Q)
AND RATE (R) PER 100 km OF RIVER PROTECTED

	(A) 1974		(B) 1975		(C) 1976		(D) 1977		(E) 1978		(F) 1979		(G) 1974-1979		(H) By year 1980-1985		(I) Total 1980-1985	
	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R
Phase I	-		75 631	40	88 243	46	72 116	38	75 000	39	75 000	39	385 990	40	75 000	39	450 000	39
Phase II	-		-	-	33 611	54	17 523	29	20 000	33	20 000	33	91 134	37	20 000	33	120 000	33
Phase III	-		-	-	-	-	57 968	22	80 000	31	80 000	31	217 968	28	80 000	31	480 000	31
Ivory Coast extension	-		-	-	-	-	-	-	38 000	93	75 000	92	113 000	93	75 000	92	450 000	92
Total	-		75 631	40	121 854	49	147 607	29	213 000	39	250 000	42	808 092	39	250 000	42	1 500 000	42

VECTOR COLLECTOR TEAMS BY YEAR AND PHASE ABSOLUTE NO. (Q)
AND RATE (R) PER 100 000 km OF RIVER PROTECTED

	(A) 1974		(B) 1975		(C) 1976		(D) 1977		(E) 1978		(F) 1979		(G) 1974-1979		(H) By year 1980-1985		(I) Total 1980-1985	
	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R
Phase I	-		31	16	31	16	31	16	24	16	24	14	141	15	24	14	144	14
Phase II	-		-	-	19	32	19	32	14	23	14	23	64	27	14	23	84	23
Phase III	-		-	-	-	-	36	14	32	12	32	12	100	13	32	12	192	12
Ivory Coast extension	-		-	-	-	-	-	-	8	19	8	10	16	13	8	10	48	10
Total	-		31	16	50	20	86	17	78	14	78	13	321	15	78	13	468	13

Programme activities during the period 1980-1985 will require, annually, a total of 6430 helicopter flying hours and 1583 fixed-wing flying hours. The grand total will be 38 580 and 9498 hours for helicopter and fixed-wing, respectively. Compared to 1979, this represents no increase in aircraft or in aircraft hours per kilometre of river protected.

These hours are distributed annually as follows:

	Helicopter	Fixed-wing
Phase I	1 800	367
Phase II	898	200
Phase III	2 582	516
Ivory Coast extension	1 150	500
Total	6 430	1 583

Approximately 250 000 litres of insecticide will be required annually. Although the trend for insecticide use in Phase I and Phase II reflects decreasing amounts per kilometre of river protected, uncertainty exists with regard to consumption in Phase III. Also, the effect that treatment of the Ivory Coast extension zones will have on insecticide use in the interior, northern zones of Phases I and II cannot be determined with precision.

A total of 270 capture points will be serviced by 78 teams operating from 22 subsectors and six sectors. There is no increase in the number of vector collecting teams, sectors, and subsectors, respectively, per kilometre of river protected, compared to the status quo as anticipated at end 1979.

Epidemiological evaluation

Field evaluation: The total number of villages included in the first evaluation of the Programme area was 313, of which 45 were detailed evaluation villages (DE). Not all these 300 villages will be included in future follow-up for reasons such as change of population and very low endemicity of onchocerciasis. About 50% of the total number of simple evaluation villages (SE) will be regularly re-examined, whereas nearly all the 45 detailed evaluation villages will be included in the follow-up.

The sample for the future longitudinal study will therefore be, approximately, 150 villages SE and 45 villages DE, in principle equally distributed within the three phases of the Programme area.

In some of the SE villages a stratification of the sample may be used to confirm the absence of transmission in certain areas, for instance, examination only of children born since the beginning of the vector control programme. For the same reason non-infected populations resettling oncho-freed areas may also be included.

Follow-up intervals: The selected villages will be re-examined every third year. Areas of very stable and successful vector control will be controlled every fifth year by simple evaluation, to confirm the absence of transmission, whereas it may be necessary to make more frequent passages in areas of doubtful transmission control.

	Phase I	Phase II	Phase III
1st passage	1975	1976	1977
2nd passage	1978	1979	1980
3rd passage	1981	1982	1983
4th passage	1984	1985	

The criteria for selection of villages to be included in the future follow-up will be based mainly upon:

- the duration of vector control;
- the level of ongoing transmission, if any.

A third factor to take into consideration will be the statistical background, i.e. a sufficient number of carefully selected villages must be examined to enable reliable conclusions.

The follow-up villages will therefore be grouped together, according to the above criteria, and taking into account geographical and epidemiological characteristics, such as endemicity levels.

The research activities undertaken by the Unit are described on page 65.

Economic development

The experience gained by the Unit during its first three years has highlighted the importance of the following essential components for development of the oncho zone:

(a) a basic socioeconomic infrastructure, particularly basic health services, schools and roads, especially in resettlement areas;

(b) the need for integration of public health components into development projects;

(c) integration of the oncho zone into the national economy of each country through regional development and planning; and

(d) the necessity for anticipating development problems and bottlenecks by keeping these under continuing study and review in order to prevent their becoming critical issues.

The evolution of these different aspects should be closely followed during the period 1980-1985.

In this respect the report on the economic aspects[1] of the Programme has suggested that the Unit could expand its research and policy analysis activities by undertaking research and analysis and by organizing research to be done by others. It should specialize substantially on socioeconomic subjects directly related to the vector control programme. Resettlement and migration are areas where the need for a programme and policies are acute in several countries. Other possible areas suggested for socioeconomic research are health and health care delivery.

Also, on several occasions the participating countries have suggested that the Unit give particular attention to putting in evidence the economic benefits derived by the countries from the vector control activities.

Training

The training programme will continue to aim at three objectives:

(a) to improve the skills of personnel already employed;

(b) to prepare new personnel as may be required;

(c) to instruct personnel from other African countries in the procedure of survey, control and evaluation of onchocerciasis and its vectors.

---

[1] See Part II of Evaluation Report.

Research

The research activities undertaken or sponsored by the Programme during 1980-1985 will continue to be closely related to its changing requirements.

The principal objectives of future entomological research are as follows:

(i) to find a series of alternative larvicides and formulations to replace Abate;

(ii) to locate the resting sites of the adults in order to determine the feasibility of employing adulticides to strengthen control measures;

(iii) to prepare suitable keys for the identification of the adult females and males, pupae and larvae of the different species of S. damnosum common to the Programme area;

(iv) to study the movements of S. damnosum s.l. and the factors influencing migration; this would enable the Programme to predict when reinvasion would take place and from where, and to take appropriate action before, rather than after, the event;

(v) to develop appropriate technologies which will facilitate the control of the vector; this will involve seeking alternative methods of control, including environmental manipulation, to reduce the sources of the vector.

The aquatic monitoring operations will be pursued. Trials will be undertaken to determine the efficacy of environmental manipulation, e.g. modification of some breeding sites which should lead to a corresponding reduction in the quantity of insecticide applied to the watercourses. Following these experiments a SAP Working Group will be convened to consider the possible wider application of the technique, especially in those areas where development and intensive settlement is taking place.

Medical research will continue to emphasize studies involving the epidemiology of the disease and the search for a safe and efficient therapeutic agent.

The role of EPI will include the evaluation of drug trials and their eventual application on selected populations, as well as applied research to define cases at risk of blindness and in need of treatment. Another important aspect of research will be the investigation of more refined evaluation techniques that may become available in the future, and which may improve the diagnosis or treatment of onchocerciasis.

Contracts will be established with a certain number of specialized institutions or research workers for the execution of studies which have priority for the operational objectives of the Programme, and which cannot be undertaken by Programme personnel.

Close liaison will be maintained with the WHO Special Programme for Research and Training in Tropical Diseases, regarding basic research oriented towards greater understanding of the disease.

B. BUDGET

Budget requirements for the period are estimated at $ 132 646 300; this figure was calculated on the basis of estimates for capital requirements, the possible cost of the aerial contract,[1] and estimates for the remainder of recurring expenditures using 1979 as a base.

The following assumptions have been made:

- an annual increase of 11.5% for staff (3.5% for statutory increase plus 8% for inflation);
- an annual increase of 8% for all other operational costs (excluding aerial operations);
- replacement of one-third of the total vehicle fleet per year.

The increase in cost from 1974-1979 to 1980-1985 is $ 77 286 703, of which $ 49 276 300 (64%) is due to inflation and $ 28 010 403 (36%) is due to increased activity. By the end of 1985, however, a sufficiently high level of control will have been achieved to permit a considerable reduction of the level of activities required to maintain control. This reduction of activities will almost certainly reflect decreased costs.

---

[1] The estimated aerial contract costs for 1980-1985 have been calculated on the basis of the expected number of flight hours and an hourly rate estimated on the basis of "losing" bids submitted in 1976 plus 7% inflation per year; plus 9% for unknown factors (1976 bids plus 30%). The costs for 1983-1985 represent estimated flight hours at 1980-1982 rates plus 30% (10% per year increase due to inflation and contingencies). These calculations are summarized as follows:

	1980-1982		
	No. hours	Rate ($)	Total ($)
Helicopter	19 290	659	12 712 110
Fixed-wing	4 749	594	2 820 906
Total			15 533 016

	1983-1985		
	No. hours	Rate ($)	Total ($)
Helicopter	19 290	857	16 531 530
Fixed-wing	4 749	772	3 666 228
Total			20 197 758
Grand total			35 730 774

These rates are, of course, tentative. The actual rates will be known only after the results of an international call for bids in 1979 for the period 1980-1982 and in 1982 for the period 1983-1985.

The following series of tables are presented:

	Description
I.A	OCP 1980-1985 by Programme activity
I.B	Comparison between 1974-1979 and 1980-1985 by Programme activity
I.C	Pie Chart by Programme activity
II.A	OCP 1980-1985 by category of expenditure
II.B	Pie Chart by category of expenditure
III.	Vector Control Unit 1980-1985 by category of expenditure
IV.	Epidemiological Evaluation Unit 1980-1985 by category of expenditure
V.	Economic Development Unit 1980-1985 by category of expenditure
VI.	Environmental Protection, Applied Research and Training 1980-1985 by category of expenditure
VII.	Office of the Programme Director and Administrative Support/Ouagadougou 1980-1985 by category of expenditure
VIII.	Administrative Support Geneva, Rome, Brazzaville 1980-1985 by category of expenditure
IX.	Meetings, 1980-1985
X.	Joint Coordinating Committee, 1980-1985 by category of expenditure
XI.	Total Expenditures 1974-1985 emphasizing transition periods 1979, 1980, 1981

TABLE I.A. OCP 1980-1985 BY PROGRAMME ACTIVITY

	1980	1981	1982	1983	1984	1985	Total 1980-1985
Vector control operations	12 405 600	13 090 500	13 851 500	16 239 700	17 154 600	18 207 000	90 948 900
Epidemiological evaluation	850 300	936 200	1 029 600	1 133 700	1 250 600	1 359 100	6 559 500
Economic development	413 000	458 000	507 600	562 700	624 300	692 200	3 257 800
Applied research, environmental protection and training	1 188 000	1 283 000	1 385 600	1 496 200	1 616 000	1 745 200	8 714 000
Programme director and administrative support - Ouagadougou	2 420 300	2 641 800	2 918 300	3 226 400	3 569 700	3 919 700	18 696 200
Meetings	163 300	176 300	190 400	205 600	222 000	239 800	1 197 400
Administrative support - Geneva	208 700	231 500	256 800	284 900	316 100	350 700	1 648 700
Technical support - FAO/ROME	24 100	26 000	28 100	30 300	32 800	35 400	176 700
Regional liaison - Brazzaville	60 700	67 600	75 400	84 100	93 700	104 500	486 000
Independent Chairman and JCC	124 400	137 000	150 700	165 700	182 400	200 900	961 100
Total	17 858 400	19 047 900	20 394 000	23 429 300	25 062 200	26 854 500	132 646 300

TABLE I.B. COMPARISON BETWEEN 1974-1979 AND 1980-1985 BY PROGRAMME ACTIVITY

	1974-1979	1980-1985	Increase (decrease)	%
Vector control operations	35 174 873	90 948 900	55 774 027	158.5
Epidemiological evaluation	2 978 987	6 559 500	3 580 513	120.2
Economic development	713 048	3 257 800	2 544 752	356.9
Applied research, environmental protection and training	4 316 937	8 714 000	4 397 063	101.9
Programme Director and administrative support - Ouagadougou	8 506 031	18 696 200	10 190 169	119.8
Meetings	530 594	1 197 400	666 806	125.7
Administrative support - Geneva	2 421 876	1 648 700	(773 176)	(31.9)
Technical support - Rome	113 748	176 700	62 952	55.3
Technical and administrative support - Brazzaville	124 146	486 000	361 854	291.5
Office of the Independent Chairman and JCC meetings	479 357	961 100	481 743	100.5
Total	55 359 597	132 646 300	77 286 703	139.6

TABLE I. C
ONCHOCERCIASIS CONTROL PROGRAMME
1980–1985 BY PROGRAMME ACTIVITY

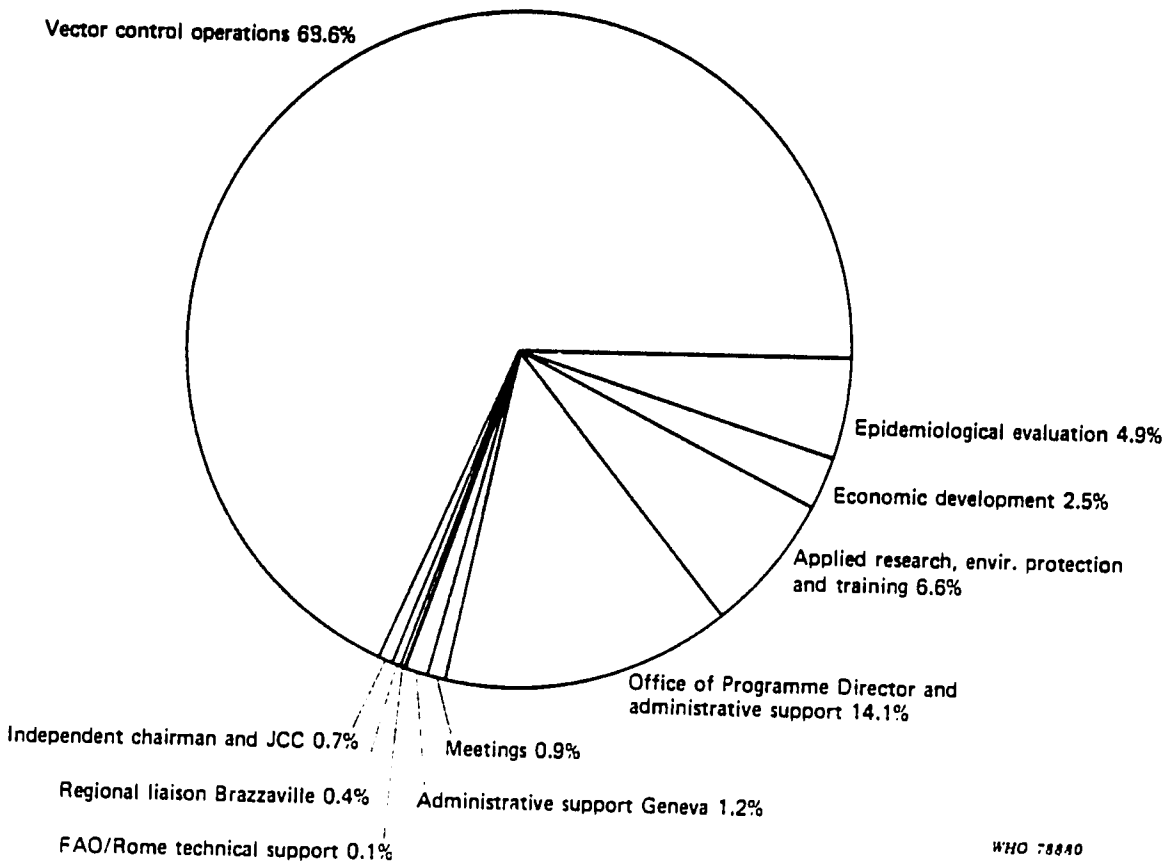


TABLE II.A. OCP 1980-1985 BY CATEGORY OF EXPENDITURE

	1980	1981	1982	1983	1984	1985	Total
Annual costs							
Personal services	6 273 600	6 995 100	7 799 500	8 696 400	9 696 400	10 811 400	50 272 400
Aerial operations	5 177 700	5 177 700	5 177 700	6 732 500	6 732 500	6 732 500	35 730 600
Insecticide	1 675 400	1 809 400	1 954 200	2 110 500	2 279 300	2 461 600	12 290 400
Research and training	1 188 000	1 283 000	1 385 600	1 496 200	1 616 000	1 745 200	8 714 000
Rent, supplies, operations and maintenance	1 477 900	1 596 100	1 723 700	1 861 500	2 010 300	2 171 000	10 840 500
Operational travel	624 900	675 000	728 800	787 000	850 100	918 100	4 583 900
Consultants	207 700	224 300	242 200	261 500	282 500	305 000	1 523 200
Meetings	163 300	176 300	190 400	205 600	222 000	239 800	1 197 400
Independent Chairman and JCC	124 400	137 000	150 700	165 700	182 400	200 900	961 100
Total - Annual costs	16 912 900	18 073 900	19 352 800	22 316 900	23 871 500	25 585 500	126 113 500
Capital items							
Buildings	80 000	50 000	50 000	50 000	50 000	50 000	330 000
Furniture	5 000	5 000	5 000	5 000	5 000	5 000	30 000
Vehicles	785 500	844 000	911 200	982 400	1 060 700	1 139 000	5 722 800
Equipment	75 000	75 000	75 000	75 000	75 000	75 000	450 000
Total - Capital items	945 500	974 000	1 041 200	1 112 400	1 190 700	1 269 000	6 532 800
GRAND TOTAL	17 858 400	19 047 900	20 394 000	23 429 300	25 062 200	26 854 500	132 646 300

TABLE II. B

ONCHOCERCIASIS CONTROL PROGRAMME 1980–1985 BY CATEGORY OF EXPENDITURE

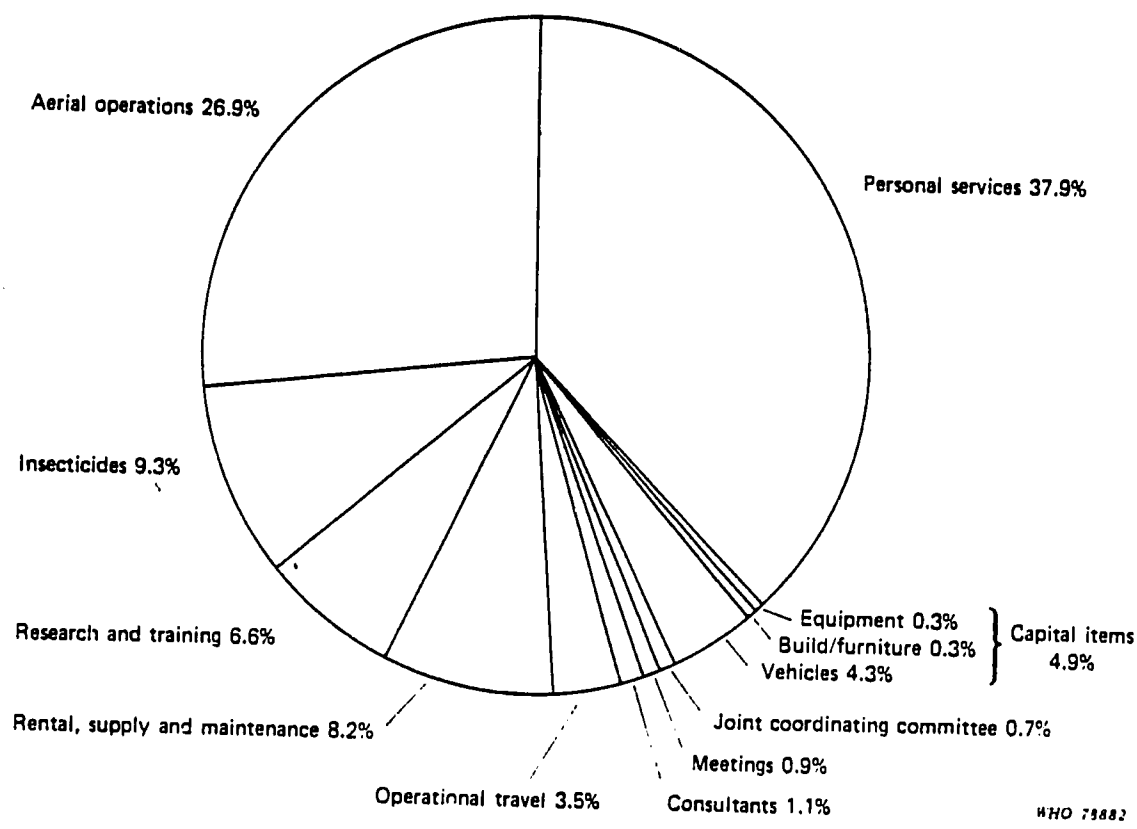


TABLE III. VECTOR CONTROL UNIT 1980-1985 BY CATEGORY OF EXPENDITURE

	1980	1981	1982	1983	1984	1985	Total
Annual costs							
Personal services	3 391 800	3 781 900	4 216 800	4 701 700	5 242 400	5 845 300	27 179 900
Aerial operations	5 177 700	5 177 700	5 177 700	6 732 500	6 732 500	6 732 500	35 730 600
Insecticide	1 675 400	1 809 400	1 954 200	2 110 500	2 279 300	2 461 600	12 290 400
Research and training	-	-	-	-	-	-	-
Supplies	36 600	39 500	42 700	46 100	49 800	53 800	268 500
Accommodation and utilities	52 500	56 700	61 200	66 100	71 400	77 100	385 000
Operations and maintenance	879 200	949 500	1 025 500	1 107 500	1 196 100	1 291 800	6 449 600
Operational travel	415 200	448 500	484 300	523 000	564 900	610 100	3 046 000
Consultants	77 400	83 600	90 300	97 500	105 300	113 700	567 800
Meetings	-	-	-	-	-	-	-
Independent Chairman and JCC	-	-	-	-	-	-	-
Total - Annual costs	11 705 800	12 346 800	13 052 700	15 384 900	16 241 700	17 185 900	85 917 800
Capital items							
Buildings	30 000	30 000	30 000	30 000	30 000	30 000	180 000
Furniture	2 000	2 000	2 000	2 000	2 000	2 000	12 000
Vehicles	617 800	661 700	716 800	772 800	830 900	939 100	4 539 100
Equipment	50 000	50 000	50 000	50 000	50 000	50 000	300 000
Total - Capital items	699 800	743 700	798 800	854 800	912 900	1 021 100	5 031 100
GRAND TOTAL	12 405 600	13 090 500	13 851 500	16 239 700	17 154 600	18 207 000	90 948 900

TABLE IV. EPIDEMIOLOGICAL EVALUATION UNIT 1980-1985 BY CATEGORY OF EXPENDITURE

	1980	1981	1982	1983	1984	1985	Total
Annual costs							
Personal services	553 000	616 600	687 500	766 600	854 800	953 100	4 431 600
Aerial operations	-	-	-	-	-	-	-
Insecticide	-	-	-	-	-	-	-
Research and training	-	-	-	-	-	-	-
Rent and utilities	13 900	15 000	16 200	17 500	18 900	20 400	101 900
Supplies	26 700	28 900	31 200	33 700	36 400	39 300	196 200
Operation and maintenance	86 300	93 200	100 600	108 600	117 300	126 700	632 700
Operational travel	62 900	68 000	73 400	79 200	85 600	92 400	461 500
Consultants	18 700	20 200	21 800	23 500	25 400	27 400	137 000
Meetings	-	-	-	-	-	-	-
Independent Chairman and JCC	-	-	-	-	-	-	-
Total - Annual costs	761 500	841 900	930 700	1 029 100	1 138 400	1 259 300	5 960 900
Capital items							
Buildings	-	-	-	-	-	-	-
Furniture	1 000	1 000	1 000	1 000	1 000	1 000	6 000
Vehicles	62 800	68 300	72 900	78 600	86 200	73 800	442 600
Equipment	25 000	25 000	25 000	25 000	25 000	25 000	150 000
Total - Capital items	88 800	94 300	98 900	104 600	112 200	99 800	598 600
GRAND TOTAL	850 300	936 200	1 029 600	1 133 700	1 250 600	1 359 100	6 559 500

TABLE V. ECONOMIC DEVELOPMENT UNIT 1980-1985 BY CATEGORY OF EXPENDITURE

	1980	1981	1982	1983	1984	1985	Total
Annual costs							
Personal services	337 200	376 000	419 200	467 400	521 100	581 000	2 701 900
Aerial operations	-	-	-	-	-	-	-
Insecticide	-	-	-	-	-	-	-
Research and training	-	-	-	-	-	-	-
Supplies	5 800	6 300	6 800	7 300	7 900	8 500	42 600
Accommodation and utilities	-	-	-	-	-	-	-
Operation and maintenance	24 500	26 500	28 600	30 900	33 300	36 000	179 800
Operational travel	35 000	37 800	40 800	44 000	47 600	51 400	256 600
Consultants	-	-	-	-	-	-	-
Meetings	-	-	-	-	-	-	-
Independent Chairman and JCC	-	-	-	-	-	-	-
Total - Annual costs	402 500	446 600	495 400	549 600	609 900	676 900	3 180 900
Capital items							
Furniture	-	-	-	-	-	-	-
Vehicles	10 500	11 400	12 200	13 100	14 400	15 300	76 900
Equipment	-	-	-	-	-	-	-
Total - Capital items	10 500	11 400	12 200	13 100	14 400	15 300	76 900
GRAND TOTAL	413 000	458 000	507 600	562 700	624 300	692 200	3 257 800

TABLE VI. ENVIRONMENTAL PROTECTION, APPLIED RESEARCH AND TRAINING 1980-1985 BY CATEGORY OF EXPENDITURE

	1980	1981	1982	1983	1984	1985	Total
ANNUAL COSTS							
I - Environmental protection	162 000	174 900	188 900	204 000	220 300	237 900	1 188 000
II - Applied research							
A - Entomological							
(i) Vector control staff	216 000	233 300	251 900	272 000	293 800	317 300	1 584 300
(ii) Vector ecology contractual	108 000	116 600	126 000	136 000	146 900	158 600	792 100
(iii) Vector control contractual	199 800	215 800	233 000	251 600	271 800	293 500	1 465 500
Subtotal - Entomological research (A)	523 800	565 700	610 900	659 600	712 500	769 400	3 841 900
B - Medical research (UNDP component)	421 200	454 900	491 300	530 600	573 200	619 000	3 090 200
Subtotal - Applied research (II)	1 107 000	1 195 500	1 291 100	1 394 200	1 506 000	1 626 300	8 120 100
III- Training (UNDP component)	81 000	87 500	94 500	102 000	110 000	118 900	593 900
GRAND TOTAL - I, II and III	1 188 000	1 283 000	1 385 600	1 496 200	1 616 000	1 745 200	8 714 000

TABLE VII. OFFICE OF THE DIRECTOR AND ADMINISTRATIVE SUPPORT OUAGADOUGOU 1980-1985
BY CATEGORY OF EXPENDITURE

	1980	1981	1982	1983	1984	1985	Total
Annual costs							
Personal services	1 757 200	1 959 300	2 184 600	2 435 800	2 715 900	3 028 200	14 081 000
Aerial operations	-	-	-	-	-	-	-
Insecticide	-	-	-	-	-	-	-
Research and training	-	-	-	-	-	-	-
Supplies	59 400	64 100	69 200	74 800	80 700	87 100	435 300
Accommodation and utilities	18 900	20 400	22 000	23 700	25 600	27 600	138 200
Operation and maintenance	239 100	258 200	278 900	301 200	325 300	351 300	1 754 000
Operational travel	111 800	120 700	130 300	140 800	152 000	164 200	819 800
Consultants	87 500	94 500	102 000	110 200	119 000	128 500	641 700
Meetings	-	-	-	-	-	-	-
Independent Chairman and JCC	-	-	-	-	-	-	-
Total - Annual costs	2 273 900	2 517 200	2 787 000	3 086 500	3 418 500	3 786 900	17 870 000
Capital items							
Buildings	50 000	20 000	20 000	20 000	20 000	20 000	150 000
Furniture	2 000	2 000	2 000	2 000	2 000	2 000	12 000
Vehicles	94 400	102 600	109 300	117 900	129 200	110 800	664 200
Equipment	-	-	-	-	-	-	-
Total - Capital items	146 400	124 600	131 300	139 900	151 200	132 800	826 200
GRAND TOTAL	2 420 300	2 641 800	2 918 300	3 226 400	3 569 700	3 919 700	18 696 200

TABLE VIII. ADMINISTRATIVE SUPPORT GENEVA, ROME, BRAZZAVILLE 1980-1985
BY CATEGORY OF EXPENDITURE

	1980	1981	1982	1983	1984	1985	Total
GENEVA HEADQUARTERS							
Annual costs							
Personal services	173 700	193 700	216 000	240 800	268 500	299 300	1 392 000
Operation and maintenance (data processing)	35 000	37 800	40 800	44 100	47 600	51 400	256 700
Total	208 700	231 500	256 800	284 900	316 100	350 700	1 648 700
FAO/SUPPORT/ROME							
Consultant services	24 100	26 000	28 100	30 300	32 800	35 400	176 700
BRAZZAVILLE/AFRO							
Personal services	60 700	67 600	75 400	84 100	93 700	104 500	486 000

TABLE IX. MEETINGS 1980-1985

	1980	1981	1982	1983	1984	1985	Total
Meetings	163 300	176 300	190 400	205 600	222 000	239 800	1 197 400

TABLE X. JOINT COORDINATING COMMITTEE 1980-1985 BY CATEGORY OF EXPENDITURE

	1980	1981	1982	1983	1984	1985	Total
Annual costs							
Personal services	70 900	79 100	88 200	98 300	109 600	122 200	568 300
Supplies	4 400	4 800	5 200	5 600	6 000	6 500	32 500
Operational travel	14 100	15 300	16 500	17 800	19 200	20 800	103 700
JCC meeting	35 000	37 800	40 800	44 000	47 600	51 400	256 600
Total	124 400	137 000	150 700	165 700	182 400	200 900	961 100

TABLE XI. TOTAL EXPENDITURE 1974-1985, EMPHASIZING TRANSITION PERIODS 1979, 1980, 1981

	1974-1978	1979	1980	1981	1982-1985	Total 1974-1985
Vector control operations	26 084 473	9 090 400	12 405 600	13 090 500	65 452 800	126 123 773
Epidemiological evaluation	2 279 787	699 200	850 300	936 200	4 773 000	9 538 487
Economic development	343 148	369 900	413 000	458 000	2 386 800	3 970 848
Applied research and environmental protection and training	3 216 937	1 100 000	1 188 000	1 283 000	6 243 000	13 030 937
Programme Director and administrative support - Ouagadougou	6 399 631	2 106 400	2 420 300	2 641 800	13 634 100	27 202 231
Meetings	379 394	151 200	163 300	176 300	857 800	1 727 994
Administrative support/Geneva	2 233 676	188 200	208 700	231 500	1 208 500	4 070 576
Technical support/FAO/Rome	91 448	22 300	24 100	26 000	126 600	290 448
Technical support/Brazzaville	69 746	54 400	60 700	67 600	357 700	610 146
Independent Chairman and JCC	366 157	113 200	124 400	137 000	699 700	1 440 457
Total	41 464 397	13 895 200	17 858 400	19 047 900	95 740 000	188 005 897

ANNEX I

REINVASION

Insecticide treatment of the rivers of Phase I, which began in February 1975, was followed within three weeks by a general reduction in S. damnosum s.l. biting densities over the whole area treated. At the end of April 1975, however, disturbing numbers of biting flies began to appear along the River Bandama and on the River Léraba at Pont Léraba.

At first it was considered that control might be breaking down with the increase in discharge caused by the onset of the wet season, and the supervision of the treatments was intensified. In spite of this, biting rates increased through June, July and August (Fig. I). At the same time intensive ground and helicopter prospections on the affected and nearby rivers failed to produce any but the very occasional larva.

The flies were characterized by parous rates approaching 100% and heavy infections with filaria larvae indistinguishable from O. volvulus. This last factor was believed to indicate that the flies might originate from the forest where such infections are usual.

In April 1976 OCP staff and members of the Institut de Recherches sur l'Onchocercose (IRO), Bouaké, met in Bobo-Dioulasso to plan the field research to be undertaken to investigate the nature and origin of the reinvasion, should it recur. The study utilized as many methods of catching and observing the flies as was feasible, and included cytotaxonomic determinations of adults and larvae reared from eggs obtained from biting adults. Other reinvading flies were fed on onchocercal carriers to determine whether they could transmit O. volvulus. Adults caught in the affected areas were compared with larvae and pupae from suspect source rivers outside the Programme area, by fluorescent X-ray spectroscopy to see if they could be traced to specific rivers. Fly catches were made daily at eight stations and extra vector collectors and chauffeurs were specially recruited for this purpose.

The results of the studies undertaken between April and October can be summarized as follows:

(i) The increase of biting flies recurred in April and continued through September not only along the River Bandama and at Pont Léraba, but also to a much lesser extent at points in the Black Volta river basin. No local breeding could be found that could account for the adult populations.

(ii) Daily catches at strategic points revealed that flies were only to be caught close to the river banks, and appeared in successive waves with peaks which were synchronous at well separated points (e.g. Pont Léraba and Niaka), suggesting the influence of meteorological factors. Over 97% of females were parous, of which 5 to 15% carried infective larvae similar to O. volvulus. Comparatively few flies had developing stages of O. volvulus. Since some of the arrival zones were uninhabited this suggested that the infections were obtained some distance away and at least seven days prior to capture.

(iii) Flies from Pont Léraba developed infective O. volvulus larvae after feeding on an infected capturer. Eggs were obtained from other engorged flies and the larvae eventually reared from them were identified as belonging to the savanna cytospecies S. damnosum s.s. and S. sirbanum. Later in the season the techniques of adult identification had progressed sufficiently for captured adults to be identified directly. These confirmed that the great majority were of the two savanna cytospecies named above with the occasional occurrence of a few S. soubrense.

(iv) The fluorescent X-ray spectroscopy studies indicated that, in general, there was a reasonable correlation between the "fingerprints" of larvae and adults from the same source area. Applied to flies caught in the reinvasion area it indicated that those caught at Pont Léraba along the Bandama river were similar, suggesting a common origin. They appeared to originate from areas to the southwest of Phase I in April and May with a shift to the west and northwest in June. This last area included the untreated rivers of Phase III W of the OCP area.

(v) Once it became evident that reinvasion was occurring, and in the belief that flies might be of forest origin, the Lower-Bandama River was experimentally treated with insecticide from Lake Kossou to Tiassale. Between 4 June and 7 July 1976 six treatment cycles were carried out, and had the effect of reducing the biting density at Tiassale from about 1000 per day to less than 10 per day. There was no equivalent effect on the biting densities along the Bandama or at Pont Léraba although slight reductions were observed on some of the Bandama/Bou stations such as Marabadiassa.

The lower Bandama treatments began before results of the cytotaxonomic studies were available, and confirmed that the reinvading flies were generally not of forest origin.

From these results it was concluded that:

(i) the biting S. damnosum were not of local origin and with few exceptions consisted of savanna cytospecies;

(ii) they were parous, therefore had taken a blood-meal prior to their arrival, and were importing and transmitting O. volvulus;

(iii) they must have originated from breeding sites of savanna species and therefore may have come from either the south-west, west or north of Phase I;

(iv) the exact origin of the flies was not known.

As 1977 was the first year in which Phase III W, part of the suspect source area for reinvasion, was routinely treated, studies on the reinvasion problem were extended to include this area. Sixteen daily catching stations were set up and manned with additional vector collectors. Studies on female flies caught in source and invaded areas included cytotaxonomic determination, dissection to determine age, infection rates and morphological characteristics. Specimens were also collected for XFS "fingerprinting". Collecting methods were extended to include Bellec "plaque" traps sited at Pont Léraba to catch arriving adults, and Johnson suction traps located at Korhogo, Banfora, Sikasso and Bougouni to monitor airborne insects. Fig. II compares the techniques used in 1975-1977.

Potential source areas on the Marahoué and Upper Sassandra river systems were prospected by helicopter. Once it became obvious that the routine treatments of Phase III W did not prevent the reinvasion of the Bandama and Léraba rivers, the Upper Marahoué (22 June to 10 August) and Upper Sassandra systems (5 July to 10 August) were experimentally treated with insecticide.

The results of the 1977 studies showed that:

(i) The reinvasion of the Bandama and Léraba rivers occurred as usual despite the routine treatments of the Phase III W rivers.

(ii) The 1976 observations on the cytotaxonomic status and physiological conditions of the invading flies were confirmed.

(iii) Fly collections on Bellec "plaques" at Pont Léraba showed peaks one or two days before those on vector collectors and most flies were gravid. There was an increase in humidity on the day the "plaques" caught their first S. damnosum.

(iv) At the beginning of the rainy season savanna cytospecies were breeding on the Marahoué and Upper Sassandra systems.

(v) Flies caught biting on the Léraba, Bandama and Bou rivers tended to have longer wings than those biting at the Bagoé, Baoule and Ouassoulou rivers, suggesting different origins.

(vi) Following the second cycle of experimental treatments on the Marahoué an immediate drop in fly densities was observed at Pont Léraba and along the Bandama (Fig. I). It could not be decided whether the extension to the Upper Sassandra river system materially reduced densities any further although local fly densities (e.g. at Massadougou) were dramatically reduced.

After consideration of the results of three years' studies, the Scientific and Technical Advisory Committee, at its sixth meeting in November 1977, endorsed the following conclusions:

(i) The Programme area is invaded by S. damnosum s.l. females from outside sources and this phenomenon can be expected to occur each year. The reinvading populations were composed of savanna cytospecies. The south-west to north-east direction of the reinvasion corresponds to the direction of the prevailing winds, confirming that migration is wind-assisted. Large numbers of females travel 200-250 km, smaller numbers may travel up to 300 or 400 km from source areas. The large majority arrive after a blood meal and oviposit within the OCP area before taking a further blood meal. A high proportion of parous biting flies is therefore indicative of ongoing reinvasion. The studies indicated that the invading flies can carry O. volvulus from the source area. The experimental treatment of the Marahoué significantly reduced the fly population in the invaded areas. It is not yet known whether forest cytospecies have the same pattern of migration.

(ii) Any area situated 250 km downwind from major breeding sites is open to reinvasion by, possibly, infective flies. Therefore, successful local vector control may not necessarily result in an entirely satisfactory epidemiological situation.

Strategy for 1978

With the beginning of the Ivory Coast extension activities a new subsector was opened at Seguela in early March 1978. This became the centre of the reinvasion studies for 1978. Fourteen every-day catching stations were set up in both source and arrival areas.

Following the results of the experimental insecticide application of 1977 it was decided to treat the River Marahoué as soon as it began flowing, and to observe the effect on the Bandama and Léraba catches. After a reasonable interval, the River Sassandra would be treated to see if further reductions might follow.

Observations to date show that flies began to arrive at Pont Léraba and along the River Bandama before the Marahoué started to flow. Treatments began on 25 April when flow began and have resulted in lower fly densities in the reinvasion zone than in previous years. It is at present too early to comment on the effect of the Sassandra treatments which commenced on 7 June 1978.

FIG. I. MEAN DAILY CATCHES OF S. DAMNOSUM AT STRATEGIC REINVADED SITES

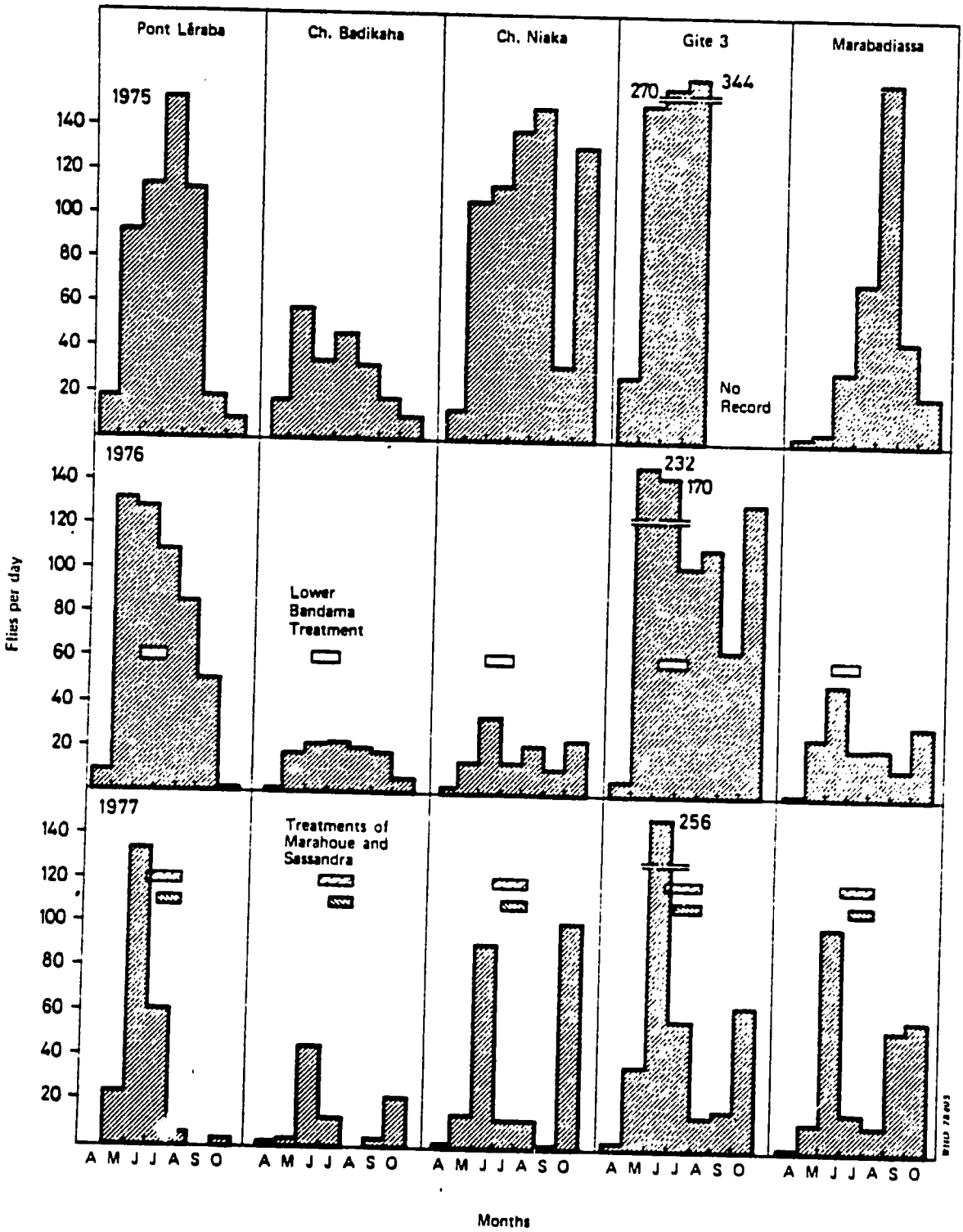


FIG. II. ACTIVITIES UNDERTAKEN IN THE REINVASION STUDIES

Year	Normal catches	Daily catches: Inside OCP area	Daily catches: Outside OCP area	Larval species determination	Female species determination	Check on possibility of local transmission	Site survey inside treated area	Survey outside treated area	Treatment - Phase III West	Treatment of potential sources outside area	Aircraft trapping and meteorological studies (Rainey)	Fluorescent X-ray spectroscopy (Bennett)	Suction traps (Johnson)	Plate traps (Bellec)	Synoptic weather studies	Local meteorological data Léraba
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1975	+	-	-	+	-	-	+	+	-	-	-	-	-	+	+	+
1976	+	+	-	+	+ i.p.	+	+	+	-	Bandama downstream	+	+	-	+	+	+
1977	+	+	+	+	+	+	+	+	+	Sassandra upstream	+	+	+	+	+	+

DATA RECORDED UP TO 1 OCTOBER 1978 BY THE OCP EPIDEMIOLOGICAL EVALUATION UNIT (EPI)

1. Villages and visits

	In the OCP area	Outside the OCP area	Total
Villages evaluated by EPI	307	28	335
Villages evaluated by other teams	26		26
Total	333	28	361

Data not collected by EPI

For 26 villages, data from surveys conducted according to the OCP methodology and in liaison with EPI were recorded. These are the only data available for these villages.

In 24 villages, similar data were recorded and verified during a later visit by EPI.

Visits (to 335 villages evaluated by EPI)

A number of villages have been visited once or more by EPI since 1975:

1 visit	311 villages
2 visits	21 villages
3 visits	2 villages
4 visits	1 village

Type of evaluation (in 335 villages evaluated by EPI)

Simple evaluation	272 villages
Detailed evaluation	63 villages

2. Overall evaluation activities, by year

Country	Size of sample (recorded population)	Subjects examined at least once by EPI		No. of subjects examined in:			
		Simple evaluation	Detailed evaluation	1975	1976	1977	1978 (to 1 Oct.)
Niger	3 578	1 246	794	-	560	1 469	-
Togo	10 764	7 431	1 797	-	3 966	5 197	-
Ivory Coast	14	7 637	3 168	4 174	3 480	2 375	-
Benin	8 931	5 929	1 436	-	-	2 681	4 662
Mali	16 440	11 480	1 256	-	5 444	7 991	-
Upper Volta	32 562	23 743	4 177	11 260	9 223	6 268	4 442
Ghana	18 972	13 084	3 336	3 422	8 175	-	4 885
		70 550	15 964	18 856	30 848	25 981	13 989
Total	105 433	86 514		89 674			

3. Total sample (recorded population)

	No. of villages	Population concerned
Programme area	333	96 625
Outside present OCP area	28	8 808
Total	361	105 433

4. Situation by country and endemicity level, 1 October 1978

Level of endemicity	PAG estimates		Actual figures		No. of people examined by EPI
	No. of clusters	No. of people	No. of villages	Recorded population	
NIGER					
Hypoendemic	2	600	5	1 268	581
Mesoendemic	2	600	3	563	179
Hyperendemic	2	600	6	1 228	875
Total	6	1 800	14	3 059	1 635
TOGO					
Hypoendemic	2	600	-	-	
Mesoendemic	2	600	5	2 912	2 540
Hyperendemic	2	600	12	5 049	4 257
Total	6	1 800	17	7 961	6 797
GHANA					
Hypoendemic	5	1 500	3	648	605
Mesoendemic	5	1 500	8	2 605	2 311
Hyperendemic	6	1 800	30	11 084	9 458
Total	16	4 800	41	14 337	12 374
UPPER VOLTA					
Hypoendemic	16	4 800	19	5 480	4 326
Mesoendemic	17	5 100	28	8 399	6 990
Hyperendemic	17	5 100	64	15 083	13 208
Immigration zones			6	3 600	3 396
Total	50	15 000	117	32 562	27 920

Level of endemicity	PAG estimates		Actual figures		No. of people examined by EPI
	No. of clusters	No. of people	No. of villages	Recorded population	
MALI					
Hypoendemic	4	1 200	14	4 261	3 249
Mesoendemic	5	1 500	14	4 486	3 817
Hyperendemic	5	1 500	35	7 693	5 670
Total	14	4 200	63	16 440	12 736
IVORY COAST					
Hypoendemic	4	1 200	1	189	172
Mesoendemic	4	1 200	5	1 725	1 501
Hyperendemic	4	1 200	51	12 272	9 132
Total	12	3 600	57	14 186	10 805
BENIN					
Hypoendemic	2	600	1	509	444
Mesoendemic	2	600	8	2 502	2 069
Hyperendemic	2	600	15	5 069	4 135
Total	6	1 800	24	8 080	6 648

Percentage share of each country in the sample

	Niger	Upper Volta	Mali	Ivory Coast	Ghana	Togo	Benin
According to PAG	5.5%	45.5%	12.5%	11%	14.5%	5.5%	5.5%
Actual EPI figures	3%	33.5%	17.5%	15%	14%	8.5%	8.5%

Respective percentages of the different endemicity levels in the OCP area
(excluding immigration zones)

Hypoendemic	12 355	13%
Mesoendemic	23 192	25%
Hyperendemic	57 478	62%
Total	93 025	100%

Activities in the planned extension area and outside the Programme area

State	No. of villages	Recorded population
Niger	3	519
Ghana	12	4 635
Togo	10	2 803
Benin	3	851
Total	28	8 808

RESEARCH AGREEMENTS

I. ENTOMOLOGY - VECTOR ECOLOGY

Institution	Research proposed	Progress and/or results	Period	Amount US $
ORSTOM, France Institut de Recherches sur l'Onchocercose (IRO), Ivory Coast	To study methods of sampling adult and aquatic stages of species of S. damnosum complex; to develop suitable adult trapping device and artificial substrate for larvae; to observe behaviour of adults and feeding habits of the larvae; to carry out research on the resting sites of the adults.	Two adult traps developed. The aluminium sheet trap which shows most promise is being extensively tried in OCP area in 1977; concurrently many useful observations made on behaviour of the adults. An artificial substrate of plastic strips tested satisfactorily and its limitations noted. The vertical distribution of the larvae in the water has been recorded. The range of particles ingested and their rate of passage through the larval gut was studied.	Sept. 1974-75 Oct. 1975-76 1977 1978	64 700 45 100 50 400 50 000
Institut de Médecine Tropicale Prinz Léopold, Belgium			Dec. 1975 1976-77	10 000 10 000
OCCGE, Upper Volta IRO, Ivory Coast	To study the distribution of the different species of the S. damnosum complex inside and outside the OCP area; to observe and record morphological and ecological differences between the species; to determine the vectorial capacity of each species.	By cytotaxonomic means the distribution of the different species of the S. damnosum complex have been plotted in Phase I and Phase III west of the OCP area and the area surrounding it. Morphological differences have been recorded in the West African species of the complex and a classification key prepared for field workers to identify the adult females. Studies continue on the epidemiological importance of each of the species.	Sept. 1974-75 Oct. 1975-76 1977 1978	54 200 45 000 43 000 38 000

RESEARCH AGREEMENTS (Continued)

I. ENTOMOLOGY - VECTOR ECOLOGY (Continued)

Institution	Research proposed	Progress and/or results	Period	Amount US $
Biosystematics Research Institute, Ottawa, Canada	To study in detail the morphological characteristics of all stages of the species of the S. damnosum complex associated with OCP and prepare classification keys.	By conventional means and the use of a scanning electron microscope and computer, a comprehensive range of morphological characters is being studied in the different species of the S. damnosum complex. The methods were refined in 1976 and with a freer flow of typed specimens from OCP and Bouaké substantial progress was made in 1977 with the development of a key to identify the adults. This is being refined in 1978.	Nov. 1975-77 1978	55 000 24 000
Bernhard-Nocht-Institut, Hamburg, Federal Republic of Germany	To determine whether the filarial larvae developing in Simulium vectors can be differentiated histochemically.	Using enzymatic and histochemical techniques clear differences have been shown in microfilariae of O. volvulus strains from Guatemala, the forest region of Liberia and the OCP savanna area. The same techniques are being used to see if the developing stages in the S. damnosum adults can be similarly differentiated. This study is being continued in 1978 by a consultant working in close association with the institution.	1977 1978	14 700 3 500

RESEARCH AGREEMENTS (Continued)

I. ENTOMOLOGY - VECTOR ECOLOGY (Continued)

Institution	Research proposed	Progress and/or results	Period	Amount US $
Liverpool School of Tropical Medicine, UK	To study enzyme polymorphisms in species of the S. damnosum complex and determine whether a method could be developed whereby the adults of the various species could be differentiated.	Fifteen enzymes have been examined in the adult S. damnosum s.l. Using phosphoglucomutase it has been possible to differentiate S. yahense from other species of the complex at sites studied. There is evidence to support consideration of S. squamosum and S. yahense as separate species. The method has so far permitted the identification of flies biting man at a site in Ghana as S. yahense.	Oct. 1975-76 1977	14 500 11 000
Bennett Analytical X-ray Ltd., Vancouver, Canada	To relate migrating adult S. damnosum s.l. to their breeding sources by X-ray energy dispersive spectroscopy (XES) analysis.	Using XES analysis it proved possible to "fingerprint" individual flies and relate them to the riverine site from which they emerged. Each river presented a different and specific pattern. In this way it was possible to trace flies caught reinvading the controlled area back to their source rivers, thereby incriminating the Marahoué and Bagoé rivers.	1976 1977	12 500 2 500

RESEARCH AGREEMENTS (Continued)

I. ENTOMOLOGY - VECTOR ECOLOGY (Continued)

Institution	Research proposed	Progress and/or results	Period	Amount US $
CDC, Atlanta, United States of America	To study the possibility of establishing a colony of S. damnosum s.l.	Following success with a rearing chamber in developing S. decorum and S. vittatum from eggs to adults and getting the adults of S. decorum to blood-feed and mate, similar experiments were planned with S. damnosum species. Due to the difficulty of transporting material in good condition from West Africa to the United States of America, only one egg batch was successfully reared to adults.	Aug. 1975-76	4 000
Tropenmedizinisches Institut der Universität, Tübingen, Federal Republic of Germany	To study the possibility of establishing a colony of S. damnosum s.l.	The principal investigator had experience with rearing Simulium species in East Africa. It being more satisfactory to send eggs from West Africa to Germany several trials of his rearing system were possible. It was found necessary to maintain the chemical composition of the water within strict limits. Larvae reaching second instar would normally develop to adults. A blood feeding mechanism was developed.	Aug. 1975-76	1 800

RESEARCH AGREEMENTS (Continued)

I. ENTOMOLOGY - VECTOR ECOLOGY (Continued)

Institution	Research proposed	Progress and/or results	Period	Amount US $
University of Ghana, Legon, Ghana	To determine whether electrophoretic methods would be sufficiently sensitive to separate species of the S. damnosum complex.	Following application of the method to the study of Anopheles mosquitos, some preliminary trials were undertaken with Simulium species but results were inconclusive.	Aug. 1975-76	1 800
Centre for Overseas Pest Research, London, UK	To carry out biogeographical studies to determine whether changes in distribution of S. damnosum can be associated with concurrent weather features and the direction of movement be inferred from the windfield.	Two biogeographers have been involved in the Programme area and in London analysing data on the distribution of S. damnosum adults and trying to relate their movements to the major wind currents and, in particular, to the Intertropical Zone. There is evidence of flies appearing at certain sites in relation to line squalls but the final conclusions are still awaited.	Feb. 1975-76	11 000

RESEARCH AGREEMENTS (Continued)

II. ENTOMOLOGY - VECTOR CONTROL

Institution	Research proposed	Progress and/or results	Period	Amount US $
OCCGE, Upper Volta IRO, Ivory Coast	To evaluate new insecticides and formulations in artificial channels and in rivers, for controlling S. damnosum s.l.	After many trials and modifications to the system, a floating cage method for testing insecticides has now been perfected to the extent that results obtained from it are comparable with tests carried out in the river. A series of candidate insecticides and formulations have been tested following which chlorphoxim was selected for large-scale trials. Much information has been collected on the most appropriate type of formulation. These trials continue as alternative products are made available.	Sept. 1974-75 Oct. 1975-76 1977 1978	36 500 29 500 33 000 28 300
ORSTOM, France Hydrobiological Unit, Bouaké, Ivory Coast	To survey the aquatic environment and collect information relative to the effect of chlorphoxim on nontarget organisms during large-scale trials.	With the assistance of a consultant, data has been collected on the N'zi river prior to the treatment of the river on a weekly basis from the beginning of the rainy season. The results will indicate whether chlorphoxim could be introduced as an alternative insecticide to Abate.	1977	16 500
University of Kiel, Kiel, Federal Republic of Germany		Some funds were provided to Kiel University to assist the consultant in the sorting of material and finalization of the report due in July 1978.	1978	1 350

II. ENTOMOLOGY - VECTOR CONTROL (Continued)

Institution	Research proposed	Progress and/or results	Period	Amount US $
University of Alberta, Edmonton, Canada	To study the detachment, reattachment and mortality of Simulium larvae after larvicide treatment and determine the parameters relating to detachment and reattachment in laboratory and riverine conditions.	Using artificial flumes with pumped streamwater, detachment rates, mortality of detached and non-detached Simulium larvae were determined with Abate and methoxychlor. Larvae detach within 15 minutes after treatment with methoxychlor but take up to four hours with Abate. Larvae reattaching after insecticide treatment pupate and produce apparently normal adults. Non-reattaching larvae die.	1975-76 1977	8 100 6 000
Center for Disease Control (CDC), Atlanta, United States of America	To carry out research on the chemical analysis, the physical properties and the specifications of Simulium larvicides.	Methods for analysing the active ingredient have been developed for Abate and methoxychlor and are under study for other insecticides. A method for extraction of water, mud and organisms and analysis of residues has been described for Abate, methoxychlor and chlorphoxim and is being developed for other larvicides. Interim specifications have been issued for 20% Abate EC. The physical-chemical properties of formulations have been studied including half-life, absorption on particles and biological uptake in living organisms.	1977	5 000

RESEARCH AGREEMENTS (Continued)

11. ENTOMOLOGY - VECTOR CONTROL (Continued)

Institution	Research proposed	Progress and/or results	Period	Amount US $
Institute for Medical Research, Zagreb, Yugoslavia	To investigate the simultaneous exposure of experimental animals to different organophosphorus compounds.	Trials were carried out with rats fed with the larvicide Abate and the drug metrifonate, used agains. schistosomiasis, to determine whether there was any potentiating effect when these two organophosphorus compounds were used together. The answer was negative.	Aug. 1975-76	5 000
ORSTOM, France IRO, Ivory Coast	To develop a suitable method for testing the susceptibility of S. damnosum larvae to different insecticides and collect baseline data throughout the Programme area.	A satisfactory method for testing susceptibility levels in field conditions by exposing larvae to different concentrations of insecticide for three hours was developed. Using this method a range of data has been collected from rivers in the OCP area.	Sept. 1974-75	25 000
University of Reading, UK	To study the acute toxicity of insecticides against Simulium and agricultural pests, which might be employed in the Programme area, on non-target invertebrate organisms.	A continuous flow and simulated stream technique was developed to establish basic tolerance levels of representative stream invertebrates to Simulium larvicides. The results obtained by this method, though consistent, did not correspond to what is observed in field applications.	July 1974-75	4 000

RESEARCH AGREEMENTS (Continued)

III. GENERAL EPIDEMIOLOGY, MEDICAL AND PARASITOLOGICAL RESEARCH

Institution	Research proposed	Progress and/or results	Period	Amount US $
Medical Research Council, London, UK	To carry out longitudinal parasitological and ophthalmological studies in hyper-, meso- and hypo-endemic villages of northern Cameroon savanna; to continue studies to correlate the clinical and ocular findings in onchocerciasis with immunopathological findings; to conduct studies on DEC and Suramin and certain new drugs; to study the prognostic value of head nodules and outer canthus skin biopsies as risk factors for blindness.	Data have been collected from a number of villages of different endemicity on the prevalence of microfilariae in the cornea and in the anterior chamber of the eye, as well as the prevalence of eye lesions by age and village. Correlated with entomological data, preliminary results indicate little transmission can be associated with quite a high prevalence of positive skin snips in that area. Depigmentation, common in the forest area, is rare in the savanna and this may be associated with biting density of the flies in each area. Head nodules were removed from 55 patients who are still being followed up. Optic nerve disease has been found to be very common in onchocerciasis. Patients have been treated with DEC followed by Suramin to determine whether Suramin is better tolerated after microfilariae have been killed. It has been found that heavily infected patients cannot be treated with DEC without corticosteroid cover. Lampit may have a macrofilaricidal effect. These studies were concluded at the end of 1977.	Nov. 1975-76 1977	43 000 44 000

RESEARCH AGREEMENTS (Continued)

III. GENERAL EPIDEMIOLOGY, MEDICAL AND PARASITOLOGICAL RESEARCH (Continued)

Institution	Research proposed	Progress and/or results	Period	Amount US $
Tropenmedizinisches Institut der Universität, Tübingen, Federal Republic of Germany	To carry out longitudinal parasitological and entomological studies in hyper-, meso- and hypo-endemic villages of northern Cameroon savanna to complement the studies of the MRC team (above). The completion of both sets of data will be used for the contruction and testing of a mathematical model.	During the first year the villages were selected, catching points established, the distribution of breeding sites plotted, and flies collected on a routine basis and dissected. At the end of one year it was possible to calculate the annual transmission potential at villages with different levels of endemicity, related to the conditions, hydrological and climatic, pertaining throughout that year. These studies are continuing through 1978 to provide three years' consecutive data.	Mar. 1976-77 1978	88 600 33 600
Bernhard-Nocht-Institut, Hamburg, Federal Republic of Germany	To study the effect of nodulectomy in onchocerciasis patients living in areas where transmission has been interrupted.	In 1977 the nodules were removed from a number of patients in villages in Upper Volta. This study is being followed up in 1978 in cooperation with the Epidemiological Evaluation Unit.	1977-78	5 000
Istituto di Anatomia e Istologia Patologica, Rome, Italy	To carry out histological examinations of skin biopsies taken from selected patients in the OCP area to assist in the identification and classification of skin lesions due to onchocerciasis.	More than 500 histological examinations were carried out in 1976 on material submitted by OCP. A further 500 examinations are being done with colour pictures being made of the most significant specimens. Final results will be considered for publication in a monographic document.	1976 1977	400 5 000

RESEARCH AGREEMENTS (Continued)

III. GENERAL EPIDEMIOLOGY, MEDICAL AND PARASITOLOGICAL RESEARCH (Continued)

Institution	Research proposed	Progress and/or results	Period	Amount US $
Muséum national d'histoire naturelle, Paris, France	To attempt to prepare an inventory of Onchocerca species found in domestic and wild animals in the OCP area, to determine which are transmitted by S. damnosum and to identify morphological characteristics of the infective stages.	The Gomba cow in Togo is parasitized by O. gutterosa, O. armillata, O. dukei and O. ochenzi. The vectors are unknown but the distribution of the microfilariae in the skin is being studied which may give indication of potential vectors. S. damnosum bites cattle in the area but it has not been incriminated as yet as a vector of any of the above Onchocerca species. This work is continuing in 1978 with the assistance of a consultant recruited directly by the Programme.	July 1976-77	37 700
The Johns Hopkins University, Baltimore, United States of America	To study the in vitro culture of Onchocerca volvulus microfilariae.	O. volvulus larvae in blackflies collected in Guatemala were cryopreserved and still viable 259 days after freezing. These larvae exhibited normal characteristics during subsequent cultivation in vitro. Microfilariae of O. volvulus remain viable at least 17 months in vitro after cryopreservation.	Feb. 1976-77	10 000

RESEARCH AGREEMENTS (Continued)

III. GENERAL EPIDEMIOLOGY, MEDICAL AND PARASITOLOGICAL RESEARCH (Continued)

Institution	Research proposed	Progress and/or results	Period	Amount US $
Royal Commonwealth Society for the Blind, UK	To collect data on the density of the parasite and the clinical symptoms of onchocerciasis in certain villages in northern Ghana; to establish the prevalence and clinical severity of the disease by examination of the population of first-line villages; to carry out trials with DEC.	Detailed ophthalmological and parasitological examinations were carried out at Zongoiri in 1974 and 1975, and at Awrigu in 1975. In trials with DEC it was found that its effect is most pronounced the first two to three weeks after treatment. There was a marked improvement in subjective eye symptoms after seven weeks; the low dose of 12.5 mg/kg in subjects up to 40 kg can be given without clinical supervision and is effective.	Oct. 1974-75 1975-76	31 000 10 000
Institut für Parasitologie, Giessen, Federal Republic of Germany	To finalize a reference list on Suramin.	A bibliography on Suramin 1970-1975 was published.	Feb. 1976	850
CDC, Atlanta, United States of America	To determine the extent to which the equine parasite O. cervicalis will develop in the jird, Meriones unguiculatus using Culicoides variipennis as a source of infective larvae.	Many of the technical problems associated with producing third stage larvae in C. variipennis were worked out. Only 11 male jirds were exposed, nine of these to low levels. The final report on this study should be available towards the end of 1977.	March 1976	3 950

RESEARCH AGREEMENTS (Continued)

IV. CHEMOTHERAPY

Institution	Research proposed	Progress and/or results	Period	Amount US $
Ministry of Health, Accra, Ghana (Chemotherapeutic Research Centre, Tamale)	To establish a chemotherapeutic research centre at Tamale and undertake studies on the chemotherapy of onchocerciasis. DEC and Suramin will be used to increase the understanding of their mode of action and trials will be carried out with other old and new drugs alone or in combination.	The Centre was established and equipped and some preliminary trials undertaken with metrifonate in three dosage schedules. It has been shown to be an effective microfilaricidal drug. Trials continue in 1978 with other drugs separately and in combination, and attempts made to alleviate the mazzotti reaction.	1977 1978	50 000 (56 500)
Liverpool School of Tropical Medicine, UK	To provide technical and professional assistance to the Ghana Government for special investigations to be conducted at the Chemotherapeutic Research Centre (above)	As above.	1977 1978	12 000 (79 000)
Unité d'enseignement et de recherche de médecine et de santé tropicale, Hopital Michel-Lévy, Marseilles, France	To develop a protocol for treatment of onchocerciasis using Suramin either by modifying the weekly dose or prolonging the interval between injections so as to reduce the secondary effects of the drug; five regimens of treatment to be tried on medium to heavily infected patients.	This work is being undertaken in Mali and in 1977 some trials were undertaken to determine the protocols of treatment to be adopted. A number of patients were treated according to three different protocols and these will be followed up in 1978.	July 1976 1977	10 000 10 000

RESEARCH AGREEMENTS (Continued)

IV. CHEMOTHERAPY (Continued)

Institution	Research proposed	Progress and/or results	Period	Amount US $
OCCGE, Upper Volta Centre Muraz, Bobo-Dioulasso	To carry out chemotherapeutic trials on onchocerciasis in infected patients with DEC, levamisole and Nifurtimox according to established protocols.	Three protocols are being followed: (a) trials with DEC and with levamisole; (b) trials with DEC and levamisole together; and (c) trials with Nifurtimox. Progress is being made with (a) and (b) although final results will not be available until the end of the evaluation period. With DEC, six months after treatment the microfilarial density remained low. With levamisole the microfilarial density reduced perceptibly one month after treatment. A combination of DEC and levamisole at half the prescribed dose also shows a reduction in microfilarial count immediately after a 21 days' treatment.	Feb. 1976	13 500

RESEARCH AGREEMENTS (Continued)

V. ENVIRONMENTAL PROTECTION

Institution	Research proposed	Progress and/or results	Period	Amount US $
ORSTOM, France Hydrobiological Unit, Bouaké, Ivory Coast	To carry out the aquatic monitoring programme on rivers in Ivory Coast, Upper Volta and Mali and undertake research on the quality and quantity of fish and invertebrate fauna in the rivers treated and untreated.	The effect of weekly applications of Abate on fish and nontarget invertebrate fauna was studied on a monthly basis following an approved protocol. Data so far collected reveal that although Abate has an impact on the aquatic environment, the quality and the quantity of fauna remains at a very high level and fish are apparently unaffected. Considerable advances have been made in the classification of the insect fauna. In 1978 the frequency of monitoring was reduced to four times a year and additional sites in the proposed extension area selected for routine surveillance.	Jan. 1975-76 Mar. 1976-77 1977 1978	103 300 61 500 54 500 85 700
Institute of Aquatic Biology, Achimota, Ghana	To carry out the aquatic monitoring programme on four rivers in Ghana.	Data collected monthly from the Black Volta, White Volta and Daka have shown the effect of the weekly treatment of Abate to be at an acceptable level. Baseline data was collected on the Oti river for 18 months prior to the commencement of treatment. In 1978 the frequency of monitoring was reduced to four times per year and additional points in the proposed extension area incorporated in the surveillance programme.	Mar. 1975-76 1977 1978	35 000 46 000 54 000
University of Waterloo, Ontario, Canada	To sample the aquatic fauna in rivers in the OCP area not covered in the routine monitoring programme.	This study was carried out by a consultant and additional funds were provided to the institute to assist with the sorting out of the samples. A report with all data collected was submitted in 1978	1978	1 200

RESEARCH AGREEMENTS (Continued)

V. ENVIRONMENTAL PROTECTION (Continued)

Institution	Research proposed	Progress and/or results	Period	Amount US $
Mrs B. Walsh, Ouagadougou, Upper Volta	To study the effects of the regular treatment by Abate of the Red Volta, a seasonally flowing river in Upper Volta and Ghana, following the established protocol.	This study was completed at the end of 1977 and a report submitted comparing the situation on the river pre- and post-control. The initial impact of the treatment was marked but a measurable recovery in the fauna is apparent as control continues.	1977	5 000
Dr B. Roman, Ouagadougou, Upper Volta	To study the fish population in rivers before and after treatment and to make a catalogue of the species and composition present.	The results to date show that most of the rivers have a very healthy and varied population of fish. None of the species appears to have been affected by the Abate and the presence of alvelings indicates that breeding is proceeding normally.	July 1975-76 1977	15 000 6 000
University of Salford, UK	To study and make a qualitative assessment of the invertebrate aquatic fauna in a number of seasonal rivers prior to treatment.	This study showed the proportional variation of taxa present amongst different rivers in West Africa with particular reference to the fauna found in S. damnosum breeding sites.	Jan. 1975	1 000

ANNEX IV

ESTIMATE OF INPUTS FOR AN EXTENSION INTO BENIN, GHANA AND TOGO

An extension of full operations into Benin, Ghana and Togo covering those areas described in document JCC4.4[1] will depend upon the outcome of studies currently in progress and the decision of the Joint Coordinating Committee. Initial calculations indicate that such an extension would result in an additional 97 935 km of river to protect annually, representing 17% of the total Programme area as of December 1979.

Preliminary estimates for extending operations in Benin, Ghana and Togo are currently as follows:

(1) A total of 5760 helicopter hours and 3000 fixed-wing hours would be required.

(2) During the period 1980-1981, two extra helicopters representing an estimated additional 1440 guaranteed flying hours per year. It is estimated that 500 fixed-wing hours would be required using aircraft currently engaged by the Programme.

(3) A reduction in treatment may be possible after two years, which would mean that one of the additional helicopters could be dispensed with in the period 1982-1985. During this period 960 helicopter and 500 fixed-wing hours per year would be required.

The proposed extension would result in considerably more flying in the south-eastern corner of the Programme area. The use of the Tamale base would involve a two-hour return ferry-flight, i.e. two helicopters would use four hours ferry-flying each week to reach the treatment area. This would represent 208 (52 x 4) hours per year, or 416 hours for the initial two years. At the present cost of flight hours ($ 394) this represents a total of US$ 163 904 in ferry-flying alone. Therefore, the transfer of the Tamale base to another, more centrally located, site may have to be envisaged.

The annual insecticide requirement for the extension areas of Benin, Ghana and Togo would be 110 000 litres. However, it is estimated that these operations will decrease insecticide needs in Phase I, II and III by 30 000 litres. Thus the total annual insecticide requirement would be 80 000 litres or 480 000 for the six-year period.

The entomological surveillance would be conducted by 21 teams operating from certain of the original subsectors as well as from three new subsectors. A total of 88 general service staff and two professional staff would be required as follows:

LOCATION	GENERAL SERVICE	PROFESSIONAL
Vector Control Unit		
VCU/HQ/Ouaga	4	2[2]
Tamale sector	7	
Bole S. sector	3	
Lama-kara sector	5	
Porga S. sector	3	
Parakou sector (formerly Natitingou)	6	
Parakou S. sector	18	
Atakpame S. sector	20	
Hohoe S. sector	20	
Administrative services	2	-
TOTAL	88	2

[1] Study of the geographical extension of the Programme area requested by the Governments of Benin, Ghana, Ivory Coast, Mali and Togo.

[2] Aerial operations, entomological surveillance.

Projected helicopter hours, fixed-wing hours, insecticide, and vector collection teams for the period 1980-1985 are in the order of 15%, 32%, 32%, and 27% of those required for the regular Programme. These estimates are largely based on the experience acquired during start-up years in the other areas of the Programme and will be used until the results of the extension studies demonstrate that changed inputs would be appropriate.

Simple and detailed medical evaluation would be conducted by the Epidemiological Evaluation Unit but at this time additional costs are not anticipated.

Budget

An extension of Programme activities into Benin, Ghana and Togo for the period 1980-1985 would cost about $ 16 239 800.

This projection is based almost entirely upon requirements for the vector control programme; i.e. 5760 helicopter hours, 3000 fixed-wing hours, 480 000 litres of insecticide, two additional professional posts, 88 general service posts and the replacement of 18 vehicles in 1981 and in 1984.[1]

The following series of tables is presented:

Description

Table I. 1980-1985 by Programme activity
II. 1980-1985 by category of expenditure
III. Vector Control Unit 1980-1985 by category of expenditure
IV. Office of the Programme Director and administrative support 1980-1985 by category of expenditure.

[1] These inputs have been costed as for the regular budget 1980-1985.

TABLE I. EXTENSION - OCP 1980-1985 BY PROGRAMME ACTIVITY

	1980	1981	1982	1983	1984	1985	Total 1980-1985
Vector control	2 692 100	2 882 300	2 319 100	2 500 700	2 912 600	2 827 300	16 134 100
Epidemiological evaluation	-	-	-	-	-	-	-
Economic development	-	-	-	-	-	-	-
Applied research environmental protection and training	-	-	-	-	-	-	-
Programme Director and administrative support/Ouaga	13 200	14 700	16 400	18 300	20 400	22 700	105 700
Meetings	-	-	-	-	-	-	-
Administrative support/Geneva	-	-	-	-	-	-	-
Technical support-FAO/Rome	-	-	-	-	-	-	-
Regional liaison-Brazzaville	-	-	-	-	-	-	-
Independent Chairman and JCC	-	-	-	-	-	-	-
TOTAL	2 705 300	2 897 000	2 335 500	2 519 000	2 933 000	2 850 000	16 239 800

TABLE II. EXTENSION - OCP 1980-1985 BY CATEGORY OF EXPENDITURE

	1980	1981	1982	1983	1984	1985	Total
Annual costs							
Personal services	448 200	499 700	557 200	621 300	692 700	772 300	3 591 400
Aerial operations	1 425 900	1 425 900	951 500	1 003 100	1 003 100	1 003 100	6 812 600
Insecticide	492 000	531 200	573 600	619 200	668 800	721 600	3 606 400
Research and training	-	-	-	-	-	-	-
Rent, supplies, operations and maintenance	156 300	165 100	176 800	192 300	218 100	246 600	1 155 200
Operational travel	58 000	61 300	65 600	71 500	81 100	91 200	428 700
Consultants	-	-	-	-	-	-	-
Meetings	-	-	-	-	-	-	-
Independent Chairman and JCC	-	-	-	-	-	-	-
TOTAL ANNUAL COSTS	2 580 400	2 683 200	2 324 700	2 507 400	2 663 800	2 834 800	15 594 300
Capital items							
Buildings	120 000	5 200	5 400	5 800	6 800	7 600	150 800
Furniture	-	-	-	-	-	-	-
Vehicles	-	203 400	-	-	255 600	-	459 000
Equipment	4 900	5 200	5 400	5 800	6 800	7 600	35 700
TOTAL CAPITAL ITEMS	124 900	213 800	10 800	11 600	269 200	15 200	645 500
GRAND TOTAL	2 705 300	2 897 000	2 335 500	2 519 000	2 933 000	2 850 000	16 239 800

TABLE III. EXTENSION - VECTOR CONTROL UNIT 1980-1985 BY CATEGORY OF EXPENDITURE

	1980	1981	1982	1983	1984	1985	Total
Annual costs							
Personal services	435 000	485 000	540 800	603 000	672 300	749 600	3 485 700
Aerial operations	1 425 900	1 425 900	951 500	1 003 100	1 003 100	1 003 100	6 812 600
Insecticide	492 000	531 200	573 600	619 200	668 800	721 600	3 606 400
Research and training	-	-	-	-	-	-	-
Rent, supplies, operations and maintenance	156 300	165 100	176 800	192 300	218 100	246 600	1 155 200
Operational travel	58 000	61 300	65 600	71 500	81 100	91 200	428 700
Consultants	-	-	-	-	-	-	-
Meetings	-	-	-	-	-	-	-
Independent Chairman and JCC	-	-	-	-	-	-	-
TOTAL ANNUAL COSTS	2 567 200	2 668 500	2 308 300	2 489 100	2 643 400	2 812 100	15 488 600
Capital items							
Buildings	120 000	5 200	5 400	5 800	6 800	7 600	150 800
Furniture	-	-	-	-	-	-	-
Vehicles	-	203 400	-	-	255 600	-	459 000
Equipment	4 900	5 200	5 400	5 800	6 800	7 600	35 700
TOTAL CAPITAL ITEMS	124 900	213 800	10 800	11 600	269 200	15 200	645 500
GRAND TOTAL	2 692 100	2 882 300	2 319 100	2 500 700	2 912 600	2 827 300	16 134 100

TABLE IV. EXTENSION - OFFICE OF THE PROGRAMME DIRECTOR AND ADMINISTRATIVE SUPPORT 1980-1985 BY CATEGORY OF EXPENDITURE

	1980	1981	1982	1983	1984	1985	Total
Annual costs							
Personal services	13 200	14 700	16 400	18 300	20 400	22 700	105 700
Operational travel	-	-	-	-	-	-	-
Consultants	-	-	-	-	-	-	-
Accommodation and utilities	-	-	-	-	-	-	-
Supplies	-	-	-	-	-	-	-
Operations and maintenance	-	-	-	-	-	-	-
TOTAL ANNUAL COSTS	13 200	14 700	16 400	18 300	20 400	22 700	105 700
Capital items							
Buildings	-	-	-	-	-	-	-
Furniture	-	-	-	-	-	-	-
Vehicles	-	-	-	-	-	-	-
Equipment	-	-	-	-	-	-	-
TOTAL CAPITAL ITEMS	-	-	-	-	-	-	-
TOTAL	13 200	14 700	16 400	18 300	20 400	22 700	105 700

JOINT COORDINATING COMMITTEE
Onchocerciasis Control Programme
in the Volta River Basin Area

Office of the Independent Chairman
c/o World Health Organization
1211 Geneva 27, Switzerland
Tel. 34 60 61 Telex 22836 27821

J.C.C.-C.C.C.

COMITÉ CONJOINT DE COORDINATION
Programme de Lutte Contre l'Onchocercose
dans la Région du Bassin de la Volta

Bureau du Président Indépendant
c/o Organisation Mondiale de la Santé
1211 Genève 27, Suisse
Tél 34 60 61 Télex 22836X 27821

JOINT COORDINATING COMMITTEE
Fifth session
Lomé, 5-8 December 1978

JCC5.7
Part II: Economic aspects

3 November 1978

Provisional agenda item 11

The Independent Chairman submits for the consideration of the Joint Coordinating Committee, at its fifth session, part II of the Evaluation Report: Economic aspects. This document has been reviewed by the Steering Committee which has made the following comments:

"It is noted that an earlier draft of the second part of the OCP Evaluation Report has been reviewed by EDAP and by Representatives of Participating Countries. While recognizing that this is a responsible document on the impact of OCP activities on economic development, the Steering Committee fully endorses the opinions expressed by the EDAP which in the main are still relevant to the final version of the Part II. The Steering Committee noted that EDAP had not commented on the section of the OCP Evaluation Report concerning the future of the Panel. The Steering Committee found the suggestion made by the mission to be an interesting alternative approach which is worthy of due consideration."

ONCHOCERCIASIS CONTROL PROGRAM

Economic Review Mission

October 25, 1978

TABLE OF CONTENTS

CONCLUSIONS AND SUMMARY OF MAIN FINDINGS

1. This report presents the findings of the mission which was organized to make a general assessment of the economic development aspects of the Onchocerciasis Control Program (OCP).

2. The general conclusions and main themes of the report can be briefly stated at the outset:

(a) by reducing the misery caused by onchocerciasis, the OCP improves the well-being of hundreds of thousands of people in improverished and neglected regions of West Africa.

(b) In addition to this important humanitarian effect, the OCP will affect economic development by increasing the quantity and quality of the area's productive factors - labor and land.

(c) Few economic generalizations are fully applicable to all seven of the OCP countries. Demographic pressures and factors explaining population distribution are not the same in all the countries. The generalization which pictures the OCP area as typified by abandoned river valleys alongside crowded plateaux is only partially accurate. The economic impact and implications of the program vary between countries.

(d) Given the diversity of conditions, development planning for the area can take no single form. Each development scheme needs to be evaluated in terms of its social and economic merits in the context of national development plans, objectives, policies and constraints.

(e) While it will make more accessible much land that is presently underutilized, the OCP does not provide a panacea for development. There exist many constraints to the development of the new lands, in addition to the presence of onchocerciasis, and many other general constraints on development which are being addressed by economic planners in the OCP countries.

(f) The OCP has made a significant contribution to the economic development of the area in several indirect ways. It has given the Upper Volta, the country most affected by onchocerciasis, a breathing spell, more time to address its fundamental development problems; and OCP-related experiences and studies have clarified the nature of the obstacles to development in the area, thereby underscoring the need for increased attention from the world community if development constraints in these areas are to be reduced.

(g) Given the extreme poverty of the OCP area and the difficulties that lie in the way of its development, increased external assistance is urgently needed to help accelerate the pace of economic change and improve standards of living in this disadvantaged region. Such assistance should not be limited to settlement projects but should take account of the wide diversity of development needs in the area. In addition to dryland farming the OCP region has great potential in irrigated agriculture and in livestock production, among others; this potential should be given close attention by donors.

(h) Major efforts must be directed toward transformation of traditional farm practices. Seed-based technical improvements will help but the objective must be the development of a permanent system of dry land farming which will require something more. The adaptation to West-African conditions of low-input, soil-enriching techniques based on better water management has great promise and pilot schemes using these techniques should receive strong support from local governments and donors.

(i) The transformation of farming systems on existing lands, where most people live, is the area's central problem. New lands development will greatly help and controlled settlement schemes certainly deserve continued assistance but they are necessarily only a part of the solution to the population redistribution problem.

(j) The AVV might benefit from continued concentration on the white and red Voltas, thereby extending its competence in organizing cultivation of heavy soils. It could also intensify its experimental activities in dryland farming and explore the possibilities of opening irrigated perimeters.

(k) Settlement policy should be flexible, it should encourage alternative approaches with varying degrees of "control". In Upper Volta, collaboration between AVV and ORDs would be desirable as would be other kinds of efforts to assist spontaneous migrants.

(l) Greater attention needs to be given, in settlement schemes and in general, to the needs and rights of women, in order to release labor constraints on output and make rural development more equitable.

(m) The OCP "planning methodology" needs to be adapted in the light of experience, and greater recognition given to the diversity of planning needs.

(n) The OCP must during the next phase find more cost-effective ways of disease control. The possibility of an intermediate technology for vector control should be explored as should the feasibility of utilizing the existing OCP transport and communication infrastructure for a primary health delivery program of some kind.

3. The Onchocerciasis Control Program (OCP) area has much in common, in terms of ecological environment, soils, the nature of cropping systems, income levels. From an economic point of view, however, the area is diverse in several key respects. The degree to which people are afflicted with onchocerciasis, the physical coverage of the vector control program, its economic impact and its implications for development policies and programs, differ substantially from country to country. The belief that the OCP area is generally characterized by overcrowded plateaux bordering on river valleys which are infested with onchocerciasis, is not universally applicable; it is in fact relevant mainly to the Upper Volta. Hence general concepts applied to all the states in the region, and uniform approaches related to development planning or policy, are likely to be unsuitable. Recognition that the OCP area is an entomological, not an economic unit helps in understanding the economic development aspects of the control program.

4. In addition to its substantial humanitarian benefits, the OCP will bring significant economic benefits to the seven participating countries. These economic benefits are of two kinds: those related to increase in labor productivity and those deriving from the opening up of new lands which the control program makes possible.

5. Three main labor-related benefits flow from vector control: reduction in debility, which is the generally lower level of physical performance caused by the parasite; reduction in disability (impaired vision) and reduction in blindness. In principle, the benefits could be measured by the estimated output losses involved; in practice the necessary data are lacking. There are reasons to believe that these benefits unweighted by income distribution factors, and using "conventional" approaches to benefit measurement, are relatively modest. This is inevitably so, because of the low incomes of the target population. But it is precisely because of the especially disinherited character of the affected populations that the benefits should be heavily weighted. In addition, use of lower discount rates and longer time horizons, which can be justified in projects like OCP makes the likely benefitcost relationship attractive, even for labor related benefits alone.

6. The major economic benefits, moreover, will come from the OCP contribution to the opening of new lands. Net benefits from new lands availability would not have to be improbably high to make the benefits exceed the costs of the control program. The devastating effect of erosion in reducing areas cultivable on the Mossi plateau suggests that substantial benefits will arise from new lands - induced reductions in erosion on old lands. Moreover, lower-than-conventional discount rates and longer time horizons substantially increase the purely economic returns on the "new lands" effects of the control program.

7. From detailed analysis of soil, land use, and population distribution maps the mission estimates that some 276,000 km^2 of relatively empty land exists in the present program area of which 134,000 to 154,000 is "suitable for agriculture". About two-thirds of this land is similar in quality and potential to soils in the plateau region, i.e. ferruginous soils. Some 7% consists of alluvials and colluvials in flood plains and bas-fonds.

8. The mission found some uncertainty regarding the definition of "onchocerciasis zone projects" and the nature of their claim on development resources. New project possibilities will arise in the OCP zones because the vector is under control. But there should be no presumption that these zones, per se, have a priority claim on available development resources. For purposes of development planning, the costs of onchocerciasis control should be regarded as sunk costs, and "onchocerciasis zone projects" should be evaluated on a case by case basis, on their merits.

9. In addition to estimating how much "empty land" there is in the OCP area, and its suitability for agriculture, the mission sought to determine what obstacles other than onchocerciasis inhibited more productive use of these areas. In addition to inaccessibility of drinking water, several constraints are present in the river valleys of the area. The valleys and bas-fonds are subject to frequent flooding and excessive moisture. Some soils are excessively permeable, ruling out economically viable use in irrigated production. Other soils are heavy, and hence difficult to work by traditional methods and expensive if other methods are used. Diseases other than onchocerciasis exist, and uncertainty about tenure rights hinders utilization in some places.

10. The OCP, then, will help make available large areas of presently underutilized land of considerable potential economic importance, especially in the Upper Volta. The major economic impact of the potential availability of these "new lands" is, in fact, in the Upper Volta, where the several million hectares of land under effective onchocerciasis control can help relieve population pressures on the Mossi plateau and in other parts of the country. In most of the other OCP countries, there is underutilized land outside of zones where onchocerciasis is endemic, so the economic impact while significant, is likely to be less dramatic and less immediate than in Upper Volta.

11. There is evidence that in some settlement schemes, women may be disadvantaged in the migration/settlement process; they are given arduous new tasks while being deprived of valuable traditional rights. Outside interventions should aim at reducing demands on women's time. Broader economic participation by women means increased labor and better nutrition for the household. It is therefore critical to the improvement of rural living standards as well as essential for equitable rural development.

12. Settlement and/or migration into new lands provides only a partial solution to the problems of population pressure, shortened fallows, declining yields and disastrous erosion which exist in the Upper Volta and a few places elsewhere in the OCP area. The several million hectares of the Upper Volta's new lands can absorb only a few years' population growth, unless underlying conditions change. However, to the extent that the control program has helped open new areas for occupation, it gives temporary relief from these urgent pressures. It gives the Upper Volta in particular a vitally needed breathing spell, time to address the fundamental problem: improvement and eventual transformation of farming practices, in the direction of permanent, intensive cultivation.

13. Broader introduction of existing seed-based packages (better spacing, more timely planting and weeding, better seed selection, etc.) can do much to raise grain yields above their present low levels. But the longer-run objective should be the introduction of low-input, soil enriching technologies, based on better use of rainfall. These approaches have shown extremely promising results in India, Botswana and elsewhere in LDC's, but have not yet been tested in West African conditions. Pilot efforts and experimental projects deserve high priority.

14. Since it is neither desirable nor possible to continue to absorb population increases by enlarging the flow of migrant labor to the Ivory Coast, the Upper Volta must utilize its new lands and urgently address the bottlenecks to expanded agricultural output on its existing lands. One thrust of its development strategy generally should be to increase food crop output per hectare and per capita, thereby making land and labor available for export crop production and other activities. For the Upper Volta, as for the other parts of the OCP region, there are abundant opportunities for export crop expansion provided that extension efforts are expanded and improved and suitable price, marketing and transport policies are adopted. Extension opportunities also exist for greater utilization of the livestock potential of the OCP area. And potentially irrigated land is very extensive; irrigated agriculture in the OCP zones has a vital role to play in anti-drought strategies for the Sahel. The settlement struggle to improve and transform farming systems, however, must take place on the plateaux where most of the people live. The OCP, by allowing the softening of demographic pressures for a generation or more, significantly improves the prospects for success in that struggle.

15. While the mission report stresses that there is no universally applicable development strategy for the OCP area as a whole, and that each development scheme needs to be evaluated on its merits in its national context it also leads to one generally applicable conclusion: more development resources are desperately needed in this disadvantaged region if development constraints are to be reduced and economic progress accelerated. The fact that settlement of new lands which OCP help open up will provide only a partial and temporary solution increases the urgency and importance of expanding international assistance. Massive aid is needed not only to help in agricultural growth and transformation but more broadly in transportation, livestock, irrigation, mineral exploration and agro-industrial development.

16. Associated with the OCP is a "standard methodology" for planning the development of the OCP area. The "methodology" has moved forward at an uneven pace, but generally slowly. In part this is due to different interpretations as to what the methodology intended; for example, with respect to the rigidity with which its recommended sequence (creation of a "data bank", drafting a long-term development plan, preparation of projects) was to be followed, and the relationship between "onchocerciasis zone planning" and national planning. In part, also, hesitation in implementation has been due to the uneven "fit" of the methodology to the varied needs of the countries concerned; in some, information-gathering for potential settlement programs is

a high priority, in others it is not; in some, regional planning machinery is relatively well-developed, in others, it is embryonic; in some the OCP area is of central economic importance, in others it is less so. No single planning approach can be equally suitable for countries in such heterogenous circumstances, except at a very general level.

17. The following adaptations are recommended:

(a) The OCP countries following the standard methodology should be given continued encouragement, and their efforts regarded as pilot experiences. Those OCP countries which have chosen to adopt the planning methodology partially or not at all should be equally encouraged in this interpretation of their priorities.

(b) The suitability of the Development Planning Group idea should be tested in those OCP countries where "permanent" or "senior" advisors have been appointed (Benin, Mali, Ghana). Extension to other countries should await an evaluation of experience in these countries.

(c) Development Planning Groups should be fully integrated into existing planning bodies, where they are not already integrated.

(d) The priority and utility of drafting "long term development plans" for the "oncho zones" should be carefully reassessed. The applicability of this notion to the Upper Volta (where "onchocerciasis zone" is virtually the whole country), is uncertain, as it will be for the four coastal states if the control program is extended southward.

(e) The appropriate use of the OCP-related planning machinery depends on national needs and will vary from country to country. In Upper Volta, for example, settlement policy and migration are high priority matters and OCP planning inputs, therefore, could usefully be devoted to project and policy-related research in the settlement/migration area.

(f) The results of the methodology and of existing approaches to planning for the development of the OCP area should be evaluated at the end of 1979, by which time there should exist an adequate accumulation of experience.

18. The Economic Development Unit has provided excellent and useful monitoring of economic developments in the OCP area, but is seeking to define a new role. The EDU could expand its research and policy analysis activities by undertaking research and analysis on its own and by organizing research to be done by others. It should specialize on socio-economic subjects directly related to the vector control program. One appropriate subject is resettlement and migration, an area where the need for program-and policy-related research is acute, particularly in the Upper Volta. Another possible

area for socioeconomic research is health and health care delivery. The EDU could also undertake studies aimed at determining the economic impact of the control program, as was recently recommended by OCP Government representatives.

19. The Economic Development Advisory Panel was formed in 1975. It has two related problems: lack of focus because "economic development" is so diffuse a concern; and lack of contact with a well-defined audience for its advice. One way to remedy these difficulties would be to form a single, overall advisory panel for the OCP, with ad hoc sub-panels on specific, scientific, ecological and economic development issues which arise over time. The EDAP functions would be exercised within these ad hoc panels.

20. The technology of the vector control operation is extremely efficient and impressive. For long-run maintenance of onchocerciasis control, however, a simpler, less expensive technology will be more appropriate. During the next phase of the OCP, intensive efforts should be made to develop more cost-effective approaches and techniques of control. Special funding should be made available to finance these efforts.

21. Means should be sought to utilize more intensively the infrastructure put in place by the OCP, particularly its unmatched transport and communications network. It should be possible to devise a workable scheme for delivery of primary health care services by "piggy-backing" on the OCP transport network. A mission should be sent to the field to explore this idea in detail and develop it further if it proves feasible.

22. The decision to extend vector control operations will depend in part on medical or entomological factors -- the need to prevent or reduce reinfestation of the present OCP area, and the prevalence and severity of onchocerciasis in the proposed extension area. The economic benefits of extension will be of the same nature as the benefits of the existing program (higher labor productivity and increased accessibility to new land) plus reduction in costs of combating reinvasion in the existing OCP area.

23. The proposed extension area for the three coastal states would bring protection against onchocerciasis to relatively large numbers of people - 1.4 million in Ghana, 850,000 in Togo, over half the total population of Benin. A critical question in assessing the extension request is the extent to which these populations are presently exposed to onchocerciasis.

24. The "empty lands" in the extension area have substantial economic potential: 792,000 ha. are good bottomlands and about 1.4 million ha consist of ferralitic soils, according to mission estimates. The unknown element in the economics of the extension is the extent to which onchocerciasis is a critital factor explaining the present underutilization of these lands.

25. The economic case for program extension should be based on the following considerations: the size of the at-risk population and the intensity of their exposure; the extent to which new lands access is augmented; the cost and/or technical difficulty of instituting effective disease control by alternative programs; the impact on reinvasion of the existing OCP area.

26. Focus on the economic aspects of the control program, while suitable and necessary, should not obscure the substantial humanitarian aspect of the OCP. The extension, like the OCP itself, is intended to reduce the misery brought by disease to an impoverished part of mankind. The degree to which the extension of the program area contributes to this goal should be a major criterion for determining its extension.

OCP ECONOMIC REVIEW - MAIN REPORT

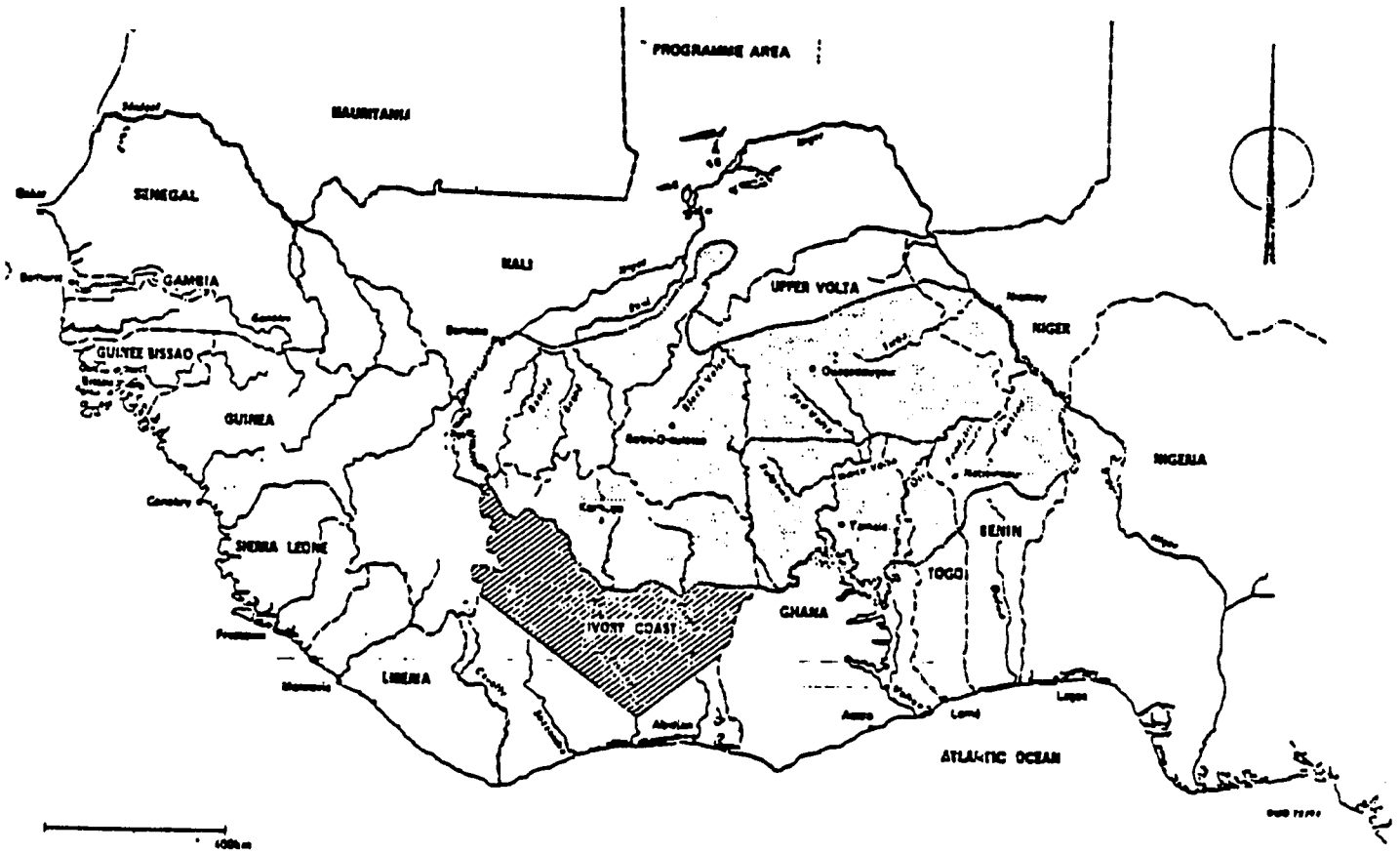
I. INTRODUCTION

1. At its meeting in Rome on September 1 and 2, 1977, the Steering Committee for the Onchocerciasis Control Program (OCP) decided that the sponsoring agencies of the Program — FAO, UNDP, WHO and the IBRD — should carry out a comprehensive review of the program in order to lay a proper basis for its next six-year phase which will start in 1980. It was decided at the same time that the review should be divided into two parts — an assessment of the vector control program by the WHO, and a review of the economic development aspects of the program by a multi-lateral team, to be put together by the IBRD in collaboration with other participating agencies.

2. The Economic Review Mission began its work in January 1978. It consisted of ten members, of whom a group of five composed the "core" which visited most of the countries. Country economists of the World Bank assisted in several countries. A list of participants in the Review Mission is attached in Appendix I.

3. Mission members made three trips to the OCP countries between January and May 1978. Each of the seven countries was visited by most mission members; only one member went to Niger. The mission travelled in the OCP zone of each of the countries, except in Ghana, where transport availability and scheduling constraints prevented a trip to the upper and northern regions. Logistical support was provided by local government agencies, in particular by the various National Committees on onchocerciasis, and by the IBRD, UNDP and FAO representatives. A calendar of the mission's activities is included in Appendix I.

4. In its terms of reference, the mission was asked to assess the economic impact of the OCP, review development strategies and obstacles to development in the program area, determine the extent to which the program has opened up new lands, assess existing settlement policies and make recommendations on approaches to planning and on the proposed extension of the Program area. A report of 50 pages was to be submitted. The detailed terms of reference are reproduced in Appendix I.


PROGRAMME AREA
MAURITANIA
SENEGAL
GAMBIA
MALI
UPPER VOLTA
NIGER
GUINEE BISSAO
GUINEA
NIGERIA
SIERRA LEONE
BENIN
TOGO
GHANA
IVORY COAST
LIBERIA
ATLANTIC OCEAN

II. THE ONCHOCERCIASIS CONTROL PROGRAM AREA AS AN ECONOMIC REGION

5. The Onchocerciasis Control Program (OCP) covers an area of some 654,000 km^2 in seven countries of West Africa. They are, from west to east: Mali, Ivory Coast, Upper Volta, Ghana, Togo, Benin, and Niger. More specifically, the region comprises: in Mali, the territory east of the line Bamako-Mopti (125,000 km^2); in Ivory Coast, the part north of the line Odienne-Bouake-Bondoukou (110,000 km^2); in Upper Volta, the entire country, except its northern tip (230,000 km^2); in Ghana, the area north of the Volta Lake (98,000 km^2); the northern part of Togo (18,000 km^2); in Benin, the area north of Djougou (56,000 km^2); in Niger, the tip of the country southeast of Niamey (17,000 km^2). The map below shows the region and the OCP area.

6. The OCP zones of each of the seven countries have many common features. They are wooded savannah with between 700-1100 mm. of rainfall annually. Ferruginous soils are dominant, with scattered bottomlands and flood plains. Farmers cultivate mainly cereals in the northern parts of the region (sorghums, millets, some maize), cassava and yams farther south, as well as cotton, groundnuts, rice and cowpeas. Animal-raising us widespread; the Fulani own and/or manage most cattle herds; small ruminants are more widely owned. Animal traction is widely used in Southern Mali and parts of Northern Benin; elsewhere it is only beginning to enter cropping systems. Shifting cultivation techniques with long fallows remain dominant. Incomes are low; the people of this region are among the poorest in the world. They have one-third to one-half the income of those in forest and coastal regions in West Africa. The large differentials in income and access to social services, combined with historical and sociological factors, encourage a flow of migration southward -- massive in magnitude in the Upper Volta, significant in most of the other states.

7. Perhaps because of this array of common features, combined with a natural tendency to generalize in discussion of complex undertakings like the OCP, there has emerged in the public understanding a general view of the economic significance of the OCP, a kind of standard perception or "paradigm." This can be summarized as follows: the OCP area typically consists of overcrowded plateaux bordering on river valleys which are uninhabited largely because the black fly, Simulium damnosum, the vector of onchocerciasis, has driven away the former inhabitants. 1/

1/ See below, Chapter IV for a statement of this view from the Main Report of the Preparatory Assistance mission to Governments, (PAG) Onchocerciasis Control in the Volta River Basin Area, Report of the Mission for Preparatory Assistance to the Governments of Dahomey, Ghana, Ivory Coast, Mali, Niger, Togo, and Upper Volta, presented by UNDP, FAO, IBRD, WHO, Geneva, August, 1973. Hereafter PAG Report.

TABLE 1. AREA AND POPULATION COVERED BY THE PROGRAMME

Country	Total area (km^2)	Area Covered by the Programme (km^2)	% of total area covered by programme	Estimated total population	Approximate population in programme area	% of total population in programme area
Dahomey	112 620	56 000	49%	2 770 000 (1)	547 000	5%
Ghana	238 377	98 000	15%	8 546 000 (3)	1 600 000	16%
Ivory Coast	333 270	110 000	17%	5 100 000 (2)	1 000 000	10%
Mali	1 204 000	125 000	19%	5 300 000 (1)	1 400 000	14%
Niger	1 187 000	17 000	3%	4 000 000 (2)	90 000	1%
Togo	56 600	18 000	3%	1 956 000 (2)	555 000	5%
Upper Volta	274 000	230 000	35%	5 421 000 (1)	4 900 000	49%
Total	3 405 867	654 000	100%	33 093 000	10 092 000	100%

(1) 1971.

(2) 1970.

(3) 1970-71 census

Source: PAG Report, 1973, pp. 15/16.

8. This paradigm or model has gained wide acceptance in participating countries as well as among donors and outside observers. Its acceptance has been encouraged by the fact that the region does have many common features, as noted above. But there are real differences between the OCP countries in terms of the impact of the control program on their economies and in terms of the degree of applicability of the paradigm. Table 1, which comes from the PAG Report shows the variations in area and population covered; though the data refer to 1970, the picture has not changed. In terms of area covered as well as population affected, Upper Volta is obviously the major focus of the program. It makes up over a third of the total of 654,000 km^2 in the OCP area, its inhabitants are half the total affected population; virtually all of its national territory is encompassed by the control program. Moreover, Upper Volta fits the conventional model more closely than the other OCP states. Only in Upper Volta does there appear to be fairly general and substantial pressure of people on the land, as evidenced by large-scale migration, made necessary by the declining potential of the natural resource base, e.g. loss of top soil through erosion, declining fertility and yields, failure of the age-old shifting cultivation system. Also in Upper Volta, crowded plateaux and empty river valleys do coexist, and onchocerciasis seems to be an important reason for this peculiar distribution of population. Of the 70,000 cases of blindness reported for the OCP area as a whole by the PAG study in 1973, 80 percent were found in Upper Volta.

9. In each of these respects -- geographic importance of OCP coverage and economic relevance, or the degree of "fit" of the conventional paradigm, the other six states vary. In Niger the disease control program covers less than 1.2 percent of the land area and affects less than 1.5 percent of the population. 1/ The "OCP zone", though small, figures prominently in the Niger Government's development planning. In Mali, the control program covers a large and important area -- one third of the most fertile, best watered part of the country. But the empty valleys/crowded plateaux model applies very little if at all; population distribution in the areas affected by onchocerciasis does not seem to be different than in other parts of southern Mali. There is little evidence of "abandoned valleys" in Mali.

10. The four coastal countries in the OCP have large portions of their national territories included in the OCP area -- roughly the northern 35-50 percent of each country. Three of these countries contain pockets of high population density: the Korhogo region in Ivory Coast, the Bawku-Bolgatanga zone in northeast Ghana, and the area immediately surrounding Lama-Kara in Kara Province, Togo. They also have large stretches of thinly-populated land; but the economic impact of onchocerciasis in these regions is not clear. According to local sources, the major factor explaining the existing population distribution is historical. As a result of the 19th century military

---

1/ The PAG Report originally included part of Tera district but the OCP area in Niger in practice now covers only the Say Arrondissement, which is 15,000 km^2 in size, with an estimated population of 75,000 in 1977.

upheavals a wide east-west belt on the border between savannah and rain-forest was depopulated. This is said to explain why population densities are so low throughout these latitudes, and not only in the river valleys. The "paradigm" then is of limited applicability in at least several of the coastal states -- Benin and Ivory Coast, for example. 1/

11. That such differences exist within the OCP area should hardly be surprising. The boundaries of the control program area were chosen for entomological reasons, not on grounds of economic homogeneity. The central purpose was to define the boundaries of the area in such a way as to make vector control effective.

12. It follows from the diversity within the OCP area that the seven participating countries are not equal beneficiaries of the control program. All benefit in some measure, but those states with the most numerous afflicted population and those most urgently in need of new lands are the principal beneficiaries. The Upper Volta is obviously the state most affected. Differential benefit-sharing however must be viewed in the context of the economic interdependence of the region. Some of the Voltaic benefits for example, are indirectly shared with other states of the region because Voltaics -- made healthier and more productive as a result of onchocerciasis control -- emigrate in large numbers, to the Ivory Coast, in particular. Similarly to the extent that disease control allows expansion of annual production in the OCP zones, the coastal countries share the benefits.

13. Control of the onchocerciasis vector in West African conditions thus inherently involves differential sharing of benefits. The costs (regardless of how they are financed) also vary, and the individual country benefit-cost relations are different. At the same time there are large "externalities" in each country's action. If the control program is ineffective in one country, it affects not only the at-risk population in that country, but those in neighboring countries as well. In the absence of the regional fiscal institutions, this provides a special rationale for external financing of the program.

14. Since the economic impact and implications of the OCP vary between countries, uniform approaches to the region's economic development problems risk being inappropriate. Emphasis on settlement of new lands, for example,

---

1/ The Rapport Mensuel (Sept. 1977) of the Permanent Advisor, Development Planning Group, Onchocerciasis Development Project Republic of Benin states the following. "Concerning the determination of zones abandoned because of onchocerciasis, discussions and field visits allow the following conclusion; unlike other countries such as the Upper Volta there are no villages which have been abandoned because of onhocerciasis. Several explanations have been put forward, but need to be verified: (1) The virulence of transmission is weaker than in the Black Volta, because the river flow is less steady; (2) the existence of fertile soils far from rivers ..."

is applicable only in a few of the countries, and particularly in Upper Volta. Similarly a planning methodology directed toward settlement programs may not fit the planning needs of OCP countries where formal resettlement schemes are presently of relatively little interest or priority — e.g., Mali, Niger, Benin, Ivory Coast. Moreover, the concept of the "OCP area" or the "onchocerciasis free zone" as a unit of economic planning within each country has varied meaning. In the Upper Volta, the OCP area covers almost the whole country. In Mali, the distinction between the "onchocerciasis zone" and other parts of southern Mali is very tenuous. The "Onchocerciasis zone" is among the best endowed areas of Mali. In the four coastal countries, on the other hand, the "onchocerciasis zones" are the most disadvantaged regions.

15. The central points in this chapter may be summarized as follows. The "crowded plateaux - empty valleys" paradigm is not general in the OCP region. Demographic pressures and the factors explaining the distribution of population are not the same in each of the seven states of the OCP area. Onchocerciasis is more critical a development constraint in some of the countries than in others. The OCP is an entomological unit, not an economic one. Few economic generalizations are fully applicable to the OCP zone of the seven participating OCP countries. Uniform approaches to development planning or economic policy are therefore unlikely to be equally suitable for all the countries in question.

III. THE ECONOMIC IMPACT OF ONCHOCERCIASIS CONTROL

16. The OCP, like all disease control programs, has two objectives: to improve human welfare in the affected area and to accelerate economic development. It is essential to underscore the humanitarian dimension, as we embark on analysis of the economic impact of the program. The reduction of human misery is one of the ends of economic development, so disease control programs are ends in themselves as well as means to economic growth. Moreover, better health is a "basic need," the satisfaction of which is given high priority both by local governments in the OCP area and by the international donor community. Health projects like the OCP are therefore not the same as projects for dams, textile mills or even roads, and should not have to be justified the same way as these more purely "instrumental" projects.

17. Having said this, we now proceed in the analysis that follows to set it aside, and to consider the OCP in a narrowly economic cost-benefit framework, much as any "ordinary" development project would be evaluated. Such an analysis is essential to any overall assessment of economic impact.

18. The generally-accepted methodology for evaluation of health programs defines two main sets of benefits as flowing from these programs: (a) reductions in lost working time (i.e., reduced death, disability and debility) and (b) reduction in costs of treatment. The benefits are measured by the estimated incomes earned by those who would otherwise have died, been disabled or weakened by the target disease or illness, plus treatment costs no longer necessary when the disease is eliminated or controlled.

19. In the original project documents, the economic benefits of OCP are not defined and measured in this "standard" fashion. The PAG Report does mention the conventional benefits of disease control, but the cost-benefit analysis in that report considers only "new lands" effects. In effect, the PAG economic methodology 1/ couples the vector control program with a collection of settlement projects which were proposed to follow control of oncho, and defines the benefits of vector control as the output of these settlement projects. That is, the costs of vector control were added to the costs of the proposed settlement projects, and these total costs were compared with the settlement project outputs to derive a rate of return estimate.

20. This approach is innovative and ingenious. But, among other problems, it has a major inconvenience: it implies that if the proposed settlement projects do not come about, the expected rate of return of the project will not be attained, and any formal economic assessment would to this extent have to be negative. This, however, would not be correct. The "conventional" economic benefits of a disease control program should be incorporated formally into benefit calculations and a broader view taken of

---

1/ See PAG Report Ch. VI and Annex VI-5, The Methodology of the Economic Analysis.

new lands availability (i.e., one not dependent only on the introduction of formal settlement schemes). Such an approach, which will be outlined below and in Appendix II, gives a clearer picture of the economic benefits of the program.

21. In addition to its substantial humanitarian benefits, the OCP will generate a broad range of economic benefits. The control of onchocerciasis increases the quantity and/or quality of productive factors — labor and land — in the OCP area, and this is the basic impact of the program. With respect to the labor factor, the control of S. damnosum leads to a probable increase in productivity for three principle reasons:

(a) In the absence of vector control some proportion of the population in the affected zone would develop impaired vision. Others would become blind. Contributions to output would decline for the former, disappear or diminish sharply for the latter. The avoidance of loss of output from reduced vision and from blindness is the first source of labor-related economic benefits.

(b) The parasite Oncocerca volvulus presumably affects human performance like all parasites — it weakens the organism, making it more vulnerable to other diseases. With the reduction in onchocerciasis prevalence and severity, people in the OCP zone will be healthier, hence more energetic and capable of harder work. This reduction of oncho-induced debility is a second source of labor productivity increase.

(c) The "nuisance effect" of black fly is eliminated or sharply reduced. Without vector control, farmers cultivating in areas close to streams and rivers can be bitten hundreds, even thousands of times in a day. With the removal or reduction of the fly population these farmers can work better and longer.

22. In most economic analyses of health projects, these labor-related effects are the main source of economic benefits, and they are measured by the estimated increases in output due to reductions in debility, absenteeism, and blindness. The mission did not try to develop in detail a cost-benefit analysis along these conventional lines; the labor-related benefits of the OCP are probably secondary to the "land-creation" effects, and in any event not enough is firmly known about their magnitude — either in the OCP or from experience elsewhere — to allow credible results.

23. It is nonetheless of some interest to explore the matter briefly, to see what insights such analysis might provide as to the relative importance of the different sources of economic benefits, and their orders of magnitude. We have put together calculations of aggregate benefits under a likely set of assumptions about output effects of reduced blindness, eyesight impairment, debility and nuisance. The calculations are given in Appendix II, along with an explanation of their derivation.

24. The exercise yields two main conclusions:

(a) The direct labor-related benefits of vector control, by themselves and unweighted for income distribution impacts, appear to be rather modest. Table I in Appendix II gives a range of benefit estimates under various assumptions about blindness incidence, output losses through debility and disability, and the marginal product of labor.

(b) The analysis confirms that the avoidance of blindness is the major source of economic benefits, even with the assumption that onchocerciosis-caused physical weakness and disability reduce individual output by as much as 10 percent.

25. That these labor-related benefits of onchocerciasis control appear modest relative to the costs of the control program should not be surprising. Such an outcome is almost inevitable, given the low incomes of the target population; with such low incomes, the incremental impact of better health must necessarily be relatively small.

26. For the same reasons, however, the benefits of these low income beneficiaries of the program should be heavily weighted. The approximately one million people affected by the vector control program are among the poorest in the world. Average incomes in the affected regions are under $75 per capita; in Ghana, Ivory Coast, and Togo the overall national income per capita is higher, but the OCP area covers the poorer northern zones where incomes are much below the national average, and where access to social services is extremely restricted.

27. These results, moreover, refer to the labor-related benefits. But major economic benefits of the onchocerciasis control program derive also from its "new lands" aspect. These benefits come from the additional output generated by migration from "old" to "new" lands. Gross benefits can be defined as output produced by migration from "old" to "new" lands, plus the increase in output from an anti-erosion effect -- a larger area remaining cultivable in the "old" lands in comparison with what would be cultivable in the absence of OCP-related migration. 1/ To get net benefits the following costs have to be deducted: (1) the reduction in output on old lands as a result of departure of migrants, (2) the costs of migration, and (3) "complementary costs," those investments required to bring new lands into production. 2/

1/ This is mainly due to lengthened fallows. That it may be significant is suggested by numerous observers (see para. 30).

2/ See Appendix II for a more detailed discussion.

28. Measurement of net benefits from new lands development presents great difficulties. The consequences of migration on productivity on "old" lands; the kind of migration (relatively spontaneous or heavily controlled), the nature and level of complementary investment expenditures -- all have to be specified. However, these are highly variable, and many of the underlying data are unknown.

29. Simulated estimates, however (given in Appendix II), indicate that net benefits from new lands availability would not have to be improbably high in order to make the financial returns from the OCP attractive. For example, using a 10 percent rate of discount, the present value of the benefits from new lands would only have to total $60 million to bring total program benefits up to total costs under certain assumptions about the length of the control program. The annual flow of benefits involved is quite low -- an average of $7 million per year over 25 years with one set of assumptions -- and is presumably easily attainable. 1/

30. The erosion-reducing effect due to emigration made possible by new lands accessibility may by itself generate a significant flow of benefits. That this is likely is suggested by a recent FAO study which states that 25 percent of the cultivable area of the Mossi Plateau may be rendered unusable by 1990 if present trends continue.

31. Earlier analysis used discount rates of 10 and 15 percent and a time horizon no longer than twenty-five years. These "conventional" rates of discount are based on assumptions about the productivity of development resources in alternative uses, and the twenty-five year cut-off is used in part because at 10-15 percent discount rates, present values of costs and benefits beyond twenty-five years are usually too small to be significant. It can be argued that these discount rates are too high for projects which are so centrally aimed at poverty-stricken populations in poor countries, and in countries which have limited absorptive capacity. In short, according to this view, lower rates of discount more truly reflect opportunity costs for the resources involved in vector control. Moreover, the control of onchocerciasis will improve living conditions for generations of West Africans yet unborn. It will also contribute to a slowing down of the permanent destruction of national resources (erosion via shortened fallows), which will benefit future generations. For these reasons, it can be argued that lower discount rates and longer time horizons are more appropriate in evaluating programs such as the OCP. As is shown in Appendix II, extending the time horizon and lowering the discount rate leads to dramatic increases in the economic returns of the project.

32. All of this confirms what is well-known and has been stressed earlier: that benefit-cost analysis of projects such as OCP is highly sensitive to the assumptions adopted, and cannot therefore be leaned on too heavily. It also indicates, however, that with certain not implausible

---

1/ See Appendix II for further discussion.

assumptions about productivity effects, new lands benefits, rates of discount and time horizons, the purely economic analysis of the OCP yields favorable results.

33. We have stressed the need to correctly define benefits from onchocerciasis control for two main reasons.

(a) If -- as is common practice in evaluations, we were to assess the economic impact of OCP by looking at the expected internal rate of return as specified in the original project documents, then the assessment would be rather somber, since only one of the proposed five formal settlement projects has materialized and on a smaller scale than envisaged. Definition of the Program's economic benefits in terms of labor-related and more general new lands effects makes for a more relevant as well as a more optimistic assessment.

(b) The dependence of the vector control program benefits on ensuing development projects (especially formal settlement projects) leads to a dubious linking in program terms. It encourages the widespread view that <u>because</u> the vector control program has reduced biting and transmission rates, new development programs and projects should be initiated in the OCP area. This may be so. Vector control will create new development opportunities. Local governments and external assistance agencies should certainly be attentive to the new project possibilities which are likely to exist in those areas. However, vector control and development projects are nonetheless quite separate, conceptually. Because of onchocerciasis control, human misery is reduced, people are healthier, and hence have the potential to work harder and better, and cultivable land is made more accessible for productive use. These will be the benefits of vector control. The introduction of development projects in the OCP zone, once onchocerciasis is under control, depends on the social advantages and economic costs and benefits of the specific projects proposed, and on whether these projects are more desirable in terms of national objectives than alternative expenditure possibilities. Special weight can of course be given to projects aimed at more balanced regional development or meeting basic needs of the poorest groups. But in assessing proposals for development programs for the OCP area, the disease control costs are most appropriately regarded as sunk costs.

IV. EMPTY LANDS

34. An important aspect of the economic development impact of the OCP concerns the opening up of lands which could not be cultivated because of the presence of S. Damnosum. The PAG Report said: 1/

> ..."onchocerciasis, or river blindness ... constitutes for the (OCP) area the most important single deterrent to human settlement and the subsequent economic development of many fertile valleys, which lie uninhabited and unproductive. This situation inhibits the development of the vast savannah belt of the Volta River Basin area, and countless thousands of families have left productive ancestral lands to crowd the adjacent areas where low-yielding poor soil predominates."

35. In the available project documentation the mission could find no detailed and systematic assessment of the extent of the "empty lands" which the OCP would help open up for cultivation, nor could we locate any detailed pedological or agro-economic analysis of their potential. An estimation is included in the PAG Report, which indicates that the Program would make 65,000 km^2 of "new lands" available of which a third, i.e. 22,000 km^2 would be suitable for agricultural purposes. The mission therefore made special efforts to determine the quantity of new lands which are being made available in the OCP area, as well as soil types. In doing this the mission recognized that it would not be possible to obtain an accurate and unambiguous estimate in view of the limitations of soils information at present available and that any estimate it came up with would still provide only an indication of orders of magnitude. Nevertheless, we believed it would be useful to apply a certain rigor to this particular aspect and in doing this to take into account knowledge acquired since 1972. This initially involved bringing together existing maps of topography, land use, agricultural potential, population distribution, etc. and reducing them to a common scale by planimetering.

36. Estimates were derived as follows: (a) "occupied" or populated areas were determined from population distribution maps and/or by inferences based on hectarage required for subsistence, and lands with a population density of less than 20 per km^2 were considered to be available for settlement; (b) areas committed to forest reserves and national parks were set aside; (c) remaining areas considered "available" were classified by soil type. The hectarages thus derived are "gross", in the sense that they include all "non-populated lands", including areas that are not suitable for agricultural development, because their soils are poor - part of the area is covered by litho soils which consist of rock debris, iron pans and gravel at the soil surface and/or have very shallow profiles, mountainous areas, rock outcrops,

---

1/ PAG Report, pg. 1.

etc. They also include land associated with human settlement - roads, dikes, irrigation canals, houses, schools etc. The "gross" hectarage was reduced by varying percentages to take account of these factors. The result gives "net" hectarage estimates of land available for cropping. This was then classified into six types:

> (1) brown eutrophic soils; (2) alluvial and colluvial soils in the river valleys and bottomlands (bas fonds); (3) vertisols, heavy clay soils, hard to work and poorly drained; (4) ferralitic soils with good physical properties (deep profiles, fine texture, porosity, good moisture retention), but low in major nutrients; (5) ferruginous soils physically and biochemically shallow, coarse-textured, slowly permeable, sensitive to erosion, very low in main nutrients and in organic matter; (6) unsuitable soils include soils with iron pans or laterite gravel at the surface, very sandy soils, rock outcrops, stones, etc.

37. The basic findings are summarized in Table 2. They show the total (gross) land area not utilized for agricultural purposes in the oncho zone, and amounts estimated to be available for agricultural development. On the basis of these tables and the assumptions underlying them, the Program would help make available some 276,000 km^2 of land of which some 134,000 to 154,000 km^2 would be suitable for agricultural purposes. About two thirds of the soils are Class 5 ferruginous tropical soils, typical for West African savannah regions in general.

38. It is essential to stress again that these estimates have to be taken with a great deal of caution, for the figures are only indicative. They give only rough orders of magnitude rather than precise statements about "available" land. The figures are based on general data, mostly of a reconnaissance nature, supplemented by some more detailed, locally available information. In some cases, no suitable information was available, and estimating methods were particularly crude. Furthermore, the concept of "available land" itself is imprecise; it should ideally be analyzed in a dynamic framework which would take into account the effects of technological innovations, potential fertility etc., which has not been done in the present analysis. Finally, there is reason to believe that some of the area in question may not be readily "available". There are, for instance, a number of factors for which we make no reductions in determining net hectarage, but which may present serious obstacles to productive utilization of the "new land" in the OCP area. Some have to do with soil and topographical characteristics, others with medical hazards, and perhaps others yet undesignated, also exist. Some major constraints that are known to present obstacles to use of the "new lands" are listed below. All are constraints in an economic sense, since their removal may require substantial resource costs.

(a) Drinking water - In large parts of the area the geological substratum is the pre-Cambrian basement complex, which is notorious for its poor acquifer qualities. Except on bottomlands close to the rivers therefore, substantial stretches

Table 1

HECTARAGES OF "NEW LAND" AVAILABLE IN OCP AREA BY

TYPE OF SOIL, WITH AND WITHOUT APPLICATION OF REDUCTION FACTORS

(in 1000 ha)

G= Gross hectarage; R_1 = hectarage available after reduction for impurities; R_2=hectarage available after reduction for infrastructure

Soil Categories	1			2			3	3		4			5			6			Total		
	G	R_1	R_2	G	R_1	R_2	G	R_1	R_2	G	R_1	R_2	G	R_1	R_2	G	R_1	R_2	G	R_1	R_2
Benin	-	-	-	39	37	26	1	1	1	-	-	-	2547	1656	1490	860	86	69	3447	1780	1586
Ghana	-	-	-	1072	1018	713	59	53	48	-	-	-	5507	3580	3222	966	96	77	7604	4747	4060
Ivory Coast	130	124	112	363	345	242	-	-	-	410	308	277	1992	1295	1166	1539	154	139	4434	2226	1936
Mali	-	-	-	333	316	221	-	-	-	-	-	-	4696	3059	2753	915	92	83	5944	3460	3057
Niger	-	-	-	33	31	22	-	-	-	-	-	-	119	77	69	100	10	8	252	118	99
Togo	1	1	1	70	67	47	-	-	-	1	-	-	475	309	278	130	13	10	677	390	336
Upper Volta	290	276	248	88	84	59	360	324	292	-	-	-	2790	1814	1633	1640	164	131	5168	2662	2363
Total	421	401	361	1998	1898	1330	420	378	341	411	308	277	18126	11783	10611	6150	615	517	27526	15383	13437

Soil Types: 1= brown entrophic soils

2= alluvial - colluvial (bas fonds)

3= vertisols

4= ferralitic

5= ferrigompis

6= unsuitable lands

of the OCP region are likely to be without ready access to drinking water. This was strikingly confirmed in two recently completed studies - one of the Oti Valley in Togo, the other of the Bougouriba Valley in Upper Volta. 1/ However, the absence of potable water is not necessarily an absolute prohibition on land use. It may be possible to find ways to provide water at reasonable costs. In some countries, for example, underground water retention structures have been successfully used to cope with the problem.

(b) Flooding and waterlogging - Many of the valleys and bas fonds of the OCP area are subject to frequent flooding and the soils then suffer from excessive moisture. Topographical and climatic factors conspire to give this problem special severity. The valleys tend to be long and narrow, which makes protection against flooding especially difficult; drainage by gravity up to now has not produced the desired results. It is not only the alluvial soils of the immediate river bed regions which are involved. The vertisols of the region are also commonly waterlogged because of their flat, depression-like position and their heavy clay textures and poor structures . (By some unfortunate trick of nature, the same flood plains, which contain large waterlogged areas, also contain some soils which are so highly permeable that they present difficulties to irrigated cultivation.) To cope with the discharges on these flood plains, flood protection works, and agricultural drainage works would be needed to control the excess rainfall.

(c) Heavy soils - The vertisols and related sols vertiques are often difficult to work by traditional means. Moreoever, there is a special time constraint in utilization of these soils: the period when the ground is workable and planting can occur is very restricted. Appropriate land preparation methods (mechanization, oxen) and farming systems could be usefully developed. The work done by ICRISAT on the development of tillage techniques and farming systems would seem to be particularly appropriate for the development of vertisols in the program area.

(d) Trypanosomiasis - The vectors of trypanosomiasis and of onchocerciasis tend to occupy similar habitats - particularly forested river banks. With OCP controlling Simulium, the presence of various species of Glossina has become more

---

1/ SEDES/Republique du Togo/PNUD, Mise en valeur des Terres Libérées de l'Onchocercose: Inventaire des Ressources et Programmation du Développement de la Vallée de l'Oti, Rapport d'Etude. (1977). FAO, Etude Morpho-pedologique de la Vallée de la Bougouriba, 1:1,000,000. Dec. 1976.

apparent a constraint to settlement and development in some of the OCP countries. It seems to be an important factor accounting for the paucity of the population and the limited use of land in the OCP areas of Niger, Mali and Ivory Coast and perhaps throughout the southern parts of the OCP area. It should be noted that this "constraint" is being attacked at various levels - by expanded international research on tse tse, for example, and by special research in the Ivory Coast and elsewhere in the region.

(e) Many of the river valleys are used by herders; they are part of annual transhumances. Thus, when the Sissilli Valley (Upper Volta) was investigated for potential settlement project sites it was discovered to be heavily occupied by Fulani and their herds. Lands believed to be "empty" frequently have claimants. The land may be in long fallow, or - more likely - some group claims traditional rights over its use, even though it is not part of their cropping cycle. Settlement projects sometimes unloose an army of claimants to land assumed to be empty though in general these issues of land tenure are resolved rather amicably in the framework of traditional law.

39. This discussion makes clear that there are many obstacles other than onchocerciasis to the productive utilization of the "empty lands" in the OCP areas. There are many implications. Settlement programs and projects, which at best are very difficult, will be especially difficult in the areas where onchocerciasis is being brought under control, given the range of obstacles mentioned above. Moreover, basic data required for facilitating or organizing settlement on new lands are very rare; land development, (road design, drainage, irrigation, soil and water conservation) for example, requires knowledge about relief, gradients, length of slopes and other topographical data, almost none of which exists. Detailed surveys, on a scale of 1:5,000 or 1:10,000 are also often necessary. Settlement will therefore inevitably go slowly.

40. It is evident that the economic development of the OCP area will require special efforts. Basic information must be generated -- studies of soils, topography, rainfall and river flow patterns, etc. Infrastructure must be created, especially roads. And perhaps most challenging will be water development and control, which are keys to utilization of the large flood plains. The long and narrow configuration of the valleys and bas fonds in relation to the heavy runoffs during the rainy season, make secure protection against flooding difficult and expensive. Indicative of the problem is the history of earthen dams in the Upper Volta. Strained by the pressures of concentrated, heavy rainfall, large numbers of these dams give way each year. Close and detailed study, pilot efforts, suitable construction methods drainage systems, careful maintenance-all will be needed for effective water control schemes. Utilization of the many thousands of hectares of bas-fonds and schemes involving less than full water control will be easier. In any case, further studies, and experience will make clearer the magnitude of the area's empty lands and the ease with which they will be made productive.

SETTLEMENT POLICY AND MIGRATION

41. The vector control program has helped open up large new land areas for potential exploitation. Two key questions arise: how much and which of these potentially exploitable new lands should be brought into cultivation, and how should their utilization be organized? The answer to the first question was suggested earlier: vector control increases the likelihood of new economic opportunities in the OCP zone, but creates no necessary presumption that settlement or other projects should be introduced. It is clear that given their basic differences in circumstances, there is likely to be considerable difference between OCP countries in the attention and priority given to formal new lands development programs.

42. In reality, only in Upper Volta has this been a subject of major policy concern. The other OCP countries, faced with less intense demographic pressures, have proceeded experimentally and cautiously in empty lands development and settlement programs. In the Ivory Coast there were in the late 1960's a number of pilot settlement schemes in the northern region, and there is now under discussion a small settlement project in the northeast, the Kolodio-Bineda scheme. In Togo, similarly, there are two projects in the Kara Region, a FED-financed scheme with 200 settlers near Lama-Kara, and a UNDP-assisted project for 150 families in the same area. In Benin there is no settlement activity at present; an irrigated rice project at Malanville in the Niger Valley was recently transformed from a settlement-type operation to a straight wage employment arrangement. In Niger, a proposal for a small, experimental settlement scheme in the Say District is being reviewed by the National Onchocerciasis Committee. In Ghana and Mali there appear to be no formal settlement programs under way or planned, other than those associated with dam projects.

43. In several of the OCP countries there is said to be some tendency for cultivation to spread gradually into areas where onchocerciasis is under control. This occurs as increased knowledge (acquired via agricultural extension) and technological improvements (the use of oxen, notably) allows cultivation of larger areas per farm household. So the occupation and development of the OCP empty lands should not be thought of as deriving exclusively from long distance migration or formal settlement schemes.

44. Nonetheless, there is a big difference between the size and scope of Upper Volta's migration and settlement activities and those of the other OCP states. Only in Upper Volta, where the Volta Valley Authority (AVV) is engaged in extensive resettlement programs, and where much spontaneous migration occurs, is there OCP area resettlement activity of any magnitude. The reasons why settlement activity is so important in Upper Volta have been mentioned earlier. The Upper Volta desperately needs its "new lands." On the Mossi plateau, 60 percent of the country's population live on a third of its land area. Population densities over wide areas exceed 40 per squre kilometer, more than the land can long carry with existing technology. Everywhere fallows are being shortened, sometimes drastically. Erosion is

said to be intensifying, with frightening effects; as noted earlier, a recent FAO study predicts that in the absence of changes in cultivation practices 25 percent of the Mossi plateau's cultivated land will be unusable by 1990. Already a large number of Voltaics migrate: 960,000 were estimated to be living abroad in the mid-1970's, and internal migrants number about 260,000. 1/ Almost 20 percent of the Upper Volta's population has been migratory in recent years, and a higher proportion of young men.

45. Annual migration figures are crude, and fluctuate widely. According to a comprehensive 1973 ORSTOM study, the number of Mossi who settled outside their traditional areas rose from 85,000 to 1960 to 158,000 in 1972, an average increase of 6,000 people a year. The number of people estimated to have moved to other areas grew from 1,000 a year in the early 1960's to 8,000 a year in the early 1970's. According to some estimates the drought led to a rise in the annual rate of net internal migration to 15-20,000 a year in 1974 and 1975. The estimated current flow is 10-15,000 a year, most (65 percent) to the upper parts of the Black Volta. The annual flow of external migrants is estimated to be 200,000, of which two-thirds are believed to be seasonal migrants (returning each year) and 25 percent are temporary emigrants (2-5 years away). All of these figures are subject to wide margins of error; it is indeed essential that many aspects of the migration phenomenon, including magnitude of flows, receive much more study.

46. Lack of similar pressure of people on the land in the other OCP countries is part of the reason for the marked differences between the Upper Volta and the other OCP states in terms of preoccupation with settlement and empty lands development. Except for the relatively small crowded region around Korhogo, the similarly crowded Bawku-Bolgatanga region in northeast Ghana and the Lama-Kara region of Togo, with its density of 300 persons/km^2 population pressures are less severe in the other states. People from these crowded pockets have migrated to the more developed southern regions for decades, and net growth of resident population has been generally low in these zones. It may in fact be difficult to attract settlers into the new lands, since it is not clear that settlement can be made sufficiently remunerative to attract these migrants to new lands, as is suggested, for example, in the Oti Valley Report (Togo) - at least for some time. In some countries, notably Ghana, recent growth of mechanized cultivation of rice in the river valleys of the northern and upper regions has probably absorbed considerable northern labor; and more important, potential northern Ghana emigrants to new lands have found employment opportunity further south, in the cocoa regions, particularly since 1969, when legislation discouraging foreign employment in Ghana was introduced. In Mali, there are no "empty lands" in the usual sense; population densities in the OCP area do not appear to be different than in comparable non-OCP areas in that country.

1/ K.C. Zachariah and J. Condé, Demographic Aspects of Migration in West Africa, (provisional draft) IBRD, June 1978.

47. In some of the OCP countries sparsity of population may be a constraining factor in some cases. In Mali, new settlement projects would compete with the Office du Niger for the available supply of domestic migrants. The 500 ha. Niger Valley rice project (Malanville) in Benin has experienced severe periodic labor shortages; alternative income-earning possibilities in the region are such as to make settlement (or wage labor in irrigated rice projects) unattractive to many local residents. The Ivory Coast and Ghana have been traditional importers of labor, mainly from Upper Volta, Mali and Togo.

48. The record of settlement scheme experience, both historical and contemporary, both in Africa and elsewhere, 1/ is not particularly encouraging, and this may be another reason for the low priority accorded settlement schemes by planners in most OCP countries. Ghana's Volta River resettlement project and the resettlement of 80,000 people displaced by the Koussou dam in the Ivory Coast have both proved costly and it is not clear that technically and/or economically acceptable agricultural packages have been worked out for the resettled populations. 2/ The UNDP Lama-Kara project in Togo began as a small FAO project (160 ha. in three years). It was disbanded in 1972. The project was not really a settlement project; it was rather a farmer training effort. It was resuscitated in 1974, still with a training focus. It has developed about 50 ha. and has 150 participating families. A FED-financed project has a more conventional settlement character, and has moved forward smoothly. Called the Mise en Valeur de la Vallee de la Kara, this project has settled 250 families in four years, 220 of them from the densely populated Kabrye mountains. It will be expanded to 1,000 families in its

---

1/ Cf. R. Chambers, Settlement Schemes in Tropical Africa, 1969; IBRD, The Settlement of Agricultural Land: An Issues Paper, 1977; J.C. de Wilde, Experience with Agricultural Development in Tropical Africa, 1967; Michael Nelson, The Development of Tropical Lands; Policy Issues In Latin America, 1973; K. Pelzer, Pioneer Settlement in the Asiatic Tropics, 1945.

2/ Cf. R. Chambers, The Volta Resettlement Project, 1970; and Rowena Lawson, "An Interim Economic Appraisal of the Volta Resettlement Scheme," in the Nigerian Journal of Economics and Social Studies, Vol. 10, #1, March 1968, pp. 95-109. Ghana's Damogo settlement scheme, begun in the 1950's, also had unsatisfactory outcomes. (See David Williams, The Probable Economic Effects of the Eradication of Onchocerciasis in Northern and and Upper Ghana, consultant's Report, WHO, 1970.).

next four year phase. This modest scheme is one of the most successful settlement activities in the region. 1/

49. In addition to historical experience with attempted settlement schemes, the growth of knowledge about soil potentials, costs and problems of drainage systems, etc. has given pause to efforts once recommended as feasible and desirable. Thus the PAG Report recommended, on the basis of preliminary knowledge, that a major settlement scheme be explored for the region of the confluence of the Bou and Bandama. More study and experience with the area's soil and topographical conditions have apparently led to the postponement of this proposal. 2/

50. Whatever the reasons - and there is much that remains unclear - settlement activity and sizeable spontaneous occupation of empty lands appears to be mainly an Upper Volta phenomenon. Not surprisingly, therefore, public policy discussion about occupation of the new lands has arisen mainly in the Upper Volta. This question tends to be debated in polar terms - "organized" or "controlled" settlement versus "spontaneous" migration. While many issues separate partisans of solutions leaning toward one or the other of these poles, the principal difference centers on ecology. Spontaneous migration is widely seen as destructive of the soil; "migration sauvage," it has been called. Settlers of new lands are said to apply wasteful and careless methods of cultivation, mine the soil, then move on. Controlled settlement, it is argued, is essential "in order to prevent uncontrolled and irreversible exploitation of one of West Africa's few remaining and relatively untouched natural resources." 3/ The principal hesitations expressed about controlled settlement are based on its high costs, its heavy demands on administrative and managerial skills and organizational capacity, its limited capacity to absorb the full flow of migration.

1/ The direct installation costs per family were about $2,000 in the initial four year phase. These were not total costs; many of the roads and wells were provided without charge to the project by public agencies (mainly the regional SORAD and the Sokode Service Hydraulique) and some were donated by private charitable institutions. In the second phase 180 mn. FCFA out of a total budgeted amount of 620 (excluding contingencies of 120 mn.) is allocated to housing, which will raise the cost per family installed. (Cf. Republique de Togo, Ministère du Développement Rural, SORAD, Région de la Kara, Rapport Final, Projet Operation de Mise en Valeur Agricole dans la Vallée de la Kara, Feb. 1974-mai 1977 (Agroprogress, juin, 1977).

2/ BENT/DRC/République de la Cote d'Ivoire, Ministère du Plan, Etudes d'Aménagement Intégré des Bassins versants region Nord (Korhogo boundiali ferkessedougou) Les problèmes du Sol, tome 10, avril, 1976.

3/ FAO/IBRD, Economic Development of Areas Freed from Onchocerciasis in Dahomey, Ghana, Mali, Togo and Upper Volta (Rome, October, 1975).

51. In terms of policy, the question is not whether to assist migrants, but how. Migrants into new lands will normally need some help -- with soil or production problems, marketing, the building of roads, schools, dispensaries. So the relevant policy problem is the discovery of appropriate degrees and types of organized settlement.

L'Autorité d'Aménagement des Vallées des Volta (AVV)

52. The AVV was created in 1974 to organize on ecologically and agronomically sound lines the resettlement of the river valleys in which vector control was effective. It follows a relatively highly organized approach to settlement. Detailed field studies precede choice of settlement locations; extensive infrastructure is built; land is cleared mechanically, and settlers receive food their first year or two. A cropping pattern is set down for farmers to follow.

53. In the few years since its inception the AVV has considerable achievements to its credit. It has undertaken an extraordinary range of studies - topographical, hydrological, pedological, socio-economic and other. 1/ It has put into place a highly structured organization for planning, studying and managing the complex work of creating human settlements in little-known, uncongenial environments. It has had to pioneer in the "new lands," and thereby come to grips with all the obstacles to development noted in the previous chapter. Its initial goals were extremely ambitious: 650,000 people, or an implied annual settlement rate of 43,000 people a year on a 15-year basis, 32,000 a year on a 20 year basis. 2/ But experience has revealed the true magnitude and diversity of the obstacles in the way of rapid development of the "empty valleys." The fact that AVV has succeeded in settling more than 1,200 families on 6,500 ha. in its first five years of full operation is a major achievement more than a cause for criticism. Throughout its existence the AVV has had to bear the burden of an overly optimistic interpretation of the "abandoned valleys" hypothesis: that once onchocerciasis was under control, the rest would be easy.

54. The AVV is making a vital contribution to the task of assuring ecologically rational use of the new lands. But it is of necessity only a partial contribution. By mid-1978 it had succeeded in settling over 1200 families (about 7,000 people) in 26 villages (21 in the White Volta, 4 in the Red Volta, 1 in the Black Volta) and its current absorption rate is 300 families a year. According to the introductory section of the recent Cortay

---

1/ Between 1972 and mid-1976, $3.2 mn. was spent on studies and research.

2/ The distribution was to be as follows: Red and White Volta valleys: 175,000; Black Volta valleys: 115,000; irrigated area, Bagre: 200,000; Tanema: 40,000; Karankasso, 120,000.

Report 1/ the AVV plans to settle 3,000 families a year over the coming fifteen years - a tenfold increase in its present rate. But the Report concentrates its analysis on settlement of 2,700 families in the five year period 1978-1982, largely in the White and Red Volta valleys. If AVV successfully settles 2,700 families in the next five years, (which would be almost twice as high a settlement rate as at present) it would be absorbing about one-third of the estimated number of migrants who move into new lands each year. 2/ There is also a risk that as AVV puts down roads, spontaneous migrants will move in on the edges of AVV perimeters, thus diluting the ecological rationale for controlled settlement.

55. Some of the soils in the AVV perimeters present difficult technical problems. The AVV has concentrated its activities in the White Volta Valley, where 136,000 ha. are believed to be suitable for settlement and capable of absorbing 12,000 families. In the existing settlement villages vertisols and sols vertiques predominate. These are fertile, but heavy and tight in structure. The vertisols can only be prepared for planting during a very limited period of the beginning of the rainy season when their moisture content is right. The sols vertiques are lighter but require deeper cultivation because of compaction in lower layers. It is not yet clear that farmers in the AVV perimeters can meet the required conditions of timing and depth of cultivation, even with the introduction of oxen.

56. Organized settlement operations require extensive inputs in money and other resources. Cost estimates for AVV vary, but none is below $10,000 per family settled. It employs some 600 people (34 expatriates), and has one extension worker per 25 families. Yet no one who has seen new settlers arrive in an AVV village can argue that services provided to settlers are luxurious or abundant.

57. Some of AVV's problems and difficulties are "teething troubles;" AVV is after all only five years old. Some arise from constraints on AVV's scale of operations due to lack of financing and liquidity. Some are not problems at all, but reflect excessively optimistic expectations; settlement of new lands in the Volta Basin is simply a lot harder to carry out than was generally realized a few years ago. Some, finally, derive from the fact that AVV has chosen to concentrate on the White Volta where heavy soils predominate. This has had two consequences. First, these are difficult soils, the cultivation of which require special inputs and knowledge. Secondly, these are not the typical soils of Upper Volta; so AVV's experience with cultivation of these soils is not generally transferable to the bulk of the agricultural economy.

1/ Program Globale d'Etudes et d'Investissement de l'Autorité des Aménagements des Vallées des Voltas (1978-82), Rapport Final, Fev. 1978, Synthèse et Recommendations, p. 1. Société Cortay (previously Bei-Agrer).

2/ The number of spontaneous migrants is imperfectly known. There is urgent need for an intensive study of this phenomenon.

58. The AVV, then, is concerned with only a part of the agricultural development problem of the Upper Volta. It is an important part, with great relevance for the future welfare of the Voltaic people. But fundamental constraints on the Upper Volta's economic development are rooted in the low level of agricultural productivity on the Mossi plateau and other "old lands". This is where most Voltaics live, and where most will continue to live for some time. In addition to settlement efforts on the new lands, therefore, there is urgent need to improve agricultural productivity on "old lands", and to introduce new agricultural approaches among those who will continue to farm these lands in the future.

59. It is certain that the AVV can and should play a major role in the agricultural development of the Upper Volta. It may be able to play this role most effectively by concentrating on specialized activities best suited to its unique capacities; and by seeking experimental new roles addressed to the Upper Volta's fundamental needs in agriculture. Moreover, the AVV should welcome the collaboration of ORDs in settlement activities, as was recommended in the recent Cortay (Bei-Agrer) Report, with respect to the Bougouriba.

60. The following additional observations on settlement policy emerged from the mission's discussions in Upper Volta.

(a) AVV's planners should decide whether to continue to focus AVV's dryland settlement operations in the regions of the Red and White Volta characterized by heavy soils, or to extend itself geographically. The AVV is accumulating great experience in the cultivation of these soils, which may require mechanization of some operations. Utilization of these soils will continue to require experimentation of the kind being done in AVV's perimeters at present. Specialization on the heavy soils would thus seem to present some advantages.

(b) In its other interventions in dryland settlement AVV may wish to intensify its efforts to introduce, on a pilot basis, some of the newer ideas on dryland farming relating to improved water management and low-input, soil-enriching approaches such as have been developed elsewhere and are beginning at IRAT stations. With its access to a dense network of extension agents, and its well-developed research capacity, the AVV is well-suited to try the new methods in a controlled environment.

(c) AVV might also further explore possibilities for settlement projects based on irrigation. The main requirements for successful irrigated settlement are a highly structured cultivation system, and depth in extension services - both of which AVV could provide. Most of Upper Volta's irrigation potential is in sparsely settled regions, so settlement is essential and there are no alternative extension services in the country which could do this job. The economics of irrigated settlement schemes may also be more attractive than dryland settlement.

61. With such a wide range of possible activity AVV should welcome the emergence of supplementary and/or alternative approaches to dryland settlement, including possible activities of the ORDs. Larger efforts would seem to be necessary to assist the spontaneous migrants. Experimental schemes relying on different degrees of "guidance" should be tried. It is essential to retain a flexible and varied approach, so that settlement strategies and programs can be evolved which will be most appropriate for the Upper Volta in the long-run and which may also provide lessons helpful elsewhere in the OCP area.

62. Resettlement involves a new routine for households and in particular a new family division of labor. Women are frequently given heavy new tasks in cash crop cultivation, are deprived of their traditional right to cultivate their own piece of land, forced often to walk long distances for water and firewood.

63. Some of these problems have arisen with severity in OCP area settlement schemes. 1/ Problems with aquifers and occasional administrative oversights have sometimes led to location of wells as far as 2-5 km from compounds. Nor have arrangements, in the past, always allowed for women's fields, which has deprived them of traditional sources of income. Women are responsible for part of the family food (spices, condiments) and also have responsibility for feeding of the households' children. Unless provided with alternative sources of income earning, they cannot easily meet these obligations. The problem is worse in the case of villages whose markets have not yet been created, so that even the traditional petty trade offers little opportunity.

64. Much more thought must be given to these issues, not only in settlement schemes but in general. Outside interventions at the minimum can aim at reducing the demands on women's time, notably through better planning of well locations and provision of small mills to reduce time required for food processing. Since labor is a major constraint in settlement schemes, such policies will have important economic payoffs, and also assure greater equity in the process of development.

65. Broader economic participation by women is essentially not only to reduce labor constraints, but has other implications. Unless women can earn higher incomes in both money and kind, it will be difficult to improve nutritional levels, and poor nutrition is one of the most important health problems of the region. The health of children is particularly affected. It is easy to see why the improvement of rural living standards depends to a considerable extent on assuring that women can make a positive contribution to the development process.

1/ Cf. J.N. Guissou, Etude sur les besoins des femmes dans les villages de l'AVV et Proposition d'un Programme d'Intervention. SAED, Ouagadougou, April 1977.

VI. ECONOMIC STRATEGIES FOR THE OCP REGION

66. Similarities and differences between the OCP states were noted in Chapter II. The OCP zone in each of the four coastal states presents many similar characteristics. It is north, and distant from the sea. It is wooded savannah, largely devoted to subsistence agriculture and livestock. It is a substantial part of the country in physical terms, but thinly populated. It is poor. The center of economic gravity in each of these coastal countries lies in the forest and coastal regions where most people live and where most income is generated. In the interior countries of Niger, Mali and Upper Volta, the OCP areas differ, not only from the coastal countries but among themselves. In the Upper Volta, the "OCP zone" is virtually the whole country. In Niger it encompasses a very small but potentially important part of the country. In Mali, the OCP zone covers the most fertile regions, almost one-third of what is commonly called "Mali utile."

67. Not only do the OCP zones of the program area differ in size, in economic characteristics, in economic significance, but the governments of the program area also have different policies and approaches to the development of their OCP zones. This diversity means there is no single planning strategy or set of development policies which is universally applicable to all seven states. It also means that the mission could not -- given its time constraints and the restricted size of this report -- consider in detail or depth the whole range of development policies and development strategy issues which exist in the area. What we will do instead is comment on several aspects of the economic development of the region which impressed the mission by their importance or urgency.

68. It is first of all apparent that there exists in all the governments of the area a strong political commitment to the accelerated development of the OCP areas. Each of the coastal states has a "northern strategy" which favors northern regional development. The aim is to bring about a more balanced sharing of the benefits of economic growth, and a future development which will be more evenly spread between the regions of each of the countries. For example, in the Ivory Coast, this has been an explicit and important policy since 1974; the northern regions have benefitted from a special program of infrastructure development (schools, hospitals, roads, etc.) involving some 20 billion FCFA in expenditure and from introduction of development programs aimed at increasing production of cotton, sugar cane and food crops. Similar programs have been introduced in recent years in Ghana, Togo and Benin. In fact, all the governments of the coastal states see the OCP as part of a general strategy aimed at improving the socio-economic status of their least-developed northern regions. Somewhat different circumstances exist in the interior states, for reasons mentioned earlier. But there, too, governments are anxious to encourage the social and economic advancement of the regions where onchocerciasis is coming under control.

69. It is equally evident that there is significant economic activity in the OCP areas of each of the countries. The mission did not attempt to catalogue the development projects and programs in the area; an exhaustive inventory had already been prepared by the OCP's Economic Development Unit for the Kuwait meeting of the JCC in December 1977. This inventory of projects has recently been updated and will be presented to the Lome meeting of the JCC in December 1978. These reports describe in detail the projects existing in the OCP areas of each of the states, and also discuss the overall development policies of the OCP states. It is therefore unnecessary to reproduce this information in this report.

70. There are two major economic sectors which have received a great deal of attention by government planners and by others concerned with the economic development of the OCP states: livestock production and irrigated agriculture. Each of these sectors has much potential for expansion. Each has a key role not only in general economic development, but in bringing about economic diversification. Each is also relevant in the framework of the anti-drought strategies being implemented under the auspices of the Comite Inter-Etat de Lutte Contre la Secheresse au Sahel (CILSS). Because their importance and their potential has been described extensively elsewhere, and because of space limitations in this report, they will be treated only briefly here.

71. The potential for expansion of livestock production in the OCP countries is well-established. Niger and Mali are -- after Nigeria -- the largest producers of cattle in West Africa. The coastal countries are importers of red meat -- traditionally from Mali, Upper Volta and Niger, but more recently from South American sources as well. Until recently, for example, Ghana imported approximately half her meat consumption, and the Ivory Coast in 1976 imported some 17,000 tons from non-African countries. Thus not only is there a strong demand for meat, in the coastal countries in particular, but the locus of production is in the northern regions of the coastal countries and in the traditional exporting countries (Mali, Niger, Upper Volta). Moreover, the movement of livestock production south, to the better-watered Sudanese zones, is part of the anti-drought strategy recommended by the CILSS and others. The central element of this strategy, in its livestock aspect, is the "stratification" of production -- the increased offtake of young stock from Sahelian herds, fattening them on natural grazing and on industrial by-products in the Sudanese regions, with finishing taking place near coastal markets. Similarly, the wider introduction of mixed farming requires vast expansion in the supply of suitable young animals-all of which gives the OCP area a strategic role in West Africa's livestock development.

72. Irrigated agricultural potentials, similarly, are considerable, and have been given close attention by local planners and in the anti-drought food security context, by CILSS and others. According to the FAO, Sahel Study (1975), Mali had 4 million ha of irrigable soils of which 4% are currently irrigated; Niger 1.8 million ha irrigable, with 24,000 ha (1%) irrigated;

Table 3: FOREIGN NATIONALS BY COUNTRY OF NATIONALITY AND COUNTRY OF ENUMERATION, CENSUSES, CIRCA 1975

Country of Nationality	Country of Enumeration									
	Ghana	Ivory Coast	Upper Volta	Senegal	Sierra Leone	Togo	Liberia	Gambia	Mali	Total (Emigrants)
Ghana	-	42,500	(17,300)	1,000	4,600	(30,000)	3,500	..	..	98,90
Ivory Coast	18,300	-	(44,400)	1,100	..	..	13,700	..	(7,900)	85,70
Upper Volta	159,300	726,200	-	13,700	800	(8,000)	6,400	..	(47,700)	962,10
Senegal	100	19,200	(2,100)	-	..	..	..	25,300	(11,500)	58,20
Sierra Leone	3,000	1,100	(400)	800	-	..	5,500	400	(1,000)	12,20
Togo	244,700	12,100	(2,900)	..	..	..	..	..	..	259,70
Liberia	4,600	3,400	(700)	700	11,000	..	..	300	(1,000)	21,70
Gambia	100	100	(100)	45,600	3,400	..	..	-	(1,000)	50,30
Mali	13,400	348,500	(21,800)	28,900	..	..	..	5,500	-	418,10
Guinea	..	105,800	..	160,200	41,000	..	23,800	17,000	(24,100)	394,50
Nigeria	55,500	49,600	(2,000)	..	7,300	..	..	..	..	114,40
Others	63,100	117,400	(8,300)	82,700	11,300	22,000	2,800	4,300	(5,800)	315,10
Total (Immigrants)	562,100	1,425,900	(100,000)	355,000	79,400	60,000	55,700	52,800	(100,000)	2,790,9

.. Insignificant

- Not applicable

( ) Estimates

Sources: Based on recent population censuses and surveys in the countries, Zacharia and Condé, IBRD, 1978

Upper Volta, some 450,000 ha irrigable, with 18,000 (3%) actually irrigated. 1/ The potentials for irrigation of the large flood plains in the northern regions of the coastal countries are less well known but there are surely many thousands of hectares of bas fonds with great promise for specialized, high-value outputs (vegetables, rice, etc.). And further research and experimentation will better define the development possibilities of the large river valleys in Ghana, Ivory Coast, Togo and Benin.

73. One of the most striking aspects of economic development in West Africa is the large volume of labor migration in the region. Table 3 indicates the direction and magnitudes of these migrations.

74. It is clear from the table that the Upper Volta is the major exporter of labor, the Ivory Coast the main importer. In economic terms, there is little question about the advantages accruing to the labor-importing countries. The impact of migration on the labor exporting countries, especially the Upper Volta is, however, the subject of much debate. Some observers argue that emigration has retarded the development of the Upper Volta. Others say that the relevant question is whether viable alternatives have existed. The degree of equity in the sharing of the benefits of interdependence is also a subject of some controversy. But few would deny that all parties are economically better off with interdependence than they would be were it to end. At the same time, the labor migration aspect of this regional interdependence cannot go much further. Almost a fifth of the total Voltaic population now works and/or lives outside the country. In the Ivory Coast, perhaps a quarter of the labor force comes from outside the country. In both the sending and receiving countries, socio-political limits to migration are probably near.

75. This is what makes onchocerciasis control and the opening up of new lands a matter of such critical importance, not only to the Upper Volta but to the Ivory Coast and to West Africa as a whole. Population pressures on land in Upper Volta have until now been resolved largely by migration southward. But the absorptive capacity of this outlet is shrinking and continuation of past trends is neither possible nor desirable. The availability of new lands reduces demographic pressures on the Mossi plateau, reducing thereby pressures for external migration as well.

76. It is essential to note, however, that for the Upper Volta, settlement and/or migration into "new lands" provides only a partial relief to the problems of population pressure, shortened fallows, declining yields and disastrous erosion. Assuming the Voltaic population will increase at its present rate (2-2.5 percent) and no change in cropping patterns or farming practices, two million-odd hectares potentially available because of vector control can absorb only about 800,000 people, or less than eight years of the

---

1/ FAO, Sahel Study, pages 7, 91.

incremental population growth in Upper Volta. 1/ The situation is not so ominous in the other OCP countries, but similar circumstances await them all in the future, if underlying conditions are not transformed.

77. To the extent that the control program has helped open new areas for occupation, it gives a temporary relief from these urgent pressures, which would otherwise reveal themselves in the form of declining grain yields, accelerating erosion, and higher migration rates. It gives the Upper Volta, in particular, and those outside agencies associated with it in development matters, a critically important breathing spell, time to address fundamental problems of agricultural change and general economic development.

78. There is little question that one of these fundamental problems is the relatively low level of productivity in traditional agriculture. Some of the technical means to raise yields per capita and per hectare are already at hand, for food crops as well as for export crops. Food crop research done by IRAT and by the Crop Research Institute in Ghana have produced locally-adapted input-packages. If farmers could be shown the advantages of using pure seed, appropriate plant spacing and the importance of proper timing of planting and weeding, output would grow rapidly. This will require major efforts to strengthen existing agricultural extension services, with associated efforts in rural development -- intensified experimental field trials, construction of secondary roads and social infrastructure, application of appropriate price and marketing policies which will provide incentives to expansion of production and sales.

79. The increase in agricultural productivity by broader adoption of existing seed-based technologies and by sound rural development policies, can make an important contribution to the economic development of the region. But it is not enough. Experience elsewhere in West Africa and in ecologically similar parts of the world suggests that mixed farming, sound rotations, and use of fertilizers may not be enough to allow permanent cultivation in the typical soils of low rainfall regions -- unless crop residues are recycled and cropping practices are changed in other ways. Otherwise it leads to a gradual decline in soil fertility due to loss of organic matter and acidification. Even where declining fertility can be long delayed (as some IRAT experience suggests is possible) fertilizer costs become very heavy.

80. What is demanded in these regions is not simply an improvement in agricultural practices but a basic transformation of farming systems, the introduction of new technologies which will allow intensive cultivation on a permanent basis.

1/ This is based on the assumption of 2.5 ha. per capita land requirements, which assumes 8-10 year fallows, consumption of 200 kg. of grain annually, production of 500 kg./ha.

81. Rapid and exciting progress in the development of such technologies has been made in recent years. Various new approaches have been developed in different parts of the world, particularly in India, under the auspices of the International Crop Research Institute for the Semi Arid Tropics (ICRISAT). Some of these approaches have been widely tested, with very promising results -- in Kenya and Botswana, for example.

82. The new techniques involve a variety of cropping practices, many of them already familiar: contouring, ridging, mulching, growing of leguminous cover crops, minimum tillage, extensive use of trees and bushes. These cropping systems have three elements in common. (a) Their purpose is to improve soil quality and fertility as part of the production effort; they recognize that many tropical soils will not endure permanent cultivation unless their physical and chemical properties are enriched over time. (b) They are relatively low-input using; they do not stress fertilizer application, or full water control (irrigation). (c) They stress better rainfall management. In some variants of this new system, ridges or beds are laid out on carefully graded contours, in such a way that rain water percolates slowly in the soil profile. Graded run-off systems and spillways slow water run-off, and drainage ways leading to water shortage tanks are frequently involved. Optimizing water use in this fashion leads to dramatic declines in water run-off and soil erosion, and to increases in underground water tables. It permits introduction of new cropping patterns and dramatic increases in yields. In India, ICRISAT reports yields of 5-7 tons per ha. with high yield security. And the ICRISAT approach has been implemented at relatively low cost and without complex or capital-intensive methods. Appendix IV contains further discussion.

83. The promise of these new methods is great; but so are the obstacles in the way of their adoption. Although research has provided methods for intensification which have produced superior results, their general application under practical conditions poses challenges such as high climatic risk, seasonal labor shortages (and hence difficulties in adherence to recommended cropping calendars), uncertainties about the economics of input use, etc. What is needed at this stage is widespread and systematic experimentation with the elements of better water management, increased tree cover, etc. Pilot projects along these lines and programs of related research should be given highest priority by local agricultural authorities and by donor agencies.

84. With respect to overall economic strategy in the OCP zones of the coastal countries, it is important to consider carefully the notion of "onchocerciasis zone" or "onchocerciasis-related" projects. There should be no presumption that such projects have a <u>per se</u> priority claim on national development resources. Projects for the onchocerciasis-controlled zones should be evaluated on a case by case basis, on their merits. Onchocerciasis control will certainly open up new opportunities, and in the coastal countries it will continue to be desirable to favor northern area development for both social and economic reasons. But the general policy should be to use available resources where and how they best meet national objectives.

85. At the same time, OCP-related experiences and studies have made clearer the nature of the obstacles to development in the OCP areas. By doing so, the OCP has underscored the need for increased attention from the donor community if development constraints in these areas are to be more effectively reduced and the economic progress of the region accelerated. It has made clear also the urgency of the need for transformation of dry-land farming methods in the region as a whole. A major international assistance effort aimed at bringing about this transformation is strongly indicated.

86. This point is critical and merits special stress. The poverty of the OCP area and the difficulties that lie in the way of economic development make it clear that such a strong effort is essential to an accelerated pace of development in this area. The fact that settlement of the new lands which the OCP helps open up will provide only a partial and temporary solution increases the urgency and importance of expanding international assistance. While the mission emphasizes that there is no universally applicable development strategy for the region as a whole, and that each development scheme needs to be evaluated on its merits and in its national context, it also points to one conclusion that is generally applicable: more development resources are needed in this disadvantaged region. A greater effort is urgently required by all parties to develop and implement programs which reach the broad mass of the population in the OCP area. This not only in turn entails a whole range of action by donors and participating countries not only in the agricultural and livestock development but in transport, mineral exploration, industrial development, as well as in activities that increase the absorptive capacity of these states, such as education, health and administration.

VII. PLANNING THE DEVELOPMENT OF THE OCP AREA

87. Associated with the OCP is what has come to be called "the FAO/IBRD methodology," "the standard methodology" or, more simply, "the methodology" — an approach to planning the development of the OCP zones in each country. According to the methodology, planning should proceed in three stages: (a) the gathering of basic information (creation of a "data bank") by making an inventory of existing studies and undertaking new ones, with particular emphasis on basic data generation by remote sensing; (b) the utilization of this information for preparation of a ten year "onchocerciasis zone" development plan; and (c) the implementation of specific development projects. To implement the methodology, a Development Planning Group, headed by a Permanent Advisor, was to be attached to each OCP country's planning agency. Each country's "data bank" was to take 10 months to complete, and ten year plan 4 months. 1/

88. All of the OCP governments recognize the need to plan the development of the new lands becoming available as a result of onchocerciasis control. Five of the seven governments agreed to the general approach outlined in the methodology. Two (Ivory Coast and Niger) preferred to channel their effort through their existing regional planning structures.

89. Implementation of the methodology was estimated to require approximately $7 million. The UNDP, IBRD (through IDA) and USAID offered support for various components, as indicated in Table 4. The amount of funding available as of late 1977 is indicated in Table 5.

1/ FAO/IBRD, Economic Development of Areas Freed from Onchocerciasis in Dahomey, Ghana, Mali, Togo and Upper Volta (Rome, 1975).

TABLE 4

SOURCES OF FINANCING AND CURRENT STATUS, OCP PLANNING METHODOLOGY

	Resource Inventory	Socio-Economic Studies	Establishment Planning Unit	Establishment Long-Term Plan	Studies on Specific Projects
Benin	UN/US	UN	UN	UN	ID Still Available
Ghana	US	UN	UN	UN	ID Still Available
Mali	US	UN	UN	UN	ID First Projects Identified
Togo	UN	UN	UN	UN	ID Still Available
Upper Volta	UN	ID	UN/ID	ID	ID First Projects Identified
Ivory Coast	UN	NST	NAT	NAT	UN
Niger	UN	UN	UN	UN	

Financing Agents

US: USA-AID

UN: UNDP

ID: IDA

NAT: NATIONAL FUNDS

TABLE 5

AMOUNT AND SOURCES OF FINANCING FOR OCP
ECONOMIC DEVELOPMENT PLANNING, 1977

COUNTRY	IDA	UNDP	USAID	GOVERNMENT	TOTAL	ORIGINAL ESTIMATE OF NEEDS[b/]
			US$ '000			
Benin	-	500.0	240.0[a/]	56.0	796.0	1,297.6
Ghana	600.0	500.0	200.0[a/]	54.0	1,354.0	1,421.1
Mali	500.0	500.0	—	84.0	1,084.0	1,858.6
Togo	300.0	500.0	—	26.0	826.0	556.7
Upper Volta	1,495.0	500.0	560.0[a/]	73.0	2,628.0	1,561.0
Unallocated			1,470.0			
						6,695.0

a/ Estimation of a total of approximately US$1.0 million for the remote sensing related studies.

b/ As estimated in the Joint FAO/IBRD Report, 1975, p. 11.

90. Implementation has moved forward at an uneven pace. In Togo studies of the Oti Valley and other northern regions were quickly launched. Elsewhere the "data bank" has evolved more slowly. A basic mapping study (via satellite imagery) of Upper Volta, Ghana and Benin was launched late in 1977. Other information - gathering projects are still in the discussion stage. "Permanent" or "Senior" advisors have been appointed in three countries: Benin, Ghana and Mali -- in the latter two only since early or mid-1978. No ten-year plan has been prepared.

91. During the field visits of this review mission it became apparent that the nature and purpose of the methodology has given rise to different interpretations in the OCP governments. At the outset, the methodology was

not conceived of as a substitute for local planning approaches. It was rather viewed by its initiators as a supplement to local efforts. Nor was the idea of an "OCP planning approach" meant to convey the impression that national-level planning would in any sense be replaced by an OCP-wide planning approach. The methodology, with its recommended sequence (gather information, define projects and priorities in a plan, then prepare projects) was not intended to be a rigid formula. Project work would inevitably get under way before the data bank was full, and the plan preparation and project-making processes could or should go on in tandem in many instances.

92. Experience has revealed the need not only for clarification along the lines mentioned above, but also the need to adapt the original approach. As has been stressed in previous chapters, the participating countries differ in key respects, and this makes unsuitable a uniform approach to their development - whether on the planning side or otherwise. With respect of planning, three sets of differences call for a more differentiated planning approach.

(a) The importance of the control program to national economies and national-social policies varies sharply from country to country. In the four coastal countries the OCP areas are the poorer northern regions, each of them the object of "northern strategies" aimed at more balanced regional development. In these cases special planning efforts and expenditure on the OCP area can be justified on the grounds that it runs parallel with and strengthens the "northern strategies," with desirable equity effects. But the same cannot be said for the three interior countries. Mali in particular presents a strong contrast: the relatively well-endowed OCP area there already benefits from many development actions.

(b) Each OCP country has different planning structures and institutions, and different strengths, weaknesses and needs in the planning area. Thus in Upper Volta, regional planning experience is slight and regional planning machinery embryonic. A single development authority (the AVV) has responsibility for the development of the river valleys. In Benin, Togo and Niger, where small proportions of the population live in the OCP zone, regional planning structures exist, but no river basin authorities. In Benin there are numerous state agencies with responsibility for regional planning, in Togo few. In Togo there are many studies of the northern regions, completed or under way. In Benin there are few. In Niger and Ivory Coast there is considerable physical planning experience in the planning organization; this is less true in the other states. In Ivory Coast, planning data by region are relatively

plentiful. Regionalization of planning has advanced to the stage where programmes give break-downs of investment expenditure by region. In Ghana regional planning institutions have been in place for many years, and planning offices exist at regional and sub-regional levels. An Upper Region Integrated Rural Development project provides central focus for the agricultural efforts in that part of the OCP area. In Mali the planning machinery has more of a functional than a regional cast. Major planning (and execution) of development activities occurs within the specialized "operations" which exist throughout the country.

(c) Resettlement, the planned occupation of "empty lands," is not of the same importance everywhere in the OCP. But underlying the methodology was one principal objective: to assure that resettlement of lands where onchocerciasis is coming under control received the special attention, the special planning, it requires. The background documents to the OCP show this clearly; the need for soundly-conceived settlement programs and projects was the main rationale of the planning methodology proposals. But, as was shown earlier, conditions with respect to population/land pressures and ease of access to "empty lands" differ a great deal from country to country within the OCP area. As a result, the need for and emphasis on resettlement programs varies.

93. It should be evident that, except in a very general way, no single planning approach is suitable for these heterogenous circumstances. It was inevitable that a methodology giving implicit priority to the needs of resettlement programs, and which laid out a broad but uniform approach with respect to studies, long term regional development plans, etc., should "fit" some of the OCP countries less well than others. This reinforces the need to make clear that the methodology should be broadly and flexibly interpreted, as a set of general guidelines.

94. The following adaptations or interpretations seem most in order.

(a) The OCP countries which are following the FAO/IBRD methodology as a whole, or any of its components, should be given continued encouragement in their efforts, which should be regarded as test or pilot experiences. Those OCP countries which have chosen to adopt only some components of the methodology, or none at all, should be equally encouraged in this interpretation of their needs and priorities. That diverse conditions create different needs, in planning as in other matters, should be explicitly acknowledged and allowed for.

(b) The concept of the Development Planning Group (DPG) should be tested in the three countries where "Permanent" (or "Senior") advisors have been appointed (Benin, Mali, Ghana). Further extension to other countries should await an evaluation of experience in these countries.

(c) Any ambiguity about the autonomy of the Development Planning Group should be removed; they should be fully integrated into existing planning bodies.

(d) The notion of a "long-term development plan" for the "onchocerciasis zone" (Phase 2 of the FAO/IBRD methodology), should be very broadly interpreted in the three states with DPG's, and should only be elaborated there as part of overall national planning exercises. These "onchocerciasis zone development plans" need not be contemplated in Upper Volta (because the whole country is the OCP area). Nor will they be meaningful if OCP extension southward occurs in Ivory Coast, Ghana, Togo and Benin, since the "onchocerciasis zones" will then take up a large part of these countries as well. In general, to the extent that national authorities feel it useful to have such regionally-based, localized planning efforts, they should be brief, simple stock-taking exercises, aimed at identifying major constraints and sorting out project ideas for further development. Technical assistance should continue to be provided for such efforts, if requested, though not necessarily through Development Planning Groups.

(e) The best use of the OCP-related planning machinery will vary from country to country. In Upper Volta, for example, questions of settlement and migration are of high priority. Potential OCP-related planning inputs in Upper Volta might therefore usefully be deployed to focus on socio-economic analysis of migration and resettlement policies and programs. In Mali, data gaps (on population distribution, agronomic and soil characteristics, hydrology, etc.) are particularly acute. The OCP-related planning effort might therefore stress data generation and research. In general, the OCP-related planning machinery could be used to strengthen capacity in regional planning, in project preparation and in policy-focused analysis of migration and resettlement questions, where these are of actual or potential importance.

(f) The results of the methodology and of existing approaches to planning for the development of the OCP areas should be evaluated after a reasonable amount of experience has been accumulated; the end of 1979 seems an appropriate time. Out of this evaluation should come recommendations on planning needs, including needs in related studies and research, during the next phase of the OCP.

The Economic Development Unit

95. Related to the planning methodology is the question of the role of the Economic Development Unit. The EDU has performed useful monitoring and reporting tasks in its attempts to track development projects in the OCP area. Its repertory of projects, as presented to the Kuwait meeting of the JCC in December 1977, represents a tremendous achievement. Moreover, the reports written by EDU staff members upon return from their missions to member countries are highly useful documents, informative for all those concerned with the OCP. They proved particularly helpful to this Economic Review Mission.

96. Despite the usefulness of its past activities, the EDU director and staff are searching new roles. One reason is the lower productivity inherent in keeping the inventory of projects up to date as compared to putting it together. Extension of the project zone, moreover, would create some complications: cataloging of projects in the extension zone would mean canvassing much of the area of the four coastal countries. This kind of inventory of project activities is a major task, difficult even for heavily-staffed ministries of cooperation in most developing countries. This is not a function which EDU could readily perform in the extended program area.

97. There are related activities, new emphases, which are altogether in line with EDU's mandate, and which have already been under consideration at EDU offices in Ouagadougou. The EDU could expand its research and policy analysis activities, either undertaking research directly, or -- more suitably -- serving as a research initiator or organizer. Thus EDU could seek external funding for specific research, all or most of which it would arrange to have done by contract. It could also expand its advisory activities, assisting OCP management and OCP-related officials at the individual country level on development-related research, policy or projects.

98. The EDU cannot perform these kinds of activities effectively unless the scope of its concerns is narrowed. Possible areas of concentration are as varied as the economic priorities of the OCP member states. One appropriate area is resettlement and migration. The EDU could concentrate on this particular aspect of the OCP region's development, since this is where major direct economic impact of the vector control program will be felt. It is also where the need for policy- and project-related research is great, especially in Upper Volta. By accumulating experience, knowledge, documentation on settlement and migration issues and by stimulating and organizing

research, EDU can make an important contribution to the definition of policies and the development of programs on these critical matters. Socio-economic research on health-related questions would be similarly appropriate, and in line with the recommendation made at the recent Cotonou meeting of national representatives of the OCP, that the EDU set up studies to measure the economic impact of the OCP.

The Economic Development Advisory Panel

99. The Economic Development Advisory Panel (EDAP) has attempted since its formation in 1975 to evolve a well-defined sphere of activity. Why this has proved difficult should be evident when one compares EDAP's scope of possible activity to that of STAC. The latter brings together the agency responsible for executing vector control and scientists knowledgeable in fields related to control of the vector Simulium -- specialists in entomology, biology, chemistry, medicine, etc. The central concern is unambiguous: how to control onchocerciasis more effectively. The advisory panel makes available to the OCP management the best specialists in the world on this question. "Economic Development," however, involves a much wider range of questions, from budget policies, to regional economic strategies, to livestock or rice projects. And this broad array of questions arises in different circumstances in each of the countries. Moreover, there are a large number of agencies responsible for executing economic development, none of which are represented at EDAP meetings. It is no wonder that EDAP has had difficulty in finding a suitable focus.

100. The mission was unable to consider at length the question of the future role of EDAP. We were able to consult with only a few of its members. We hesitate therefore to present firm recommendations. It is nonetheless clear that, for the reasons mentioned, EDAP in its present form suffers from severe obstacles, which reduce its productivity and its potential. The reasons, it should be stressed, are structural; they have little to do with the composition of the Panel, availability of resources, etc. Its focus would have to be much more clearly defined, and contacts with its specific audience intensified.

101. A flexible alternative might be envisaged in the framework of a reorganized advisory structure. There is much to be said for forming one advisory panel for the OCP, with ad hoc sub-panels on such scientific, ecological and economic development issues as may arise from time to time. The EDAP functions would then be exercised within these ad hoc sub-panels. This would allow the economic advisory role to be played more effectively than is possible under the present arrangements, since it would provide both the necessary focus and the specific audience now lacking.

VIII. ECONOMIC CRITERIA FOR ASSESSING THE REQUESTED EXTENSIONS OF THE OCP

102. Extension of the vector control program has been requested by a number of participating governments, and the request is under consideration. Studies of the technical aspects of extension have been launched. The Economic Review Mission was asked to comment on economic aspects of this extension.

103. The mission found it difficult to assess the economic aspects of the proposed extension, for various reasons. The new boundaries of the program remain undetermined; possible technical approaches and problems are still being studied; the degree of onchocerciasis prevalence in the proposed extension area is only partially known. Under the circumstances only general observations are in order.

104. It should first of all be noted that the decision to extend should depend on medical or entomological needs — the need in particular to prevent or reduce reinfestation of the present OCP area. It is, secondly, evident that the decision on extension must be coordinated between contiguous states and must cover adjacent zones in different countries. If, for example, it is found desirable to extend almost to Cotonou in Benin, then the controlled area in Togo must be extended roughly to the same latitude. If this is not done, lateral reinvasion would seem inevitable.

105. The economic benefits of the proposed extension will, of course, be of the same nature as the benefits of the existing program: the increase in output derived from reduction in onchocerciasis-induced debility, disability and blindness; the amount and quality of land made more accessible as a result of control of the Simulium vector. In addition, there will be benefits due to reduction of reinvasion, and hence reduced expenditure on vector control in the present OCP area.

106. The labor-related benefits will depend mainly on the size of the population in the extension area and the prevalence and severity of onchocerciasis infection. In the three coastal countries, the proposed extension will in fact cover large populations. In Ghana, the requested extension area covers 1.4 million people (1970 Census estimate), almost as many as in the existing OCP area in that country. In Togo, extension to the central and plateaux regions would protect 850,000 people, as compared to the 510,000 in

---

1/ In the Ivory Coast, extension is already approved. The present OCP area contains 900,000 people (1975 Population Census estimate), and about one-third of the total area of the country. The extension area adds another one-third of the country, with a population of 2.2 million.

the Savannah regions presently covered. And, in Benin, extension would cover some, perhaps all, of the densely-populated southern provinces (Mono, Atlantique, Maritime), which include more than 50 percent of the total population of the country, though only 10 percent of its land area.

107. The fact that the proposed extension would bring protection against onchocerciasis to relatively large numbers of people suggests that labor-related economic benefits could be substantial. The extent to which this population is presently exposed to onchocerciasis is then the critical question.

108. The mission made an estimate, by analysis of available maps, of the extent of "empty-lands" in the extension area, and the quality of the soils in question. The results are shown in Table 6. They confirm what local authorities stress: that the "empty-lands" in the extension area have much economic potential. The extension would in particular remove the onchocerciasis obstacle from 792,000 ha of bottomland (category 2) and about 1.4 million ha. ferralitic (category 4) soils. The major unknown element in the economics of the extension is the extent to which onchocerciasis is a critical factor explaining the present underutilization of these lands.

109. In this regard, it is worth emphasizing that the economic justification for the extension of the OCP area does <u>not</u> depend primarily, or even significantly, on the number of development projects and programs existing in the proposed extension area or planned for it. These are relevant only under the following conditions:

(a) The projects in question are (or will become) demonstrably and significantly more productive with onchocerciasis control than without it.

(b) There are no alternative, cheaper ways of achieving a tolerable level of disease control in the project area.

(c) For new projects, it is not possible to locate in areas of low endemicity or easy disease control.

110. The economic case for program extension should be based on the following criteria:

(a) The prevalence and severity of the disease among the working population of the area, and the size of the affected population.

(b) The existence of potentially productive resources - land in particular - the exploitation of which is significantly obstructed by the presence of <u>Simulium</u>.

(c) Evidence that the opening of these "new lands" will represent a significant addition to productive potential in the area. This is directed at the question of whether there do not already exist substantial quantities of underutilized land, in localities where onchocerciasis is absent or of low endemicity.

111. The economic case for extension would also be strengthened if it could be demonstrated that extension will result in significant reductions in dangers of reinvasion in the present OCP area, and that cost-effective alternatives to OCP extension do not exist.

112. This suggests the need, even at an early stage, for a thorough exploration of alternative methods of onchocerciasis control in the proposed zones of extension, the critical importance of which has already been noted. High costs are necessarily involved in continuous control with the existing technology over so vast and environmentally diverse a region. It should be possible to develop more cost-effective approaches; efforts in this direction should be speeded up.

113. The focus on economic benefits of the control program should not obscure the humanitarian aspect of the OCP. A central objective of this program - its extension like the existing activity - is to reduce the misery brought by sickness to an impoverished part of mankind. The degree to which the extension of the program area contributes to this goal should be a major criterion for determining its justification.

Table

HECTARAGES OF "NEW LAND" AVAILABLE IN PROPOSED OCP EDTENSION AREA BY TYPE OF SOIL, WITH AND WITHOUT APPLICATION OF REDUCTION FACTORS

(in 1000 ha)

G= Gross hectarage; R_1= hectarage available after reduction for impurities. R_2= hectarage available after reduction for infrastructure

Soil Categories	1			2			3			4			5			6			Total		
	G	R_1	R_2	G	R_1	R_2	G	R_1	R_2	G	R_1	R_2	G	R_1	R_2	G	R_1	R_2	G	R_1	R
Benin	-	-	-	238	226	158	72	65	59	114	86	77	2131	1385	1247	226	23	18	2781	1785	1559
Ghana	-	-	-	282	268	188	-	-	-	387	290	261	1831	1190	1071	549	55	40	3049	1803	1560
Ivory Coast	30	29	26	272	258	181	-	-	-	888	666	599	591	384	346	377	38	34	2158	1375	1186
Mali	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Niger	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Togo	-	-	-	-	-	-	39	35	32	39	29	26	980	637	573	126	13	12	1184	714	643
Upper Volta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	30	29	26	792	752	527	111	100	91	1428	1071	963	5533	3596	3237	1278	129	104	9172	5677	4948

Soil Types: 1= brown entrophic soils
2= alluvial - colluvial (bas fonds)
3= vertisols
4= ferralitic
5= ferruginous
6= unsuitable lands

Participants in Economic Review Mission
Timetable of Field Visits and Terms of Reference

Participants in the OCP Economic Review Mission

Elliot Berg, Mission Leader — Consultant
Jeanne Bisilliat, Sociologist — Consultant, FAO
Max Burer, Agronomist — IBRD
Heinz Graetz, Agronomist — Consultant, FAO
Ralph Melville, EDAP — Consultant (Upper Volta)
Vann Molyvan, Ecologist-Settlement Specialist — Consultant, UNDP
Jean Park, Economist — IBRD (Upper Volta, Niger)
Ram Christophe Sawadogo, Sociologist — Consultant (WHO)
Hjalte Sederlof, Loan Officer — IBRD
Kaes Van der Meer, Soils Specialist — Consultant

Timetable of Field Visits by OCP Economic Review Mission 1/

First Field Visit	January 19-21, 1978	Paris
	January 22 - February 3, 1978	Upper Volta
	February 3-12, 1978	Ivory Coast
	February 12-18, 1978	Ghana
Second Field Visit	March 23-26, 1978	Paris
	March 26 - April 3, 1978	Togo
	April 3 - 7, 1978	Benin
	April 7 - 14, 1978	Mali
Third Field Visit	May 23 - 26, 1978	Niger 2/

1/ Not all mission members visited each country, nor did each stay the same amount of time in the countries visited.

2/ Only one member of the mission could visit Niger; the government of Niger was unable to receive the mission in April.

Onchocerciasis Economic Review Mission
Terms of Reference

1. At its meeting in Rome on September 1 and 2, 1977 the Steering Committee for the Onchocerciasis Control Program (OCP) decided that the sponsoring agencies of the Program - FAO, UNDP, WHO and the Bank - should field a mission to carry out a comprehensive review of the program in order to lay a proper basis for its next six-year phase which will start in 1980. WHO has responsibility for the vector control aspects of the mission and the Bank has been given responsibility for the economic development aspects.

2. As a consequence, the Bank is launching an economic review mission with the general objective of determining the economic development implications of the program. Drawing on existing documents, studies and reports as well as on its own inquiries in the field, the mission will make a general assessment of the economic development aspects of the program and make recommendations for the next phase.

3. In the framework of these general objectives the mission will endeavor to:

(i) assess what is known and what still needs to be found out about the economic impact of onchocerciasis control in the program area;

(ii) review national development strategies and policies in the program area and assess their suitability;

(iii) determine key obstacles - agronomic, economic, sociological, health - to economic development in the program area;

(iv) determine the extent to which the program has opened up new land for cultivation and assess existing settlement/migration strategies, policies and institutions;

(v) determine the relevance of the planning methodology, identify barriers to effective planning and recommend an appropriate approach to planning for the program area;

(vi) provide guidance on the economic justification of the proposed extension of the program area.

4. Professor Elliot Berg from the University of Michigan will lead the mission, which will have the following schedule (approximate dates):

1.10 - 1.17	Orientation sessions in Washington
1.23 - 2.4	Upper Volta
7.6 - 2.11	Ivory Coast
2.13 - 2.18	Ghana
2.20 - 3.10	Report Writing
3.13 - 3.18	Mali
3.20 - 3.25	Benin
3.27 - 4.1	Togo
4.3 - 4.8	Niger
April - May	Report Writing

5. In the field, the mission will liaise with the various national authorities concerned, UNDP and FAO representatives, and Bank resident missions. During orientation sessions and the report writing phase, the mission will draw upon the advice of Bank staff as needed.

6. The mission will prepare a report of 40-50 pages containing a summary and conclusions, a general section and individual country sections; in addition, annexes can be added as appropriate. A draft report should be available by June, 1978.

The Definition and Measurement of Economic Benefits from Onchocerciasis Control

1. In the main PAG Report and the principal economics annex (Annex VI-5, the Methodology of the Economic Analysis), there is no attempt to do a formal cost-benefit analysis of the control program. In various places, mention is made of the "socioeconomic effects of onchocerciasis," "the economic impact of onchocerciasis control," various development scenarios with and without the control program. While estimates of associated benefits appear, they are not systematically treated. 1/

2. The major rate of return analysis in the PAG Report is in fact done not for the control program but for a collection of settlement projects. The costs of the control program are added to the cost of the proposed settlement projects and the benefits of the settlement projects become the benefits of the control program. 2/

1/ PAG Report, annex VI-5, The Methodology of the Economic Analysis. Methodological problems, data deficiencies, and time pressure were such that it would be uncharitable to evaluate this document too harshly. Nevertheless, the analysis contains a number of questionable assumptions and approaches. The benefits of eventual industrial production are mentioned as benefits of the control program. All the costs of soil degradaion are inputed to the onchocerciasis barrier to migration. The same is true of the aging of the population. In the general discussion, the costs of blindness are double-counted -- once in terms of income lost, a second time in terms of community costs of support. There are further ambiguities on perhaps more fundamental matters, most notably the assumptions used with regard to output produced by potential emigrants from "old" lands to new. The Report apparently assumes that there is no loss in "old land" output when people emigrate to new lands. But this either involves an implicit assumption that the marginal product of labor on old lands is zero, or it simply is double counting, i.e. counting as benefits the gross output from migrants on new lands without deducting output losses in old lands from which the migrants come.

2/ The control program is assumed to last 20 years, with total costs estimated to be $100 million. The benefits of the five major projects are projected to be $470 million. A 35-year time horizon is used. An additional table added benefits of a group of so-called "supplementary projects," for a total of $819 million, control costs remaining unchanged. Internal rates of return are then calculated. A 6% IRR is found for the five projects, a 10% rate when the "supplementary projects" are added. (Table V-5.24, Annex VI-5, The Methodology of the Economic Analysis, p. 52).

This procedure is open to numerous objections.

(a) It imputes no benefits to the control program as such. But -- and this is noted elsewhere in the PAG Report -- benefits of the program come from better health, hence reduced output loss via disability, debility, and blindness, as well as via its contribution to opening up new lands.

(b) it assumes that production from new lands requires formal settlement projects, which is not true. Spontaneous or unplanned migration is possible;

(c) it assumes that all settlement projects in the Program area are impossible or unfeasible unless the OCP is in operation; it assumes, that is, that disease control is a necessary condition of resettlement and that the OCP technique of control is cost-effective for all settlement projects; and

(d) it justifies the OCP by referring to a poorly defined, vaguely costed set of settlement projects. At the time, very little information existed on those projects; it was certainly not clear that they would prove technically feasible or economically viable. It was always possible, moreover, that the projects would not come to pass; this would take from the OCP its major economic benefits, leaving it (wrongly, as noted in point (a) above) without firm economic foundations.

4. In the paragraphs that follow we sketch out an alternative approach to cost-benefit analysis of the control program. The purpose is to help clarify definitions of economic benefits and to indicate possible orders of magnitudes of some of these benefits. As was explained in the text, the economic benefits of the control program flow from two main sources: avoidance of losses in individual output, which we call labor-related benefits, and net increases in output from the opening up of new lands. Each will be discussed in turn.

A. Methodology for Measurement of Labor-Related Benefits

5. Labor-related benefits of the control program are the costs associated with the disease. Four elements must be included in measuring labor-related costs: (1) the relevant population; (2) the time span and discount rate; (3) the value of the output of the population; and (4) the impact of the illness on productivity.

6. The population to be considered in measuring these costs should be those at risk from the illness and economically. The importance of the time horizon of the analysis is, in large part, determined by the interest rate

chosen to discount cost flows to their present value. The discount rate should reflect the preference for present over future consumption and the opportunity costs of the investment resources involved. The output cost of illness is the value of output foregone when worktime or efficiency is lost, i.e. the marginal product of labor. The productivity effects of illness are generally classified as disability (loss of working time); debility (loss of efficiency); and death. In the present case, blindness replaces death. A proportion of output lost can be assigned to each type of illness effect.

7. As noted in the text there exist no concrete data indicating the differences in productivity between individuals afflicted with oncho and individuals without it. Indeed, there are no such data from studies of the impact of other diseases, which might suggest orders of magnitude 1/ of these productivity effects.

8. In the absence of such data, we have made a range of estimates of productivity effects, and have calculated benefit flows in varying assumptions about discount rates and the productivity of labor. These are shown below in Table I.

9. The labor-related productivity benefits are undoubtedly positive, but they are probably not large, for a number of reasons.

(a) Incomes are very low in the OCP area. According to the PAG Report, annual per capita incomes in the relevant regions were between $14 and $40 (1972). 2/ Average incomes in the poor countries of the interior and the relatively poor northern regions of the coastal states remain low today — probably in the neighborhood of $50-75 per capita. The incremental output resulting from reduced nuisance effects, reduced debility and avoidance of blindness must therefore be small.

1/ Cf. The literature survey in Rolland Ballay, l'Economie due Paludisme: Essai sur l'Economie de la Santé. These Universite des Sciences Sociales, Faculte des Sciences Economiques, Grenoble, 1972, p. 8. (See B., Weisbrod, et al, Disease and Economic Development: The Impact of Parasitic Diseases in St. Lucia, University of Wisconsin Press, Madison, 1973) for the most careful attempt yet made to measure productivity effects of a disease in a less-developed country environment. Subsistence farmers, however, are not included in this study.

2/ The PAG Report gives $14 as average per capita income in Upper Volta, where 80% (52,000) of the total OCP area blind population were located. However, this seems an unusually low estimate and may refer to money income only.

(b) It is reasonable to assume that nuisance losses are relevant mainly to those who live close to the main rivers and their tributaries, but the population densities in these localities are generally low. Similarly, while oncho is highly prevalent throughout the OCP area, severe infection (for example, densitites of more than 25 microfilariae in skin snips) is probably restricted to the sparsely populated areas close to the rivers. It seems reasonable to suppose that significant losses in output due to debility occur mainly among these severely infected individuals -- i.e., a relatively small proportion of the total population.

(c) Thirdly, the factors influencing labor productivity are numerous, and the impact of change of any one of them is likely to be abscured if the others remain unchanged.

(d) Finally, there is evidence that those most intensively affected by oncho are also touched by malaria, trypanosomiasis, schistosomiasis, and other parasites. 1/

1/ This is reported in a 1951 study by Chastain, cited by Philip Zoure, Aspects de l'Onchocercose en Haute Volta, These de Doctorat, Bordeau II, p. 96.

10. The present value of the labor-related costs of illness is given by the following formula, with the notation explained below.

$$PVL = \sum_{t=n}^{m} \left[p_t \times p_r \times p_a \times (1+g)^t\right] \times \left[v \times (1+r)^t\right] \times (p_1 L_1 + p_2 L_2 + p_3 L_3) \times (1+d)^{t=n}$$

PVL = present value of the loss
n = current period
m = termination date of analysis
p = area population
g = growth rate of population
Pr = proportion of population at risk
Pa = proportion of population active in workforce
v = value of marginal product of labor
r = growth rate of marginal labor productivity
P_1 = proportion of at-risk population disabled
P_2 = proportion of at-risk pop. debilitated
P_3 = proportion of at-risk pop. blind
L_1 = percent loss of output due to disability
L_2 = percent less of output due to debility
L_3 = percent loss of output due to blindness
d = discount rate

Parameters used in Evaluation

11. The values assumed for the parameters of the above equation in evaluating the labor-related costs of onchocerciasis in the OCP area follow:

(1) Population

a. Base area population: 10 million people, given by the PAG Report

b. Population at-risk: 1 million people, given by the PAG Report

c. Population active in the workforce: 70 percent 1/

d. Population growth rate: 2.5 percent 2/

(2) Time Questions

a. Rates of discount: 10 and 15 percent

b. Time horizon: 25 years

(3) Value of output: $40 - 75 3/

(4) Productivity Impact

a. nuisance (fly bites): 0.5 - 1.0 percent of output

b. disability (reduced vision): 2.5 - 5 percent of output

c. debility (reduced efficiency due to heavy parasite load): 2.5 - 5 percent of output

d. blindness: 100 percent loss of output.

Estimated Losses

12. Table I presents a range of estimates of the present value of the 25-year labor-related costs of onchocerciasis. They range from $21-$94 million. The most important labor-related cost is the loss of output due to blindness. The labor-related benefits may be compared to the estimates of the present value of the control program costs, estimated in Table II which follows on Page 6 of Appendix II.

1/ ORSTOM, Les Migrations de Travail Mossi, Ouagadougou, 1975.

2/ This rate approximates the average population growth in the area in recent years.

3/ Estimated by inflating the PAG estimate of per capita OCP area incomes to 1978 levels.

Present Value of Labor-Related Benefits of the OCP

TABLE I

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. Total Population of Project Area (in millions)	10	10	10	10	10	10	10	10	10	10
2. Population At Risk (in millions)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
3. Productive Persons At Risk (in thousands)	700	700	700	700	700	700	700	700	700	700
4. Population Blind in 25 years (in thousands)	100	100	100	100	100	100	100	100	100	100
5. Population Growth Rate	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
6. Value of Marginal Product of Labor	$75	$75	$75	$75	$75	$75	$40	$40	$40	$40
7. Output Growth Rate	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
8. Discount Rate	10%	10%	10%	15%	15%	15%	10%	10%	15%	15%
9. Loss of Output (%)										
a. Nuisance	1%	1%	0.5%	1%	1%	0.5%	0.5%	0.5%	0.5%	0.5%
b. Disability	5%	2.5%	2.5%	5%	2.5%	5%	5%	2.5%	5%	2.5%
c. Debility	5%	2.5%	2.5%	5%	2.5%	5%	5%	2.5%	5%	2.5%
d. Blindness	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
10. Value of Output Loss (in million)										
a. Nuisance	8.5	8.5	4.3	5.3	5.3	2.6	2.3	2.3	1.4	1.4
b. Disability	17.5	8.8	8.8	9.3	4.6	9.3	9.3	4.7	5.0	2.5
c. Debility	17.5	8.8	8.8	9.3	4.6	9.3	9.3	4.7	5.0	2.5
d. Blindness	50.1	50.1	50.1	26.3	26.3	26.3	26.7	26.7	14.0	14.0
e. Total	93.6	76.2	72.0	50.2	40.8	47.5	47.7	38.4	25.5	20.5

TABLE II

Present Value of Costs of the Onchocerciasis Control Program
($ millions)
($25 million per year)

Years of Program	Discount Rate .10	.15
10	$154	$125
15	190	146
20	213	156
25	227	162

13. For reasons suggested in the text, lower discount rates and longer time horizons may be more suitable for evaluating the OCP than the "conventional" 10 - 15 percent, 25-year assumptions. These latter discount rates are based on the assumption that in alternative uses, the resources involved in the OCP can generate output streams of this magnitude. It is doubtful that this is so, for reasons mentioned in the text. The use of a longer time horizon (50 years, for example) brings benefits above costs (present values) at a 9 percent discount rate. The use of a very low discount rate (which means that the welfare effects on the next generation are valued almost as highly as the welfare effects on the present generation) brings the present value of OCP benefits to over twice the present value of the program's costs, with a fifty-year time horizon. The assumptions and results of the analysis are set out below.

Assumptions

(1) 50-year time horizon

(2) Project costs

a. First 15 years $25 mil./yr.
b. Last 35 years $12.5 mil./yr.

(3) Population growth rate - 2.5%

(4) Productivity growth rate - 3.0%

(5) Onchocerciasis productivity effects

a. Nuisance 1%
b. Disability 5%
c. Debility 5%
d. Blindness 100%

Discount Rate (%)	3	7	8	9	10	15
P.V. Project Cost ($Million)	460.9	286.5	256.5	237.7	208.5	176.6
P.V. Productivity ($Million)	1,137.6	368.3	285.3	233.4	198.8	100.5

B. New Land Benefits of Onchocerciasis Control

14. There are two main categories of benefit to opening of "new" lands through onchocerciasis control: (1) the value of output of immigrants settling on them; (2) decreased soil degradation on "old" lands because of the longer fallows allowed by increased emigration.

15. There are three categories of costs: (1) the value of output on "old" land lost because of emigration; (2) the costs associated with moving (borne by the migrants themselves); and (3) the cost of "complementary investments", i.e. costs in addition to the control of onchocerciasis required to make the "new" land habitable and productive.

16. The present value of the sum of the benefits less the costs is the net present benefit to the opening of "new" land. The following equations formalize these definitions:

A. Benefits

1. Present value of output of migrants on new lands (Q^N):

$$L_t^L \times APL_t^N \times (1 - d)^t = P.V.Q^N$$

$t = 1$

L_t^L = number of laborers migrated to new lands by year t

APL_T^N = average product of labor on new lands in year t

d = rate of discount

2. Present value of decreased soil degradation on old lands because of longer fallows ($F_Q o$):

$$(L_b^S - L_t^S) \times f \times Q_t^o \times (1 - d)^t = P.V. (^F Q^o)$$

$t = 1$

b = base year

f = relation between number of laborers and rate of soil erosion on old lands.

B. Costs

1. Present value of output of migrants on old lands ($Q_L^o L$):

$$L_t^L \times MPL_b^o \times (1 - d)^t = P.V.Q_L^o L$$

MPL_b^o = marginal product of labor on old lands before migration

2. Present value of costs of migration (M):

$$(L_t^L \times M) \times (1-d)^t = P.V.M.$$

$t = 1$

M = cost of moving a migrant farmer and dependents

3. Present value of complementary costs of opening new lands (c):

$$N^N \times c = C$$

N^N = hectares of new land

c = cost of complementary inputs required to open a hectare of new land

C. Net Benefit

$$P.V.NB = P.V.\ Q^N + ({}^F Q^o) - P.V.\ (Q_L^o L + M + C)$$

17. No attempt is made here to estimate values for these equations. Data availablu are in general too crude for credible results. The critical estimates, those for "complementary investments" depend on the types of settlement projects selected, or more precisely, the degree to which occupation of new lands involves "guided" settlement arrangements.

18. However, comparison of the present value of the labor-related benefits to onchocerciasis control with the costs of the control program indicates the size of "new lands" net benefits which must arise to make total OCP-reduced benefits equal OCP costs. Using a 10 percent rate of discount, the present value of the cost of the program ranges from $154 to $227 million, depending on its length (10 - 25 years). At ten percent, the labor-related benefits range from $38 - 94 million, so for benefits to equal costs, the average annual flow of new lands benefits must be $6.6-$20.8 million. Program

costs discounted at 15 percent range from $125 to $162 million, and labor-related benefits from $20-$50 million; so the average annual benefit from new lands, at a 15 percent rate of discount, which will make benefits and costs equal, would be $11.6 - $22.0 million.

The range of estimates is shown below, in terms of annual benefits from the new lands effect, as well as present values.

		In $ Millions			
		Present Value			Required Annual Benefit Flow From New Lands
Discount Rate	Duration of OCP	OCP Costs	Labor-Related Benefits Maximum	Labor-Related Benefits Minimum	
.10	10 yrs.	154	94	38	12.8 - 6.6
	25 yrs.	227	94	38	20.8 - 14.7
.15	10 yrs.	125	50	20	16.3 - 11.6
	25 yrs.	162	50	20	22.0 - 17.4

19. What was observed earlier about time horizons applies with particular force to new lands benefits; both the slowing down of erosion on old lands and the opening up of new lands are clearly long-term effects, which may warrant a higher valuation of future benefits than is implicit in the "conventional" discount rates. Extending the life of the benefit stream or reducing the rate of discount would make the required annual average new lands benefit smaller still.

Abandoned Valleys: The Historical Debate

1. The analysis in the text (ch. IV) of obstacles to the more intensive utilization of the OCP "empty lands" also has historical implications. The factors that inhibit present occupation of these areas must have been equally constraining in the past. They therefore must enter into the explanation of why the valleys were not occupied. This bears directly on the question of whether the valleys of the Volta River Basin were "abandoned," and if so whether onchocerciasis was the principal reason. These questions arose within the framework of a more general issue related to the Mission's work: to what extent can the existing distribution of population in the OCP area be explained by the presence of Simulium?

2. The issues are complex, and have only begun to be seriously explored. It is likely, as mentioned earlier, that different forces have been present in different parts of the region. In some countries (notably northern Ghana and northern Ivory Coast) 19th century military activities seem to have been decisive. These are said to have led to a withdrawal of population along a broad east-west belt between savannah and forest. Along this belt, population densities are low not only in river valleys, but everywhere, except for a few thickly settled pockets. 1/

3. It is with respect to the Red and White Vota that the abandoned valleys hypothesis is most forcefully presented. 2/ However, a recent study, by an ORSTOM researcher, J.P. Hervouet, argues that these valleys were never

---

1/ One early study of northern Ghana suggested that population clustered into hilly areas to avoid mounted slave raiders. (C.W. Lynn, Agriculture in North Mamprussi, Gold Coast Department of Agriculture, Bulletin No. 34, 1937, p. 9). The same writer later emphasized other factors: "... large areas of the country, particularly on the ... slopes toward some of the bigger rivers, have been left entirely, and although tse-tse flies and slave raiders often receive the discredit, the stony condition and poor vegetation of the old farm lands round the compound ruins suggest that soil exhaustion was a factor not unconnected with their abandonment." (C.W. Lynn, "Agriculture in North Mamprussi: A Review of a Decade's Progress," in Farm and Forest, Vol. 3, 1942, p. 81. These references are from David Williams, The Probable Economic Effects of the Eradiciation of Onchocerciasis in Northern and Upper Ghana, Consultant's Report, WHO, PD/MO. 1., 1968.

2/ Cf. PAG Report, p. 60

much populated, at least in recent times. 1/ According to this study, land was sufficiently abundant away from the valleys, and life in the valleys was unsafe, harsh and lonely. After 1900, riverine lands were occupied by villagers fleeing from forced labor and other exactions of colonial rule. Between the beginning of the colonial presence and 1928, the Hervouet study found 191 villages which were established for these reasons. After 1928, most of these were abandoned, again because of excessive pressures put on villagers by the colonial government. 2/ Many moved across the border to the Gold Coast. Hervouet also mentions various epidemics which ravaged the region until 1940. He believes that sleeping sickness may have been a factor, but that the role of onchocerciasis is unclear, because of its gradual character.

4. The argument in this new research is that the Red and White Voltas were unpopulated rather than depopulated. Earlier studies, which argued the contrary, 3/ are said to be based on small and unrepresentative samples, to lack historical depth, and to ask the wrong questions. They ask why the valleys were abandoned, when they should have asked whether they were ever occupied at all, and if so, why.

5. Just as these recent findings question the fact of abandonment of the river valleys, so too do they raise new questions about the role of onchocerciasis in explaining population distribution. The Hervouet study attributes population movements away from the Red and White Volta Valleys to the difficult social conditions of life there, colonial tax, labor and agricultural policies, wild animals, and perhaps disease. It is interesting that an earlier study by Rolland and Ballay gave a similar listing of reasons for the abandonment of the villages they studied. When these writers asked villagers why they moved from the valleys, the most frequent response was that it was due to the dangers of wild animals. The next most frequently

---

1/ J.P. Hervouet. Peuplement et Mouvements de Populations dans les Vallées des Voltas Blanche et Rouge, ORSTOM, Centre de Ouagadougou, 1977. Hervouet studied 287 villages, 805 neighborhoods, and over 110 sites of abandoned habitation in the Red and White Volta valleys of the Upper Volta. He interviewed former inhabitants of villages which had moved, and their neighbors, and also did much archival research in Ouagadougou and Abidjan.

2/ Ibid., p. 34.

3/ T.E. Hilton, "Growth and Distribution of Population in the Upper Region of Ghana," in Population in Tropical Africa, New York, 1968; J.M. Hunter, "River Blindness in Nangodi: A Hypothesis of Cyclical Advance and Retreat," in Geographical Review, 1966; G. Remy, "Les Mouvements de population sur la rive gauche de la Volta rouge (Région de Nobère):, in Cahiers de l'ORSTOM, Série Sciences Humaines, Vol. V, No. 2, 1968.

cited reason was forced labor recruitment (before 1946). Finally, sickness was mentioned -- people being "killed by the bush." 1/

6. Much remains unclear in this debate; many of the issues are unresolved. The debate has been based mainly on the information available on the Red and Whie Volta. Studies on other parts of the OCP area are essential for a broader understanding of the issues.

7. Based on the knowledge available from existing studies of the question, and on the experience of the OCP, the following conclusions seem justified:

(a) It is doubtful that some regions (such as the south-central parts of Upper Volta) were much populated before the twentieth century. 2/

(b) Political administrative measures during the colonial period (forced labor, taxes, military recruitment, other demands) provoked a "generalized depopulation" of the central and southern parts of Upper Volta. Other factors seem to have been at work elsewhere (e.g. wars of the time of Samory), in earlier periods.

(c) The villages which have been abandoned are situated, for the most part, close to river banks, places which are normally highly infested with the vector of onchocerciasis. This suggests that onchocerciasis was an important factor in the underpopulation and depopulation of many valleys and riverine regions.

(d) In addition to historical-cultural factors, indication of the importance of onchocerciasis can be found in local languages, a number of which contain terms specifically describing the clinical symptoms of onchocerciasis; among some groups, moreover, there exist traditional cures at onchocerciasis (the chameleon fetish at Tilé, Ghana, for example).

(e) The proposition that onchocerciasis is the only reason for such "depopulation" of the valleys as has occurred cannot be sustained on the basis of present evidence, nor does the evidence indicate that it was everywhere the principal reason. There is little doubt, however, that

---

1/ Rolland and Ballay, l'Onchocercose dans le Foyer Bisa, pp. 44 ff.

2/ Archaeological finds near Yakal, in the river bed of the White Volta, indicate a more ancient occupation of the area.

it was widely present, and that it is an important factor explaining the low rate of utilization of many riverine areas.

(f) Further research and analysis of these matters can do much to clarify the issues under contention. Such research should illuminate not only the past, but also the future development potential of the region.

The Need for Permanent Intensive Farming

1. It was noted in the text that the densely populated parts of the OCP area, and notably in Upper Volta, movement of population into "new lands" will provide only partial relief to problems of population pressure, shortened fallows and declining yields. Depending on the amount and productivity of the new land that ultimately proves cultivable in the Upper Volta, it is unlikely that more than ten years of the Upper Volta's incremental population growth could be absorbed there, in the absence of changes in farming practices.

2. There is little question that the most fundamental problem is how to improve and ultimately transform farming practices on the Mossi plateau and elsewhere in the OCP area, so that permanent intensive cultivation is possible. What is required are improved farming systems, which have been described as "management systems which are culturally compatible with existing farming practices, which increase output and which rely heavily on maintenance and improvement of soil fertility as a basis for increasing output... Soil fertility thus becomes an end, not a means, avoiding the common misconception derived from the mechanical application of the seed fertilizer technology which worked miracles in more favored areas, to zones of limited natural potential. Under the influence of this approach, we have increasingly tended to perceive yield increases as a function of (quantitatively and qualitatively) increased input use, neglecting the fact that optimal conditions have to be created for their use."

3. Farming system improvement can be introduced gradually, or it might involve a basic transformation of existing practices. Gradual introduction requires the application of "conventional" packages (choice of proper seeds, attention to spacing and to timing of planting and weeding, etc.) adding newer elements related to better land use — e.g. ridging, terracing, mulching of crop residues and leguminous fallows, as existing socio-economic conditions and constraints permit.

4. These kind of changes merge with more basic transformations, which are derived from experiences of ICRISAT 1/ stations in India and which in recent years have shown dramatic experimental results. The application of the new technology has so far been confined mainly to the Indian subcontinent, and to parts of East and Central Africa (Kenya and Botswana), where experiences revealed that traditional soil conservation measures alone were inadequate to maintain yields and prevent soil degradation.

1/ International Crop Research Institute on the Semi-Arid Tropics.

5. Water management — using rainfall more effectively — is at the heart of the new technology. In the context of arid and semi-arid situations, water management technology is a component of correct land and water use. This seeks to ensure that the maximum quantity of water is made available for crop growth, and that surplus water is slowly but effectively drained from the land and stored in tanks and reservoirs for domestic use, animal watering, and supplemental irrigation. The precise system to be used varies with local conditions, but the principles remain the same.

6. Research on this method is sufficiently advanced to test its introduction under practical conditions on a pilot basis; however, further experimentation to suit local specific conditions will be required. While basic research continues on water as an essential ingredient in crop growth and performance, pilot schemes are needed to better understand practical issues, e.g. degree of grade needed to control run-off on field surfaces and spillways in differing soil types and rainfall patterns; methods of water flow control in main channels; variants in design and construction of storage tanks and reservoirs. Also needed is more knowledge of local social conditions as they bear on absorption of the new technology.

7. Experience has shown that earlier concepts of soil conservation technology are not by themselves an adequate answer to the problems faced in the arid and semi-arid tropics. Prevention of loss of soil through soil conservation measures is, of course, sound practice, provided that it is properly carried out. Indeed, fully effective soil conservation measures closely approach modern land and water use principles. From the small farmer's viewpoint, however, soil conservation work is regarded as an unrewarding and heavy "chore" forced upon him by overzealous government officers. On the other hand, the water management technology has the advantage of yielding relatively quick and visible results, unlike traditional soil erosion practices. Farmers soon see benefits in terms of increased crop yields and thus more profitable farming as well as better water supplies. Put this way, these measures can be the basis for progressive modernization of the farming process, leading to the introduction of better crop varieties, fertilizers and pest control measures, as well as ridging, mulching, eventual green manuring, etc.

8. Modern water management technology specifically aims to do three things:

(i) In conditions of limited rainfall to ensure that maximum available water is stored in the soil profile under the surface where the crops are grown. This involves a field surface cultivation system, e.g. ridges or beds laid out on correctly graded contours which allow time for water to percolate downwards into the soil profile;

(ii) use of graded run-off systems which allow for movement of excess water at slow speed to protected (grassed) spillways.

These spillways may require additional protection and steeper grades in the form of masonry weirs, gabion weirs, etc.;

(iii) provision of clearly designed drainage ways leading either to water storage tanks or reservoirs or to main exit waterways.

9. Many other elements enter into improved farming systems, all of them aimed at enriching the soil's physical and chemical properties: deep plowing, ripping, ridging, prevention of bush fires, mulching and incorporation of vegetation, (crop residues and planted fallows), permanent soil coverage with living or dead vegetation; planting of trees, bushes and perennial crops — particularly the leguminous Acacia Albida in areas with less than 1,000 mm. of rainfall.

10. It is noted in the text that while there is immense promise in these new methods, the obstacles in the way of their adoption are also formidable. Their general application under practical conditions poses severe challenges which are outlined in the text. Pilot projects and programs of related research addressing these problems are therefore essential.

11. Transformation of farming practices will require vast effort in training and education, formal and non-formal, for women as well as men. Peasants do not easily change basic farming practices, and with reason; their present farming system is the result of hundreds of years of experimentation and adaptation. Assuming that generally suitable approaches emerge from the pilot stage, the main challenge will be to win peasant acceptance of the new farming methods. It is not too soon to begin serious planning efforts aimed at design of pilot extension/education schemes which will increase farmer receptiveness to the new approaches.

Toward More Cost-Effective Disease Control

1. The technology of the OCP is an awesome achievement, developed with care and imagination after more than a decade of West African experimentation. A fleet of helicopters, several fixed-wing aircraft, almost 200 Land Rovers, a perfectly functioning radio network, the military-like precision of the spraying and surveillance operation -- all is overwhelming to the average observer. It is hard to think of another institution in the region that works with such efficiency.

2. Indeed, the scale and complexity of the operation should be a cause for concern in the long-run. The OCP technology is not only expansive; it demands other inputs in exceedingly scarce supply - manpower, coordinating capacity, organizational flexibility. It is not easy to see how most of the governments of the OCP area could find in their budgets the recurrent costs required to keep the program going in the future. It is not easier to see how this extraordinarily complex regional undertaking could be maintained without absorbing a disproportionate share of locally available manpower and organizational capacity, or continuing reliance on foreign sources of these inputs, which would be undesirable even if possible.

3. As experience with control techniques increases, and knowledge of the behavior of the vector deepens, alternative control possibilities will emerge. Also, the objective of the control program is the achievement of a "tolerable" level of control, and new possibilities may exist for trade-offs between "tolerable" levels of the disease and the costs of control. 1/ Should chemotherapy research bear fruit, and severe cases of infection be treatable with little risk, still more trade-off possibilities would open up.

4. During the next phase of the control program, these new options must be used to reconsider the technology of vector control and to seek more cost-effective approaches. It is necessary to make available special funding to finance the research for the immediate, more appropriate techniques and approaches which are required.

5. At the same time, the magnificent OCP infrastructure will remain in place for at least the next five years. Like many other observers, the members of the Economic Review Mission were strongly impressed with the reach and efficacy of the OCP's transport and communications system, and

---

1/ More limited forms of attack on the vector may be possible. For example, limited spraying durations may be feasible, especially in forest areas; treatment could be restricted to sites near sizeable population agglomerations; small villages in hyperendemic areas could be assisted to move, etc. See J.F. Walsh, "On the Biology and Control of the Vectors of Human Onchocerciasis - With Special Reference to West Africa." Paper presented at WACP Symposium on Onchocerciasis, Accra, June 1977.

equally strongly inclined to propose some additional utilization of this system. We did not have time, nor were we adequately equipped, to systematically explore the possibilities. We did consider at length the potentials and problems of utilizing the transport network for some form of primary health care delivery, for three principal reasons:

(a) health programs have upto now tended to concentrate on curative medicine, on urban areas and on conventional delivery systems, so rural coverage and preventive efforts have been limited;

(b) the rural populations in the OCP areas have been among the least-provided with medical services of any kind because of their remoteness and difficulty of access;

(c) long-term control of oncho may be strengthened by preventive measures involving public health education - for example stress on areas during hours of particularly intense blackfly activity, etc. 1/

6. Closer reflection and extended discussion after the mission's return from the field have not diminished the fundamental appeal and potential of the idea. After all, one of the major reasons for the ineffectiveness of rural health delivery projects in less developed countries generally is inadequate transport and communication. And it is precisely its discipline, its regularity, and its capacity to overcome transport uncertainties and breakdowns that distinguishes the OCP infrastructure.

7. There are, of course, risks and problems. The existing surveillance staff cannot be used. Means must be found to devise a system which can "piggy-back" on the transport network without compromising its present effectiveness. It is essential that a program be devised which can be carried on in some form after the OCP is ended, or its present technology is changed, or which can leave behind some kind of institutional structure capable of having longer-term impact.

8. To devise such a program will require imaginative and knowledgeable inquiry in the field. We urge that a small mission be sent to explore the suitability of such a project with OCP and local government officials, and assuming it is acceptable in principle to the relevant parties, that this mission prepare a detailed project proposal in collaboration with local authorities. Such a project would be attractive from a number of points of view. First, it would significantly deepen the health impact of the OCP, by bringing additional health care to the populations most afflicted by onchocerciasis. These also happen to be the people with least access to social

---

1/ See Walsh, op. cit. for further discussion.

services generally, so the equity impact would be very strong. Secondly, utilization of the OCP network for these additional services would increase the economic "viability" of the OCP, in the sense of providing more services per dollar of infrastructure cost. Finally, an experiment along these lines would yield valuable general lessons about what might be achievable in rural health care delivery if regular transport and communication could be assured.

Definitions of Soil Categories and Methods of Estimation of Areas Available for Agriculture

1. In the soils analysis undertaken for this mission, it is assumed that the medical constraints in the unpopulated areas have been removed, that these areas can be made available for agricultural development, and that their development potential can be evaluated, based on their pedological and soil-hydrological properties. The evaluation has been based on general data, mostly of a reconnaissance nature, supplemented by some more detailed, locally available information. This local information is, however, too scanty to allow an overall extrapolation.

2. For Mali no suitable information on soil conditions is available. Consequently, the derived data are especially uncertain. The data base is limited to topographic maps, a small amount of detailed soil information and small-scale generalized soil maps, such as the FAO Soil Map of the World, on a scale of 1:5,000,000.

3. Furthermore, in many cases no information on the geographical distribution of the population could be obtained. In these cases, inferences were made based on the topographic maps, though even this was not always possible since certain maps were not available (e.g. out of stock at I.G.N., Paris).

4. Another factor hampering accurate quantification is the considerable migration and movement of people within the various countries. Nearly everywhere new villages have been built by spontaneous migrants. Reliable statistics and records on these activities are not available. Consequently, areas that are presumed to be available may prove to have been occupied in the meantime.

5. The unpopulated or sparsely populated areas were plotted with the help (where possible) of population density maps based on the latest census data; in other cases, inferences are made, based on the most recent available topographical maps, taking account of the presently cultivated areas in relation to this population. It is assumed that farming in the project area is mainly of the traditional subsistence type, with limited cash income, based on shifting cultivation. Home consumption is taken as a rounded 200 kg. of grain per capita per year. The average yield is assumed to be 500 - 600 kg/ha. This means that 0.3 - 0.4 ha. per capita are required for basic food supply. A further 0.1 - 0.2 ha. per capita is added for some cash income. In total, the necessary per capita hectarage amounts to 0.6 ha. within the shifting cultivation system generally with two-year cultivation on the same plot, followed by long fallows. This is assumed to require 5 ha. per capita. Further, since not all land is suitable for arable cropping, around 8 ha. of land will have to be available per capita for a non-degrading shifting cultivation system. Therefore a population density of 12.5/km^2 can be supported under present conditions of traditional farming inputs, yields, etc. The addition of the cashcrop, cotton, which receives applications of

some fertilizer, makes possible a rotation which, without damaging the equilibrium, can support a population density of up to 20/km^2, without a degrading influence on soil conditions. In delineating the available areas, this density (20/km^2) has been taken as indicative of the dividing line between available and non-available lands. In the distant future, when shifting cultivation will have been replaced by sedentary agriculture with all modern inputs, much higher population densities can of course be sustained.

Reduction Factors

6. The remaining areas, excluding forest reserves, national parks etc. have been evaluated as to their agricultural potential and aggregated according to suitability class. These gross area figures have been converted into net areas, considering the following reduction factors:

Part of the area is covered by litho soils (Soils mineraux bruts) which consist of rock debris, ironpans, and gravel at the soil surface and/or have very shallow profiles. These are considered to be Class 6 for halomorphic and sodic soils. As the soil conditions are very patchy, some marginally suitable spots can be found in the unsuitable areas. Based on available information, this is estimated to be 10 percent f the gross area.

ue to the scales used, soil maps show areas of suitable soils s homogeneous, but these contain patches that are unsuitable or agricultural development. Locally available detailed nformation indicates that the reduction percentages for this constraint vary between 5 percent and 35 percent, as indicated.

The reduction factor for infrastructural loss of land to cropping, the area occupied by houses, dispensaries, schools, roads, flood protection dikes, drains, etc., is estimated at 10 to 30 percent.

The Soils of the OCP Area

7. Soil conditions in the potential areas are complex. For practical purposes, six soil-agronomical groups have been distinguished (based on ORSTOM reconnaissance soil reports and detailed information relating to a few specific projects). Each unit can be considered an entity from the point of view of land development, as well as in terms of agricultural cropping practices.

Brown Eutrophic Soils (Unit 1)

8. These soils have, in general, a medium to moderately fine texture, a good structure, and are easy to work. Permeability and moisture retention are favorable. The pH is about neutral and the absorption complex shows a