



ONCHOCERCIASIS CONTROL IN THE VOLTA RIVER BASIN AREA

INFORMATION PAPER

Background

Onchocerciasis, or river blindness, is a parasitic disease caused by the threadlike worm Onchocerca volvulus which affects from 20 to 40 million people in tropical Africa, the Yemen and parts of Central and South America. Man is the only host of practical significance and onchocerciasis is transmitted by the bites of female blackflies (Simuliidae).

Among the important clinical manifestations of onchocerciasis are intense itching, rashes, wrinkling, thickening and depigmentation of the skin, the characteristic skin nodules in which the adult worms are to be found, and as the most serious consequences of the disease, eye lesions leading to blindness.

The medically most important and largest endemic areas are located in tropical Africa where the main vector is Simulium damnosum. This blackfly breeds in fast-flowing streams and rivers. As a consequence, the greatest suffering occurs among people who live close to the river valleys.

The area affected

The savanna area of the Volta River basin, in West Africa, is one of the worst endemic onchocerciasis zones of the world. In this area, which includes parts of Benin, Ghana, Ivory Coast, Mali, Niger, Togo and Upper Volta, it is estimated that over a million people are infected and that, as a consequence, at least 100 000 of these are blind while many more have serious impairment of sight.

The association of proximity to the rivers and the risk of onchocerciasis was recognized by the local populations, who moved from the fertile valleys to settle in relatively infertile lands. The disease thus constitutes for the area the most important single deterrent to human settlement, and the subsequent economic development of the fertile valleys which lie uninhabited and unproductive. Furthermore, the persistent and critical effects of drought in the sahel and the savanna, following the failure of the rains for six successive years, have gravely complicated the already precarious socioeconomic balance in the Volta River basin area.

Events leading to the programme

In July 1968 a technical conference held in Tunis under the joint auspices of USAID,<sup>1</sup> OCCGE<sup>2</sup> and WHO<sup>3</sup> concluded that onchocerciasis control in the West African savanna zone was feasible and that the time had come to undertake large-scale action against the vector Simulium damnosum in order to reduce the prevalence and intensity of the disease and to open up hitherto deserted fertile land to human settlement, livestock raising and crop growing.

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<sup>1</sup> United States Agency for International Development.

<sup>2</sup> Organization for Coordination and Cooperation in the Control of the Major Endemic Diseases.

<sup>3</sup> World Health Organization.

The recommendations of the Tunis meeting were taken into consideration by all the parties concerned. In 1969 and 1970 the seven Governments involved<sup>1</sup> confirmed their interest in such a regional onchocerciasis control programme and formulated requests in this sense to UNDP.<sup>2</sup> WHO then drew up a proposal designed to assign to the Volta River basin a Preparatory Assistance to Governments Mission (PAG Mission), for which the Administrator of UNDP agreed to provide the necessary funds. WHO was designated as Executing Agency, in association with FAO.<sup>3</sup> In July 1970 at a meeting in Geneva (organized jointly by UNDP and WHO, on the proposal of the World Bank) agreement was reached on the mandate of the Mission between UNDP, FAO, WHO, the World Bank, OCCGE and the Government of Ghana, "Conseil de l'Entente", EDF<sup>4</sup> and USAID.

The PAG Mission had a major twofold objective. In the health sector, it was requested to prepare a plan of work to achieve control of onchocerciasis over the entire recommended programme area, taking into account economic development of reclaimed zones; to work out the expected costs and benefits of the scheme; and to analyse the possible financial resources available. In the economic sector, it was called upon to identify zones within the programme area which owing to their economic potential and location in relation to centres of population density, offered development possibilities; it was requested also to draft preliminary terms of reference for feasibility studies to be conducted later in these areas.

The Government of Upper Volta accepted to act as host to the PAG Mission whose headquarters were set up in August 1971 at Ouagadougou in premises placed at the disposal of the Mission by the Government. Operating from Ouagadougou, the Mission benefited from the full collaboration and encouragement of the Government of Upper Volta as well as of the other six countries in which it carried out its activities.

Thus the PAG Mission carried out its work from mid-1971 through 1972 and was extended to cover 1973 again under UNDP regional funds with WHO as Executing Agency and FAO as Associate Agency. Early in 1972 the Executive heads of UNDP, FAO, the World Bank and WHO decided to establish a Steering Committee for Onchocerciasis Control comprising a representative from each of the four agencies to coordinate action. The Steering Committee has accordingly met regularly to monitor progress and resolve problems.

### The report

The Report of the PAG Mission, supplemented by a series of technical annexes, was submitted on 20 August 1973 to the Governments of the seven countries of the Volta River basin area. This report included a detailed analysis of onchocerciasis and its socioeconomic implications in the area as well as a costed proposal for launching an onchocerciasis control programme in 1974, and suggestions for the economic development of the fertile valleys and other abandoned areas of the Volta River basin.

No less than five years of concerted study and effort were needed to determine with the necessary precision the conditions under which an onchocerciasis control programme could be launched with the best chances of success. Onchocerciasis could be controlled through a campaign against the parasite, the vector, or both. Two drugs were available for the chemotherapy of onchocerciasis: suramin and diethylcarbamazine. However, although these drugs could be used with little difficulty and risk if individual treatment of patients suffering from onchocerciasis was given under close medical supervision, their use in mass chemotherapy campaigns raised problems that required further study. In the absence of an acceptable drug for mass chemotherapy, control of the insect vector offered the only means for interrupting transmission of the disease.

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<sup>1</sup> Benin, Ghana, Ivory Coast, Mali, Niger, Togo and Upper Volta.

<sup>2</sup> United Nations Development Programme.

<sup>3</sup> Food and Agriculture Organization of the United Nations.

<sup>4</sup> European Development Fund.

The mechanical elimination of S. damnosum breeding sites (e.g. through the construction of dams and the regularization of river beds) was not economically feasible, although in restricted areas it could be a consequence of certain river management projects. The possibility of controlling this vector with biological agents was investigated under a research programme jointly supported by the Government of Canada and OCCGE, but the development of an effective biological control methodology would have taken many years. Insecticides were therefore at that time the only effective means of interrupting onchocerciasis transmission.

As the flight range of the adult S. damnosum may, in favourable circumstances, exceed 300 km, an attack on the adult fly would have required the insecticide treatment of an immense area and was not considered feasible. As the vector breeding sites are restricted to fast-flowing sectors of rivers, control of S. damnosum in the Volta River basin area is being directed against the larvae and is based on weekly application of insecticide immediately upstream from the larval breeding places.

Because of the inaccessibility by land of many of the breeding sites of Simulium, the only feasible method of applying the insecticide was from the air. In the case of large rivers that are sufficiently straight, light planes can be used, but narrow twisting waterways and those overhung by forest require the use of helicopters.

The selection of an insecticide was based on specific criteria: the candidate compound was required to have low toxicity for man and vertebrates in general and, while being very effective against blackfly, to have as little effect as possible on non-target fauna. Only biodegradable compounds with little residual activity were considered to make sure that no contamination of the environment could take place. The insecticides selected were studied by hydrobiologists and a fishery biologist in West African laboratories and in field conditions to confirm their suitability.

Because of the long life of the adult worm in the human host, sufferers from onchocerciasis may remain infective for as long as 15 years even if not reinfected. Therefore the duration of a campaign to prevent the disease by eliminating its insect vector must not be less than this length of time after the last new case in the programme area. For this reason the Programme was scheduled to last 20 years.

The effects of the vector control campaign on the prevalence and severity of onchocerciasis must be continuously monitored by epidemiological evaluation teams.

The Onchocerciasis Control Programme is supported by appropriately applied research projects, particularly in the fields of chemotherapy, vector control and protection of the environment. Another important element of the Programme is personnel training, to ensure the progressive take over of the Programme by specialists of the seven countries concerned.

The repopulation and/or settlement of the uninhabited fertile areas freed from the disease is a major objective of the Onchocerciasis Control Programme. Such action should also permit development measures to be taken in areas of high population density.

In many cases the lands to be repopulated or colonized required infrastructure in terms of road networks, water supply and medical, educational and agricultural extension services. In other instances improvement of such facilities was essential for the success of repopulation and settlement. The required low and medium level agricultural extension services in some instances, needed backstopping by professional officers in the relevant disciplines.

The main responsibility for the economic development projects remained with each of the Governments which could however request external assistance in the methodology and planning of activities, and external funds for their financing. A series of reclamation plans based on the development of crop and livestock farming were studied and costed, as examples, to assist national authorities.

### Launching of the programme

The programme is a joint undertaking by the seven countries concerned. An Operational Agreement signed in Accra on 1 November 1973 brought into association the Governments and WHO, the Executing Agency. The Operational Agreement was supplemented by separate country protocols which established the specific contribution of each government. The Governments set up national onchocerciasis committees, which were responsible for ensuring provision of the counterpart contributions by the Governments and for liaison at the national level between the programme, the repopulation and settlement activities, and the economic development projects in the areas concerned. These committees have met annually since 1977.

As Executing Agency, WHO is responsible for the technical and logistic management of the programme. It set up the programme headquarters at Ouagadougou in Upper Volta, appointed a director, and set up four specialist units, (Vector Control, Epidemiology and Public Health, Economic Development, Support and Administrative Support), with the necessary personnel and infrastructure. It also set up a Scientific Advisory Panel to keep an eye on the technical aspects of the programme.

The World Bank agreed to mobilize contributions for implementation of the programme and to act as custodian of the Special Fund for Onchocerciasis Control for the financing of activities. The Fund Agreement was signed in Washington on 7 May 1975. A detailed plan of operations provided for an overall cost of about \$ 60 million for an initial six-year period from 1974 to 1979.

The Steering Committee remained the executive organ of the programme, with the task of studying the plans of work prepared by the Executing Agency and making recommendations on them. The Committee set up an Ecological Panel to attend to environmental protection, together with an Economic Development Advisory Panel.

A Joint Coordinating Committee representing the seven participating countries, the donor countries and institutions, and the four sponsoring agencies, and headed by an Independent Chairman, was set up in June 1974. This Committee has met each year to consider the annual budget and exercise general supervision over the planning and implementation of the programme.

The vector control operations concentrated initially on an intensely infested zone consisting of the basins of the Black Volta, the Comoé-Léraba, the Bandama, the Nzi and the Banifing, a logical extension of the campaign already carried out jointly by EDF and OCCGE. In 1976 the activities were extended to the basins of the Red Volta, the White Volta and the Daka. From 1977 onwards the operations covered the Oti-Pendjari basin and the right hand tributaries of the River Niger in Mali, Ivory Coast, Upper Volta, Niger and Benin. In 1978 operations were also undertaken in the Sassandra and Marahoué basins, and later in the Comoé basin to the south of the initial boundary of the Programme. The Programme now covers an area of 765 000 km<sup>2</sup>.

Entomological surveillance is carried out by aerial reconnaissance through a network of six sectors and 21 sub-sectors distributed throughout the programme area and linked to each other and to programme headquarters by radio transceivers. The blackfly collection points in these sectors number about 300. The catches are counted and examined to determine the morphology, physiological age and infestation rate of the blackfly. The entomological situation is kept under continuous evaluation.

It is on the basis of this evaluation that the weekly insecticide treatments of watercourses are planned. The frequency of treatments is based on the biological cycle of the vector larvae. The insecticide used since the start of operations is a biodegradable organophosphorus compound, a 20% emulsifiable concentrate of Abate. The dosages are calculated according to the rate of flow of the watercourses in the various hydrological basins, for underdosage may be just as harmful to the efficiency of the programme as overdosage is harmful to non-target fauna. The insecticide is applied from the air.

The aerial operations are conducted under contract by a commercial company. They involve the use of eight helicopters and two fixed-wing aircraft, operating from two bases: one at Bobo-Dioulasso in Upper Volta which serves the western zone, the other at Tamalé in Ghana which serves the eastern zone. In the rainy season some 18 000 km of rivers are kept under continuous surveillance and are treated wherever necessary. By the end of 1979 over 28 000 flying hours had been devoted to this work and it was believed that transmission had been interrupted in about 75% of the total geographical area covered by the programme.

Since 1975 the Epidemiological Evaluation Unit has been making a basic evaluation of the disease. It has performed parasitological and ophthalmological examinations of the inhabitants of a certain number of villages selected in advance, which made up the basic sample, in order to determine the prevalence of onchocerciasis and the endemicity and blindness rates. This evaluation is made at two levels. On the one hand there is simple evaluation, which aims to determine the prevalence of the disease and visual acuity by age and sex. On the other hand there is detailed evaluation, which uses more thorough examinations to assess the prevalence of ocular onchocerciasis, the proportion of irreversible lesions and the blindness rates.

The sample is made up of 419 villages in which a total of 105 355 persons have been examined. In actual fact the medical teams had performed 115 411 examinations by the end of 1979, as the inhabitants of some villages had been examined several times. Since 1978 a second evaluation has been undertaken in the villages where the basic evaluation started in 1975. Three years of vector control are regarded as the minimum period for detecting any trend in the disease. The first stage of this second evaluation, which covered 25 of the villages re-examined where transmission had been interrupted for three years, showed that no child under five years had contracted the disease and that in children aged 5-9 years the prevalence had dropped by as much as 50%. Besides these very tangible results, a reduction in parasite counts in infected subjects and a stabilization of the eye lesions should also be observed in due course.

The Economic Development Unit undertook to collect all available data on the development projects in progress or in preparation, at the national level and regional level, in the seven Participating States. Up to 1979, the year when this task was taken over by the Governments, the Unit reported each year to the Joint Coordinating Committee. The Unit assists missions involved in such development by making the necessary contacts and providing what basic data it has available. Since January 1980 it has been coordinating a training and research programme in health economics.

At the same time the programme is carrying out and financing activities for surveillance of the aquatic medium and research on entomology, vector ecology, vector control and general epidemiology, together with medical, parasitological and chemotherapeutic research. During the first six-year phase, over \$ 3.5 million were spent on these activities.

During the same period, with the assistance of specialist institutes, the programme developed theoretical and practical training courses in the entomology, cytotaxonomy, parasitology and ophthalmology of onchocerciasis. During the first phase about 75 nationals of the Participating States of the programme and of other African countries took these courses. Moreover, 21 fellowships for studies in entomology, hydrobiology, pesticide science, parasitology, epidemiology, public health and ophthalmology were awarded to nationals of the seven countries of the programme. The programme was visited by about 40 WHO specialists working in Africa, who came singly or in groups to obtain information on the spot about its methods and techniques in order to redirect their own activities.

The total cost of programme activities during the first phase from 1974 to 1979 was approximately \$ 54 million.

Second phase, 1980-1985

The structures initially set up have been simplified. In accordance with a new Memorandum of Agreement, approved by the seven Participating Countries at the meeting of National Onchocerciasis Committees in Bamako in 1979; all the scientific, technical and economic advisory panels and committees now form only a single Expert Advisory Committee (EAC), with an Ecological Sub-group; the Joint Coordinating Committee remains and is now called the Joint Programme Committee (JPC), with a chairman elected annually at each session; the National Onchocerciasis Committees have also been kept; the Steering Committee remains under a new name, the Committee of Sponsoring Agencies.

Since September 1979 a new Onchocerciasis Fund Agreement for the period 1980-1985 has been signed in Washington by the Governments of Belgium, the Federal Republic of Germany, France, Japan, Kuwait, the Netherlands, Switzerland and the United States of America, and by the International Bank for Reconstruction and Development and the International Development Association, the United Nations Development Programme and the World Health Organization. Canada, Norway, Saudi Arabia and the United Kingdom, together with the African Development Bank and the OPEC Special Fund, have also undertaken to contribute to the Onchocerciasis Fund during the second phase.

At the end of 1979 the estimated budget for the second phase was \$ 106.7 million.

The participating governments are to contribute 1% of the cost.

Studies are in progress concerning possible extensions of the vector control activities to the south of the present limits of the programme in Benin, Ghana and Togo. To conduct these studies four new sub-sectors have been set up in the zones concerned. A document summarizing these studies is to be submitted to the Joint Programme Committee in December 1981.

As regards the long-term prospects of the programme, the Director-General of WHO set up an independent commission in 1978 to consider what the entomological situation will be in the years to come and what action and resources will be needed to deal with it. The work of the commission will form the basis for a final report to be submitted to the Joint Programme Committee in December 1981.