Operational Guidelines for Rapid Mapping of Bancroftian Filariasis in Africa

Revised during an inter-country workshop held in Ouagadougou, 8-12 March 2000

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1 Introduction

Presently, there is inadequate information on the geographical distribution and burden of disease of lymphatic filariasis in Africa on which to establish elimination programmes. A recent review of published and reported filariasis surveys showed that only few areas, notably the East African coast and Madagascar, were well surveyed with respect to infection prevalence. Information on the distribution of filariasis is a pre-requisite for advocacy and planning for filariasis elimination programmes. This has become increasingly evident during several meetings during 1999, culminating in the joint OCP and APOC board meeting to discuss possible synergism between the programmes for elimination of lymphatic filariasis and the onchocerciasis control programmes. The urgent need to better understand the geographical distribution of lymphatic filariasis in Africa is recognised by all concerned and mapping the distribution of the disease is a top priority as prerequisite for action against lymphatic filariasis.

This document provides operational guidelines for rapid mapping of lymphatic filariasis in Africa. A standardized methodology for rapid mapping of lymphatic filariasis has been developed, based on previous work on rapid mapping (section 3) and extensive consultation with partners on the optimal approach. The last stage in the consultative process was an inter-country workshop with participants from the Ministries of Health of 7 African countries. The standard methodology, as agreed upon during the workshop, is described in section 4, and specific comments of the participants, based on their first experience with the method, are given in section 5. The final two sections of the document provide a proposal for the phased implementation of filariasis mapping in Africa.

2 Objectives

The objectives of rapid mapping of lymphatic filariasis in Africa are:

- To determine the geographic distribution of lymphatic filariasis in Africa
- To estimate the population at risk and the burden of disease by endemic country
- To identify and map the implementation units (e.g. districts or LGA's) where mass drug administration is required for filariasis elimination

3 Previous proposals for rapid mapping of filariasis

3.1 Development and pre-testing of RAGFIL

The TDR Task Force on Community-Directed Treatment of Filariasis completed in 1999 a multi-country study on the Rapid Assessment of the Geographical Distribution of Bancroftian Filariasis (RAGFIL).
A workshop was first held to review spatial patterns of filariasis in sites for which detailed survey information was available. On the basis of this review, it was postulated that filariasis foci tend to be large with a diameter of at least 50 km. A rapid mapping method was proposed that uses a spatial sampling grid with 50 km between sampled villages. In the sample villages, rapid assessment surveys would be done to estimate the prevalence of lymphatic filariasis by hydrocele examination or antigen testing (using the ICT card test) in a sample of 50 adult males. Spatial analysis techniques would then be applied to analyse the spatial correlation pattern, determine the best fitting variogram model and use this model in kriging to estimate the prevalence contours of filariasis throughout the area to be mapped. Overlay of these prevalence contours with available population data in a GIS would allow the estimation of the burden of disease.

The proposed method was field-tested in 4 countries, Ghana, Tanzania, India and Myanmar. The testing was done in areas of 200 x 200 km, and involved a comparison of the estimated prevalence contours obtained with the 50x50 km grid sample with the results of surveys done in a much larger sample of villages selected using a 25x25 km grid. The study showed that (i) there was a highly significant spatial correlation between sample villages, confirming the existence of large filariasis foci, (ii) the prevalence contours obtained with the 50x50 km grid were operationally similar to those obtained with the 25x25 km grid, indicating that the 50x50 km grid was adequate for rapid mapping of filariasis, (iii) there was a strong correlation between the results obtained with the hydrocele examination and the ICT test in 3 of the 4 sites (India being the exception). The researchers recommended that the RAGFIL method be applied for rapid mapping of filariasis in Africa. They also suggested that a regional approach to mapping is used because of the importance of cross-border foci as demonstrated by the findings from North Ghana3.

3.2. The Implementation Unit (IU) as the basis of sampling for LF endemicity

The second approach to rapid filariasis mapping was outlined in a WHO organised informal consultation of filariasis epidemiologists on Epidemiological Approaches to Lymphatic Filariasis Elimination4. The meeting was held at Atlanta, USA, in August 1998 and its purpose was to discuss issues relating to the initial assessment, monitoring and certification for lymphatic filariasis elimination.

The consultation recommended the following approach for initial assessment

1. The Ministries of Health should define the administrative level at which mass treatment will be implemented (i.e., the administrative unit within which all residents would receive mass treatment- the implementation unit [IU]). The maps generated would be based on these implementation units, and so be consistent with the existing public health administrative system of the endemic country.

2. Using all available information, (including existing data on distribution of filarial infection and disease, data on the geographic distribution of vectors, and, if available, results of any blood surveys to document infection in specific area), all administrative units in the country should be categorised as to the likelihood of filarial transmission: Transmission present (or highly likely), Transmission possible but uncertain, or Transmission absent (or highly unlikely).
3. Actions for each category of IU can be planned as follows:
   - Transmission present: Mass treatment can be implemented after collection of base-line data on microfilaraemia in sentinel sites, which will be used for longitudinal monitoring.
   - Transmission absent (or highly unlikely): No further action at this point. However, additional sampling may be warranted and “background surveillance” should be established that will detect previously unrecognised foci of transmission
   - Transmission possible but uncertain: These administrative units should be sampled for the presence of lymphatic filarial infection. A variety of sampling techniques and tools may be used, but recommended was the use of Lot Quality Assurance Sampling (LQAS) aimed at detecting a prevalence of ≥ 1%, using detection of circulating filarial antigen by the whole blood “ICT card test”.

4 Standardized Method for Mapping Filariasis in Africa

A strategy and methodology for mapping the distribution of lymphatic filariasis in Africa has been defined on the basis of the recommendations of the informal consultation, the outcome of the multi-country RAGFIL studies, interaction with national representatives and other experts in Geneva, Accra and London, the review of epidemiological information for Africa, and the comments and recommendations of the participants in the inter-country planning workshop held in Ouagadougou. This method builds on the strength of having the implementation unit as the unit for sampling and integrates the spatial sampling and analysis approach of the RAGFIL, increasing the strength of the decision making process in choosing the IUs to be targeted for mass drug administration.

The method would use the following approaches to sampling, surveys and analysis for each group of countries where filariasis mapping is required.

Step 1: Identify or define the implementation unit (IU)

The first step in the mapping process will be to identify the unit of implementation of mass drug administration in the country. This unit would be the administrative unit for which the entire population would be targeted for mass drug administration once the unit has been identified as having filariasis transmission. This will be a country specific decision based on the size and extent of different administrative levels. In most countries the implementation unit would be the district.

Step 2: Review of available information on lymphatic filariasis

- The next step in the mapping process will be to identify the implementation units where mapping is needed. All available survey data would first be reviewed.

- On the basis of the review of the available data with regard to its being up to date and valid, the implementation units will be categorised as
  1. IU with presence of transmission (red areas)
  2. IU where there is no transmission or highly unlikely (green areas)
3. IU where transmission possible but status is uncertain (grey areas): further survey for filarial antigenaemia in sample population needs to be carried out to identify these uncertain areas as those with or without transmission

**Step 3: Selection of sample villages for filarial antigen surveys**

- For each IU classified as ‘Transmission possible but uncertain’, one sample village would be randomly selected from a list of the villages in the IU. The sample would be selected during the workshop with representatives of the countries concerned. The lists of villages would be prepared using the HealthMapper database and other appropriate geo-referenced databases.

- The sample villages, together with a buffer zone around each sample village of 50 km diameter, would be mapped. Remaining gaps would be identified and additional villages would then be selected to cover these gaps in the most cost-effective manner with the smallest number of sample villages.

- Where necessary, a country-specific decision on the minimum number of IUs that need to be sampled in areas where the districts/LGAs are very small in size and where sampling each unit would lead to huge number of sample villages (eg. Nigeria and Burkina Faso). However, this minimum number does not preclude additional sampling, if resources are available.

**Step 4: Identify one "check" village in IUs where locally available information suggests that specific villages are likely to be endemic**

- In some IUs, the District Health Office (DHO) may have additional information, such as frequent reports of hydroceles and lymphoedema, that strongly suggests that filariasis is endemic in specific villages. Before undertaking the survey, the survey team will visit the DHO and seek information, if available, on the villages which are most likely to be endemic. Such information should be based on either historic evidence or on the basis of reports of elephantiasis or hydrocele presence. The village most likely to be endemic according to the DHO will be selected as a possible "check" village. The name and location of this 'check' village should be noted down before undertaking the surveys in the IU.

**Step 5: Undertake surveys in the sample villages**

- Following the visit to the DHO, the survey team would carry out filarial antigen surveys in the sample villages, i.e. the randomly and additionally selected villages but excluding the 'check' villages.

- In each sample village, 50-100 adults (equal number of males and females, age >15 years) would be tested for daytime filarial antigenaemia using the ICT test cards. If among the first 50 adults tested, more than 20% are positive, testing can be stopped (precision of estimate about 10% with 95% confidence). Otherwise, testing would continue until a total of 100 adults have been examined. The percentage antigen positives would be the prevalence estimate for the sample village.

- If all the ICT tests for the randomly selected village(s) for the IU are negative, and if a "check" village, believed to be endemic according to the DHO, has been
selected for the IU in step 4, a survey would be done in this 'check' village using the standard survey methodology. This village should have been identified during the pre-survey visit to the DHO. If the prevalence was greater than zero in any of the randomly selected villages, the survey in the "check" village would not be required even if a "check" village had been selected in step 4.

**Step 6: Data entry into HealthMapper**

- The filarial antigen prevalence rate will be calculated and entered for each of the surveyed village in the data-base manager of HealthMapper

**Step 7: Spatial analysis and preparation of a prevalence contour map**

- Once the prevalence data is entered in the data manager, a prevalence contour map based on spatial analysis of the filarial antigen prevalence in the random sample of villages would be created.

**Step 8: Identification of IUs where mass drug administration is required**

- The prevalence contour map will be overlaid on the boundaries of the IUs. Based on the contour and the prevalence rate in the random or additional sample villages, the IUs will be identified which have transmission on the basis of having more than 1% antigenaemia. A second layer of all IUs identifying them as (i) those having transmission and thus to be targeted for mass drug administration [red] and (ii) those with no transmission or where transmission is highly unlikely [green] where background surveillance needs to be established.

**General principles of the mapping exercise:**

- The MoH and the National LF Elimination Task Forces of the member countries would have 'ownership' of the LF mapping and would be integrally involved in the implementation. However, since spatial analysis would depend on data points in neighbouring countries and because of the importance of cross-border foci, a regional co-ordination would be necessary in implementing the distribution studies.

5 **Experiences with the method during the first inter-country planning workshop**

A planning workshop was held in Ouagadougou from 8-12 March 2000 at which 23 representatives of 8 countries participated, including those responsible in the Ministry of Health for filariasis control and planning. The workshop was supported by the UK Department of International Development. One of the objectives of the workshop was to obtain views about the methodologies so far developed in LF mapping and to refine them on the basis of country experience and knowledge.

The participants in the inter-country planning workshop used the draft guidelines to develop a detailed plan for rapid mapping of lymphatic filariasis in their country. During the workshop, they completed steps 1 to 3, gained experience with step 4 and 5 by undertaking filariasis antigen surveys in two selected villages in Burkina Faso and executed steps 6 to 8 using available survey data for North Ghana and North Togo.
The comments of the participants and some of their results are given below for each of the steps in the mapping method.

**Step 1: Identify or define the implementation unit (IU)**

The IU for each of the countries is given in the table below. The participants stressed the importance of using the appropriate national terminology for health administrative units. The term 'district' was often confusing, especially for the Francophone countries.

The implementation unit may not be the same administrative unit throughout the country, and smaller administrative units unit may be used in certain areas, especially at the boundary of large filariasis foci. Where the district is large in Ghana, the sub-district will be used as the implementation unit. In Tanzania, sub-divisions for the numerous large districts in the country will be used to define implementation areas, as well as geographic limits, especially as relating to altitude. Different local modifications may be required in other countries, and additional sampling may be needed in such areas

**Step 2: Review of available information on lymphatic filariasis**

The participants reviewed an LF distribution map based on published and unpublished data on lymphatic filariasis in Africa. It was noted that the available information was very limited and only very few areas could be classified as having filariasis transmission.

Most of the reported survey data were very old and the West African surveys were mainly done in the sixties. It was agreed that such old data could not be reliable used for national planning. The workshop agreed on the following guidelines for the use of existing survey data:

- If the data are less than 10 years old, and the survey methods are believed to be reliable, the data should be used
- If the data are more than 20 year old, the data should not be used and new surveys are required
- If the data are between 10 and 20 years old, the national team should use its own judgement whether to use the data for mapping or not.
Filariasis or malaria risk maps may be used to identify areas where transmission is very unlikely and which can therefore be excluded from further mapping. Risk maps have been developed for filariasis and malaria using climatological models\textsuperscript{5,6}, and detailed malaria risk maps are available for Mali, Kenya and Tanzania. However, there are only few areas which can be excluded from further mapping using these risk maps and nearly all of West and Central Africa is potentially endemic for filariasis.

Empty, unpopulated areas can be excluded from mapping, and the HealthMap database was useful in this respect for several West Africa countries. It was recommended that villages in national parks be included in the sampling.

**Step 3: Selection of sample villages for filarial antigen surveys**

The map below shows the selected sample villages with their buffer zones for Burkina Faso. The shaded circles represent the buffers for the randomly selected villages (one for each arrondissement), and the open circles the additional villages that were selected by the national team to fill the gaps. The final sample gives a good spatial coverage of the country and only a few largely unpopulated areas are not covered.

In Burkina Faso and Cote d'Ivoire, the administrative units and boundaries were not always exactly the same as the corresponding health units and their boundaries. However, this was not a major problem as the final sample for both countries had villages from each of the relevant health units.
Step 4: Identify one additional village in IUs where locally available information suggests that specific villages are likely to be endemic

A visit to the district health office before undertaking the surveys was considered essential to explain the purpose of the survey.

Step 5: Undertake surveys in the sample villages

The participants executed antigen prevalence surveys in two villages located at some 150 km West of Ouagadougou. Previous surveys in 1968 had shown a high level of endemicity in these villages with a mf prevalence of about 40%. The survey showed that little had changed as the antigen prevalence was 38% adn xx% in the two villages respectively.

Invalid tests, for which the control band does not show, should be discarded and a new test should be done instead. The invalid tests should not be included in the denominator for calculating the prevalence of antigenaemia.

Only residents should be included in the survey. A resident was defined as a person who is resident in the village for at least 10 years and who has not been absent for more than 6 months during that period.

The sample of individuals to be tested should be representative for the village and bias in the selection should be avoided. The national team should decide on a practical, locally acceptable random selection procedure to be used.

In case the village does not exist at the selected location, the closest village should be used for the survey. If the village is too small to obtain the required sample size, additional examinations should be done in the nearest village till the required number of test is reached. The additional test results should be added to the results for the selected village and entered together in the data base for the selected village.

The record sheet in Annex 1 should be used for recording the results. This record form uses a format which is compatible with HealthMap which facilitates data entry.

Step 6: Data entry into HealthMapper

The data entry form of Health Mapper is shown below. Data entry is simple but a paper copy of the completed record form should always be kept after recording of the data into the computer. The village co-ordinates should be entered in decimal degrees.
Step 7: Spatial analysis and preparation of a prevalence contour map

The spatial analysis of the survey data will involve (i) an assessment of the spatial correlation pattern in a variogram analysis and the fitting of a model to the variogram, and (ii) the use of the fitted model in kriging to create the prevalence contours for the area to be mapped. TDR will organize a short training workshop in these spatial analysis methods for the statisticians of the national teams. The final prevalence contour maps will be imported into HealthMap as a separate layer.

A demonstration of the spatial analysis was given during the workshop using the data collected for the testing of the RAG FIL method in North Ghana and some recent survey data from North Togo which were made available during the workshop. The results are shown below in a three dimensional map with the antigen prevalence on the vertical axis (showing prevalence as a kind of 'altitude'). The results from Ghana and Togo were very consistent: in both countries the highest prevalence was in the far North on the border with Burkina Faso and the prevalence declined southward to very low levels around a latitude of 9.5° N.
Step 8: Identification of IUs where mass drug administration is required

The overlay of the district boundaries on the ICT prevalence contour in the figure above showes clearly that large scale treatment is required in all districts in the North of Ghana and Togo. It is also likely that treatment may not be required in some districts in Togo which are located more to the South below 9.5°. However, this decision could not yet be taken on the basis of these partial data and will have to await the completion of the mapping exercise in the rest of these two countries, and in the neighbouring countries.

General principles: urban filariasis

The mapping process described in this document does not apply to urban filariasis for which the spatial considerations are different because of different vectors and major differences in the living conditions and migratory behaviour of the human populations. It was noted that the TDR Task Force on Filariasis Intervention Research would address research issue related to filariasis elimination in the urban environment and it was recommended that the Task Force also addresses the issue of mapping in this context.

6 Phased mapping of Bancroftian filariasis in Africa

6.1 Proposed Phases

As recommended by an independent review group, it is proposed to implement the mapping in phases. Countries were classified into four different phases according to criteria such as (i) likely burden of filariasis, (ii) likely size of population at risk, (iii) expected overlap with onchocerciasis, (iv) feasibility to undertake surveys throughout the country, (v) expressed interest of country in filariasis elimination, (vi) opportunities to rapidly follow up the mapping with filariasis elimination activities, (vii) risk of severe adverse reactions to treatment because of loiasis, and (viii) geographical clustering of countries, as the foci of filariasis extend across
international borders. Based on these considerations, it is proposed to phase the mapping as shown in the figure below.

![Map of Africa with color coding for years 2000 to 2003](image)

This proposed schedule is very provisional and should be reviewed after the completion of the first large scale mapping activities when it may be possible to revise the projected time and costs of the mapping exercise.

### 6.2 Organization

Mapping the geographic distribution of a disease in a country is a national responsibility, and ownership of the mapping exercise by the Ministry of Health and the National LF Elimination Task Forces is essential. However, mapping of filariasis is not just a national affair and regional considerations, such as the existence of cross-border foci and the use of survey data from neighbouring countries in spatial analysis, need to be taken into account. It is proposed, therefore, that planning and implementation of filariasis mapping is done by inter-country teams from clusters of countries with common borders and possibly cross-border foci. These inter-country teams would consist of representatives from each of the countries in the cluster, including the responsible officer for filariasis control in the Ministry of Health, an epidemiologist who will be responsible for the execution of the surveys (preferably a national scientist with field experience in REMO or in the pre-testing of RAGFIL), and a person with GIS and data analysis skills (preferably somebody responsible for GIS in the MoH and already trained by HealthMap).

The members of the inter-country team for a given cluster would participate in a planning workshop where they would:
Residual and potential residual foci

- **Oncho free before 2002**
- **Ivermectin after 2002**
- **Residual focus (v. control)**
- **Potential residual focus**

- Review available information on the distribution of filariasis in the participating countries and identify areas where further mapping is required.
- Assess the needs for building adequate capacities in the countries for the mapping activities.
- Train the participants in HealthMapper, and use of GPS and ICT cards as required for the mapping exercise, and demonstrate the application of spatial analysis techniques.
- Develop a joint inter-country plan and time table for mapping.
- Develop mechanism for quality control.
- Develop a sampling frame and select sample villages.

Experts in specialised areas, such as in GIS, spatial population modelling, variogram analysis and kriging, will provide technical support as required. These experts will also be involved in capacity building for GIS and spatial analysis, building on the capacity in GIS which has been created in the context of mapping for Guinea Worm elimination and onchocerciasis control.

WHO will coordinate the various activities, at least for phase I, and keep the various partners informed about planned and ongoing activities, and of the mapping results.

## 7 Phase I: year 2000

### 7.1 Sub-regional groups

The five West African countries are part of the OCP and it is likely that there is considerable overlap between the filariasis endemic areas and ivermectin distribution areas for onchocerciasis control. Such overlapping areas are probable in the forest belt along the coast where only ivermectin is used for onchocerciasis control and in several areas which used to be under vector control, and where ivermectin distribution will continue after the cessation of OCP in the year 2002 (see OCP map below).
The third group consists of the country of Nigeria only. Nigeria is highly populated and filariasis transmission probably occurs over large part of the country. Hence, the target population for treatment is expected to be very large. Secondly, onchocerciasis is wide spread and ivermectin distribution is ongoing in a large part of the country (see map of Nigeria below).

In addition to these three groups, there is the country of Madagascar for which it appears that there are ample survey data to map filariasis and to plan a national elimination programme. In view of the MoH of Madagascar indicating an interest in initiating a national LF elimination programme, it is proposed to review with the MoH the available data and decide whether any additional surveys are needed for mapping LF distribution.

### 7.2 Sample communities

An attempt has been made to estimate the number of sample communities to be surveyed in the 10 countries. One of the challenges of the proposed mapping method is to effectively combine the spatial sampling approach with the Implementation Unit based sampling of villages. Overall, the number of 50x50 km grid points (1,249) and IUs (1,749) are not very different. However, at the local level the discrepancies are sometimes large as the size of districts can be very small (e.g. in Nigeria where there are 774 LGAs) or very large (some East African districts having a diameter of more than 300 km). A first assessment of a possible sampling frame using a GIS for the 10 countries, indicates that it is possible to combine the two sampling approaches and still limit the number of sample villages to be surveyed to 1,537 (see table below).
<table>
<thead>
<tr>
<th>Country</th>
<th>No. of 'Regions' (1st level admin. units)</th>
<th>No. of 'Districts' (2nd level admin. units)</th>
<th>No. of Sample villages with 50x50 km grid</th>
<th>No. of Sample villages for proposed method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cote d'Ivoire</td>
<td>9</td>
<td>50</td>
<td>115</td>
<td>115</td>
</tr>
<tr>
<td>Ghana</td>
<td>10</td>
<td>110</td>
<td>61</td>
<td>85*</td>
</tr>
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<td>Burkina Faso</td>
<td>45</td>
<td>301</td>
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<td>97</td>
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<tr>
<td>Togo</td>
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<td>Benin</td>
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<td>Nigeria</td>
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<td>Tanzania</td>
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<td>290*</td>
</tr>
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<td>Kenya</td>
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<td>200</td>
</tr>
<tr>
<td>Uganda</td>
<td>39</td>
<td>164</td>
<td>87</td>
<td>164</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>182</strong></td>
<td><strong>1,691</strong></td>
<td><strong>1,084</strong></td>
<td><strong>1,372</strong></td>
</tr>
</tbody>
</table>

* Excluding areas that were already mapped as part of the pre-testing of RAGFIL
** Total excludes 169 sample points which fell into national parks, lakes etc

This approach would make it possible to sample each district in 8 of the 10 countries, and each 1st level administrative unit in Burkina Faso. Sampling each LGA in Nigeria may be too expensive for a first mapping of filariasis and a smaller sample is proposed.

The above figures are only indicative and the actual sample should be decided upon during the inter-country planning workshop for each cluster of countries.

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