Guidelines for analysis of REMO data using GIS

UNDP/World Bank/WHO
Special Programme for Research & Training in Tropical Diseases (TDR)

WHO/UNICEF Joint Programme for Health Mapping (HealthMap)

African Programme for Onchocerciasis Control (APOC)
Guidelines for analysis of REMO data using GIS
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1. Introduction

An informal consultation on the Analysis and Interpretation of Rapid Epidemiological Mapping of Onchocerciasis (REMO) using a Geographic Information System (GIS), was held in Ouagadougou, Burkina Faso from 3 - 6 September, 1996. The meeting was hosted by the Onchocerciasis Control Programme in West Africa (OCP) in conjunction with the African Programme for Onchocerciasis Control (APOC) and sponsored by the Task Force on Onchocerciasis Operational Research of the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases (TDR). Technical assistance was provided by the WHO/UNICEF Joint Programme for Health Mapping (HealthMap).

The workshop was convened to develop a standard methodology for the analysis of the REMO data and the identification of priority areas for Community-directed Treatment with Ivermectin (CDTI) for APOC countries. In order to achieve this objective, participants appraised the status of REMO in Cameroon, Ethiopia, Nigeria, Sudan and Uganda, analysed and interpreted the available REMO data, and identified (a) areas where CDTI was indicated, (b) areas where CDTI was not needed and (c) areas where further data were required.

The methodology developed in the course of this process was subsequently tested and refined during the analysis and interpretation of REMO data for other countries. The final methodology is described in the present document as a guideline to assist onchocerciasis control personnel, especially members of the National Onchocerciasis Task Forces, in the interpretation of REMO results and their use for effective planning and prioritization of CDTI in APOC countries.

In the preparation of these guidelines, the original REMO manual¹ and the supplemental REMO guidelines² were taken into consideration. The reader is referred to these documents for a description of the various steps involved in the planning of REMO and the execution of surveys in sample villages.

The GIS software used was Atlas*GIS which is described in a training manual prepared by HealthMap³. It is assumed that the reader has followed a training session on Atlas*GIS, and the information provided here should be seen as a complement to the training manual.

Although the present guidelines are focussing on analysis, experience shows that good preparatory work is essential. A lot of effort and duplication of work can be avoided by a good planning of the different steps required for REMO. This point was probably not sufficiently emphasized in the previous manuals and a description of important preparatory work, especially that involving GIS, has been included in the present guidelines. However, points that were sufficiently detailed in the previous manuals are only cited.
2. Preparatory work

2.1 Preparatory work on paper

2.1.1 Use of original paper maps and log book

The most appropriate maps for REMO preparatory work are topographical paper maps at a scale of 1:200,000 in Francophone countries and 1:250,000 in Anglophone countries. Even if computerized maps have already been made available to the REMO team, they should not be used initially as their scale (1:1,000,000) is not appropriate for the selection of the sample villages. The acquisition of the paper maps is part of the preparatory work, but the required maps are not commonly available. The geographer in the REMO team should be put in charge of getting the maps from national/regional survey departments, universities and other research institutions.

It is recommended to get 2 sets of original maps. One set will remain with the National Coordinator as a backup set, until the very end of the exercise. It should always be possible to refer to this set of maps if the other set has been lost, or has become difficult to read after field surveys. The other set will serve for field surveys after the selection of sample villages.

The procedures for defining the zoning using the paper maps and for selecting the sample villages are described on pages 4-9 of the REMO manual. The steps taken and the reasoning used in the zoning and the selection of villages should be documented in a log book (see Supplemental Guidelines for REMO). Experience has shown that such a log book will greatly facilitate the analysis and interpretation of the results.

2.1.2 Prepare the paper survey forms and fill available data

Some improvements have been made to the summary form for REA results per Zone, as described on p.20 of the REMO manual. They concern the addition of separate columns for coordinates taken from the maps during the initial selection of sample villages, and for coordinates collected using a GPS during the REA surveys in the sample villages. Experience has shown that keeping a record of both will avoid many problems during the processing and analysis of the results. Separate columns have also been introduced for the results of nodule palpations in males and females. The currently recommended format for the form is as follows:
At this stage of the work, it is recommended to fill Columns number 1, 4, 5, 7 and 8. All required information is directly available from the map and should be filled at the time the geographer is working with the team. Experience shows that if the map coordinates are not entered at this stage, it is likely that there will be many serious and insoluble problems during the data processing and analysis phase.

2.2 Preparatory work with the computer

2.2.1 Enter preliminary data from the forms

Once the above first data have been recorded on the forms, it is recommended to start computerizing these data. This will allow the preparation of computerized maps with the sample villages and a review of the adequacy of the sample coverage of the area.

The data entry can be done with a special data entry programme that has been prepared in EPI INFO (available from TDR or HealthMap). This programme allows to enter coordinates in Degree, Minutes, Seconds and will automatically calculate the corresponding coordinates in Decimal Degrees. The resulting file will then need to be exported as a DBASE file (*.DBF) before being imported into Atlas*GIS.

Alternatively, a database management programme or spreadsheet that is well known by the team can be used (i.e. DBASE, FoxPro, Excel, etc). However, ultimately the file will have to be exported as a *.DBF file with a structure as shown in the table in Annex 6.1.

2.2.2 Computerize the zoning, based on the paper work

Once the zoning has been completed on the paper maps, the information will need to be transferred to a computerized map. This can be facilitated by using electronic base maps.
2.2.2.1 **Use of Base Maps**

A set of electronic base maps has been prepared in Atlas*GIS format for each APOC country by HealthMap. The base maps are provided to the participants during training sessions on Atlas*GIS.

Base maps required for the analysis include:
- political boundaries
- rivers, streams and lakes
- elevation data (contour lines or elevation areas)

The base maps all come from the same source: the Digital Chart of the World, which has been assembled by the World Resources Institute (Washington) in an homogeneous set of base maps for Africa named the Africa Data Sampler. To facilitate cross border analysis it is recommended that each country uses these maps for the analysis.

2.2.2.2 **Digitize the zoning**

This task requires the following steps within Atlas*GIS (using the Atlas*GIS terminology):

- Creation of a new Geo-file for the zoning
- Creation of a layer for the bio-geographical zones
- Creation of a layer for the subdivisions into zones
- Creation of a layer for empty/unsuitable zones
- Creation of layers defining the sub-zones/river basins

The procedure is described in detail in Annex 6.2.

2.2.3 **Review of adequacy of sample coverage**

Experience has shown that a poor sample coverage of a given area is bound to lead to inadequate description of the distribution pattern of the disease. And this will have a far reaching effect on the interpretation of the REMO results and finally on the planning of control in the area. It is therefore important to review the adequacy of the sample before starting the field work. This can be done by producing a map of the sample villages.

Once the coordinates of the selected villages are entered and the zoning is computerized, the sample villages can be mapped with Atlas*GIS on top of the base maps. The adequacy of the sample spread should then be reviewed while taking the zoning into account, e.g. while no sample villages are required in the empty zones, there should be no major empty gaps in potentially endemic areas with rivers.

The review of the adequacy of coverage is particularly important if it is decided not to go for REMO in some part of the country because extensive and reliable REA data are already available from other sources. Such a decision should never be taken before having displayed the location
of available REA data on the map. Even if extensive surveys have been conducted for a certain district and data is available for dozens of villages, experience has shown that these villages could be all located in a very small radius while a large part of the district remains uncovered.

The map below gives an illustration of this. REA data were available for 70 villages in this district. Before mapping these villages, it was thought that the available REA information was more than adequate for this district. But when the data were plotted, it turned out that all REA villages were located within a radius of 10 Km. There was no epidemiological information for most of the district, in spite of the presence of several rivers. It was necessary, therefore, to select additional REMO villages to ensure adequate mapping of the distribution of onchocerciasis in this area.
3. Field surveys

The selection of communities to be surveyed and the execution of the rapid epidemiological assessment (REA) surveys in the selected sample communities has been adequately described in section 2.1 and 2.2 of the REMO manual. However, on the basis of the current experience with REMO we would like to add the following points.

Alternative villages should be selected from the map for all selected high risk (H) and secondary villages (S). In case a selected sample village cannot be found or is not accessible at the time of survey in the field, the alternative village should be located and examined. The selection of alternative villages should be done by the central REMO team at the same time that the H and S villages are selected. It should not be left to the survey team as this is most likely to results in a biased, convenience sample. Furthermore, alternative villages should be surveyed for all non-accessible villages to avoid leaving an uncomfortable epidemiological gap on the map.

The use of a Geographical Positioning System (GPS) during REA surveys in the field is highly recommended. Coordinates should be taken for every village where REA is conducted. GPS coordinates should be reported on the paper survey form.
4. REMO Analysis with Atlas*GIS

4.1 Epidemiological survey data

4.1.1 Rapid Epidemiological Assessment (REA) data

Once the REA surveys have been completed, the survey data should be entered in the computer. For this an EPI-INFO data entry programme has been developed which can be obtained from TDR. (see also section 2.2.1).

The validity of the REA data should be assessed through independent validation surveys in a small sample of villages after the completion of the main REA surveys. The validation data should be entered using the same data entry programme and the prevalence of nodules for the original and validation surveys should be compared. In case of serious discrepancies, the REA data should be carefully reviewed to identify possible reasons for the problems (e.g. inadequate performance of one of the field teams, over scoring by one examiner, etc.). Once the cause has been identified, it will be possible to determine which REA surveys will need to be repeated to ensure that the final data set is reliable.

4.1.2 Conversion and addition of other epidemiological data

In many APOC countries, there are foci where onchocerciasis prevalence surveys were undertaken before the REMO and REA methods were developed. These surveys were done by various organizations, i.e. research institutions, local health services, NGO’s working on onchocerciasis control, etc, and the survey methods used were usually different from those applied in REMO. The reported results of these previous surveys, therefore, are not directly comparable with the REMO findings. However, for many foci, these historical surveys provide detailed information on the distribution and endemicity level of onchocerciasis, and it will be important to try to integrate this information in the GIS for onchocerciasis.

Most of the previous surveys used the skin snip method to determine onchocerciasis infection, and the most commonly reported index of onchocerciasis endemicity was the prevalence of mf-positive skin snips among the total population (including both sexes and all age groups). Another common index was the Community Microfilarial Load (CMFL), which is linearly related with the burden of ocular disease and which is calculated using the skin snip results for adult males only.

A large number of surveys have been done in the West African savanna in OCP countries and elsewhere, using both the skin snip method and nodule palpation. A large set of such community based data were analysed during a workshop held in 1991. Some of the results are shown in the figure below which can be used to convert the prevalence of mf in the total village population into the estimated corresponding prevalence of palpable nodules in adult males.
4.2 Identification of areas where large scale treatment is indicated

When the REA data have been entered in a database, the results of the REA surveys should be plotted as prevalence pies (the procedure is described in annex 6.3). Then the most important analysis phase can start: the interpretation of the epidemiological patterns. This phase should be executed by the same REMO team which did the original sampling of the survey villages.

In this interpretation process, it is important to remember that the survey data do not represent a spatial random sample, but that the villages have been selected in a purposely biased manner using available information about the river basins. It is therefore critical to return to the reasoning used during the sampling process, and apply the same reasoning in the interpretation of the epidemiological results. Thus, the same division of the country into bio-geographical divisions and zones should be used, and the arguments used to select specific villages need to be taken into account. A detailed log book will prove extremely useful at this stage. Zones are often too big to allow a simple classification of the whole zone, and it may be necessary to start at the level of the river basins following the same sequence as used in the original selection process. It is also important to first separate the high risk and the secondary villages during the interpretation of the results.

The ultimate aim of this step of the analysis is to classify subsections of the river basins into three groups with respect to the indicated ivermectin treatment strategy.
4.2.1 Subdivision of river basins by treatment strategy

4.2.1.1 Types of treatment strategy areas

The following three treatment strategy areas are differentiated in the analysis.

(i). Definite CDTI area.

These are areas for which the REMO results show clearly that onchocerciasis is highly endemic (nodule prevalence in most REA villages greater than 20%) and a significant public health problem throughout the area. CDTI is indicated in all villages in the area and no further REA surveys are needed to further clarify the disease pattern. Some REA may be required to define the exact boundary of the CDTI area, but such surveys can be done in the context of the first round of treatment and should not delay the implementation of CDTI in the area.

(ii). No CDTI area

These are areas where there is no *O. volvulus* transmission or where the level of onchocerciasis endemicity is too low to consider the disease a sufficiently public health problem to warrant Community-directed Ivermectin Treatment. Clinic-based ivermectin treatment may be provided in areas where there is transmission but where the endemicity is low.

(iii). Possible CDTI area.

For these areas the epidemiological pattern is not sufficiently clear and there is a need to refine the map of the distribution of onchocerciasis through additional REA surveys. CDTI may be indicated in at least part of the area but a final decision should await the clarification of the endemicity pattern.

The 'Possible CDTI Areas' can be divided into two subgroups:

- **CDTI likely** (Priority areas for further REA surveys)
  - In these areas the pattern is not consistent. Some villages are not endemic or only hypo-endemic while others are sufficiently endemic to indicate that CDTI may be indicated in at least part of the area.

- **CDTI unlikely** (Areas where additional surveys are not urgent)
  - The pattern is a mix of non-endemic, hypo- and meso-endemic villages. However, none of the sample villages has a nodule prevalence of more than 40%.

4.2.1.2 Creation of layers for the three types of treatment strategy areas

Once the different treatment areas have been identified, the corresponding layers should be created in Atlas*GIS, and the results saved in a geo-file. The name of the geo file should start with the 2 letters of the country code and end with CDTI (eg CMC14DTI.AGF).
4.2.2 Examples of the Identification of Treatment Strategy Areas.

Some examples of the identification of treatment strategy areas are illustrated below using epidemiological maps for river basins in Cameroon and Nigeria.

Case Study no. 1: Cameroon, Zone IIIb

1. Zoom on the zone, display empty zones for onchocerciasis, the rivers and the REMO data in pie charts. First display only the results for the high risk villages.

All the selected ‘high risk’ villages along the main river have a very high prevalence of nodules. The first conclusion which can be drawn is that the area is endemic for onchocerciasis, and that CDTI is indicated along the main river and along the main affluents to the South.

2. Now display also the prevalence pies for the secondary villages. Most of the secondary villages show a very low nodule prevalence, indicating that distribution along this river follows the classical ‘savanna’ pattern with high onchocerciasis endemicity along the river and a rapid decline in endemicity with increasing distance from the main river.
2. Identify ‘definite CDTI areas’.

The high nodule prevalences in the first line villages clearly indicate that CDTI is indicated in all villages along the main river. Hence, a belt of 20-40 km wide is drawn along the main river to indicate that this is a "definite CDTI area".

3. Identify ‘possible CDTI areas’

In the Western part of the main river basin, all the secondary villages along the southern affluents are also highly endemic, and these affluents are therefore included in the ‘definite CDTI’ belt. However, in the centre of the zone, most of the secondary villages along the Southern affluents (area B) have a very low endemicity and CDTI does generally not appear indicated. It this area, some further surveys may be needed to determine the exact boundary of the CDTI area. However, these surveys are not urgent and can be done in the context of implementation of a treatment programme along the main river.

Along the major affluent in area A, the pattern is less clear: going upstream the endemicity seems to drop but the last two villages in the North, at the limit of the empty area, have very high nodule rates. CDTI is clearly needed in some of the area, but without additional surveys it is not easy to determine exactly where. Since some villages are highly endemic, further surveys are urgent in this area.
Case Study n. 2 - South-East Nigeria

This example refers to a large area around the Cross-river basin in South-East Nigeria.

1. Display the zones and the empty areas as defined during the initial selection of sample villages.

2. Display the REMO data as pie-charts, and interpret the epidemiological patterns, first basin by basin as in the above example, and then by looking at the patterns in neighbouring basins. In this example there is a high endemcity in virtually all the sample villages in river basins in the centre-north, and virtually no palpable nodules in the south-western river delta.
3. Define the different type of CDTI areas

After interpreting the results basin by basin, and then combining the results for neighbouring basins, the workshop participants identified the CDTI areas as shown here. There is a vast, highly endemic area, covering several adjacent zones, where CDTI is indicated in all villages. Further refinement is required in two areas in the North and in one area in the South-West. We will use the latter area to illustrate some of the pitfalls in the interpretation of REMO data.

4. This map shows an enlargement of the area in the South-West for which further refinement is required. Most of the villages in this area have a very low nodule rate but there are a few villages with higher rates, and even one village with a prevalence of more than 40%. Only in the area upstream of the western affluents is the nodule prevalence consistently high. For the rest of the river basin the pattern is not consistent, and this part of the basin is therefore correctly classified as "possible CDTI" with as qualification "CDTI likely".
5. Experience has shown that people interpreting REMO data often forget that these are sample data representing sections of river basins. As a result, there is a tendency to over-interpret the nodule rates for individual villages and to classify the immediate area around these villages on the basis of these results only. Examples of such erroneous interpretation are given in this map. Three “definite CDTI” and two “possible CDTI” areas have been defined around a few sample villages, while ignoring the sampling design used to select the villages. This is a common error, and it is best be avoided by using the information on the original sample design as recorded in the log book.

4.2.3 CREATION OF EPIDEMIOLOGICAL MAPS SHOWING AREAS WHERE CDTI IS INDICATED

The ultimate objective of the exercise is to draw an epidemiological map for the whole country. From the experience with Nigeria and Cameroon, (see map below) we know that the knowledge of the situation in the neighbouring countries helps to define the treatment strategy areas at the border.
4.3 Estimation of the number of villages and the total population requiring CDTI

4.3.1 The use of population or village data bases from other sources

If a national village database is available for a country, it can be overlaid on the map of treatment areas. It is then easy to make a query on the number of villages within the treatment area. If population data for the villages are available as well, the number of people to be treated can also be calculated. However, it is not very often that such databases are available.

We will use the example of Cameroon to explain the procedure for estimating the target population for treatment (see Annex 6.4 for more details). For Cameroon, there exists a national village database but it does not contain information on the population per village. Instead we used an estimate of the average population per village.

1. Overlay of village point data and treatment areas. Select all the villages that are within the "Definite CDTI" treatment area. The target population for CDTI can now be estimated by multiplying the number of villages in the CDTI area with the average population per village.

Preliminary estimates for Cameroon indicated that there were 5025 villages in the "Definite CDTI" areas, and 403 villages in the "CDTI likely" areas. Taking an average of 700 persons per village (total rural population divided by total number of villages) and assuming that CDTI would be required in some 50% of the villages in the areas classified as "CDTI likely", the total target population for CDTI was estimated at $5025 \times 700 + 403 \times 700 \times 0.5 = 3,658,550$ people.
4.3.2 The Use of Population Data for Administrative Divisions of the Country

For many countries there exists no national village database. However, the administrative boundaries and their related population census data can often be obtained. This information can be used to estimate the target population for treatment using the procedure described below for Nigeria.

This map shows for Nigeria the "Definite CDTI" treatment areas and the administrative boundaries (LGAs). First we overlay the administrative boundaries linked with population data on top of the treatment areas. Then we split the treatment areas by administrative areas. When we do this with Atlas*GIS, the programme will create a new layer and a new table. In the new layer, the treatment polygons have been split into smaller polygons according to the administrative boundaries. The new table will contain for each of the new polygons the population calculated on the basis of the proportion of the administrative areas which fall within a treatment area.

The map shows the effect of splitting for Nigeria. The treatment areas have been split into smaller polygons which relate to LGA areas for which census estimates are available. With this procedure, the target population for CDTI can be estimated for the entire country or for a limited zone (e.g. one LGA or one region).
This approach assumes that the population is homogeneously distributed within the administrative area, so that treating half of an administrative area is equivalent to treating half of the population of the area. For onchocerciasis, this hypothesis may be reasonable as long as we only use data for the rural population.
5. Final remarks

When the analysis has been completed and the first CDTI map created, there remain still a number of steps to be taken. The first is to write a report of the analysis and the interpretation of the REMO data, which clearly describes the reasoning used in the classification of areas by treatment strategy. Although the present document gives guidelines for an objective approach to the analysis, the interpretation of the results will to a large extent remain subjective. This is unavoidable with a rapid assessment method like REMO which provides only a minimal amount of data on the geographical distribution of onchocerciasis. But this subjective element makes it extra important to document the reasoning used in the classification of areas, so that this information will be available when a given classification is queried at some later stage.

The CDTI map should be submitted to the National Onchocerciasis Task Force (NOTF) in each APOC country for review and approval. The NOTF should be encouraged to review the map carefully and critically, so that any major problems can be identified at this early stage before the map is used for planning of control. However, the NOTF should also be reminded that this is only a first map for the purpose of broadly identifying priority areas for CDTI. Further refining of the map will nearly always be needed, but most of this can usually be done in the context of the implementation of CDTI. The first map will also help to identify where further refinement is most urgently required and where additional REA surveys need to be undertaken on a priority basis.

Once the NOTF has approved the first CDTI map, it becomes the basis for the national plan for onchocerciasis control. The map will enable the identification of priority areas for CDTI and to delineate CDTI projects for submission for funding to APOC.
# 6. Annexes

## 6.1 Structure of REMO database

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<td>Latitude</td>
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<td>Latitude</td>
<td>Numeric</td>
<td>11, 6</td>
</tr>
<tr>
<td></td>
<td>LONGPS_D</td>
<td>Longitude</td>
<td>Numeric</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>LONGPS_M</td>
<td>Longitude</td>
<td>Numeric</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>LONGPS_S</td>
<td>Longitude</td>
<td>Numeric</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>LONGPS</td>
<td>Longitude</td>
<td>Decimal</td>
<td>11, 6</td>
</tr>
<tr>
<td></td>
<td>REM_ECOD</td>
<td>REMO Ecological Division</td>
<td>Text</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>REM_ECOZ</td>
<td>REMO Ecological Zone</td>
<td>Text</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>RIV_BAS</td>
<td>River Basin Name</td>
<td>Text</td>
<td>25</td>
</tr>
<tr>
<td>VARIABLE (FIELD)</td>
<td>DESIGNATION</td>
<td>TYPE</td>
<td>SIZE</td>
<td>COMMENTS</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
<td>------</td>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td>X</td>
<td>RIV_NAME</td>
<td>Text</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>POP</td>
<td>Village Population</td>
<td>Numeric</td>
<td>10</td>
<td>From national census data if available, otherwise estimated</td>
</tr>
<tr>
<td>DATE_POP</td>
<td>Year of Population data</td>
<td>Text</td>
<td>6</td>
<td>Year of last census, otherwise write ES date of REMO (e.g. ES1995)</td>
</tr>
<tr>
<td>MAL_EXAM</td>
<td>Number of Males examined</td>
<td>Numeric</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAL_NOD</td>
<td>Number of Males with Nodules</td>
<td>Numeric</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>P_M_NOD</td>
<td>Percentage of Males with Nodules</td>
<td>Decimal</td>
<td>6, 2</td>
<td>Automated calculation: MAL_NOD/MAL_EXAM * 100</td>
</tr>
<tr>
<td>FEM_EXAM</td>
<td>Number of Females examined</td>
<td>Numeric</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FEM_NOD</td>
<td>Number of Females with Nodules</td>
<td>Numeric</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>P_F_NOD</td>
<td>Percentage of Females with Nodules</td>
<td>Decimal</td>
<td>6, 2</td>
<td>Automated calculation: FEM_NOD/FEM_EXAM * 100</td>
</tr>
</tbody>
</table>

Data for all fields marked with X can be entered during the preparatory work and before the execution of the field surveys.
6.2 Step by step guidelines for the creation of a new geo-file for the zoning and the creation of new layers

A. Check the default data directory: it should be where you have the base maps (rivers, elevation, etc...)

- Choose FILE|PREFERENCES
- In the Preferences list box, click on the Systems option button
- In the Default Data Directory box, type the path of your data directory. If you don’t know the exact path, you can retrieve it by clicking on the button [...] 

B. Display whatever information will be required to help you drawing the bio-geographical divisions according to the paper maps (rivers, elevation layers...)

C. Create a new Geo file to store the different layers.

- Choose FILE|NEW|GEO
The New Geo File Dialog Box opens up.
- In the New Geo File Dialog Box, type the File Name. It is recommended to start the naming with the 2 letters used for the country code.

- Fill the description. This geo file will serve to store all the layers related to the zoning (biogeographical divisions, subdivisions, unsuitable areas and river basins). The name could therefore be "REMO Zoning".

- Keep the projection as LL.

At this stage, you have created the new Geo file for the zoning. In the same step, you will create the first layer to store information on the Bio-geographical Divisions

- In the Layer Options Box, fill the Layer Name and the Description corresponding to the layer for the Bio-geographical Divisions.
- Click on OK

Nothing has changed yet on your map.

- If you choose MAP|LAYERS & THEMES, and click on Layer Info

![Layer Options](image)

You see that there is a new geo file and a new layer but the Feature Count says "0". You will now have to draw the limits of the Divisions.

4. Draw the limits of the Divisions

- Check in the Default Layer Set Window that your new layer is the only one selected.
Select the appropriate tool to draw a polygon, and draw one division on the map.

To end the polygon, double-click with the mouse.

If you make a mistake while drawing, just use Backspace to delete the nodes.

After you have drawn the division you can select it and change the information with the Info Tool.
If you want to change the shape of the Division, to adjust it for instance to the border line:

- First select the polygon, then use the "Reshape polygon" tool and click on the polygon. You will see the different nodes of the polygon. You can move each node by clicking and dragging the node. By double-clicking on the line, you will create a new node that may help reshaping the polygon.

- Click on the Arrow Tool when you have finished reshaping the polygon.

- Select again the "Polygon" tool and continue drawing the other Divisions to complete the Bio-geographical Divisions Layer.

5. Create another layer to store information on the Subdivisions into zones.

- The objective is to create a different layer in the same geo file (CMZONING.AGF)

- Choose LAYERS & THEMES and click on New
- Check that the File Name is the file for the zoning (CMZONING in our example).
- Type the Layer Name
- Type the Description
- Click on OK

Nothing has changed yet on your map.

- If you choose MAP\LAYERS & THEMES, and click on Layer Info, you see that there is a new geo file and a new layer but the Feature Count says "0". You will have now to draw the limits of the Sub-divisions into zones.

- Use the methodology described in section 4 above to draw the limits of the Sub-divisions.

- The same methodology can be applied to create a new layer for the unsuitable areas.

**Important note:** Geo files and layers are saved by default. In other words, if by error you delete a zone after having spent 2 hours drawing it, you have lost 2 hours of work... To prevent this, it is strongly recommended to make backup.

- Choose FILE\SAVE AS
- Select the File to Save as the ZONING file (i.e CMZONING.AGF).
- Type a File Name that clearly indicates that the file is a backup (i.e cmzonbac.agf)
- Do not forget to change the Description of the file, and give here as much information as you can.
- **Don’t check the box Use New File.**
  This will leave the file on your hard disk and let you continue working on the master file (CMZONING.AGF). (If you check the box, you will continue working with the backup file, and this is not recommended).
- Note that no specific action is required to save the layers as layers are part of geo files.
6.3 Creation and plotting of prevalence pies in Atlas*GIS

1. Open the REMO file (e.g. CMREMO.DBF).

2. Open the Themes & Layers Dialog Box. Select the REMO layer.

3. Click on the Theme button in the column of buttons at the bottom left of the Dialog Box. The sub-panel to the right of it will offer a number of options. Make sure the Theme On box is checked.

4. In the Map type box choose "Ranged Symbol".

5. Click on the Expression box to pop up the Expression Builder. Choose `P.M.NOD`, the column that reports Percentage of Males with Nodules, then click OK. Verify the expression and click OK to return to the previous menu.

6. Click on the Ranges Button and a Ranged Symbol Dialog Box appears.

7. In the Ranging Box, under the Method option, scroll by clicking on the arrow and choose "Discontinuous". This will allow you to set your ranges according to your preferences. They do not have to be equal size ranges.

8. In the Number of Ranges box, enter the number of ranges you want to use (e.g. 5)

9. Press calculate and the ranges will be reset. Note the statistics summary in the right-hand box.

10. In the Minimum and Maximum settings, enter the ranges you want the data to be displayed in by simply clicking on the numbers and changing them. For example:

<table>
<thead>
<tr>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

11. In the Symbols column, change the symbol. Go at the bottom of the table of symbols and you will see 21 different pie-charts. This will allow you to choose a pie-chart according to the ranges you have defined. For example:

0-0  🌟
12. In the Size column, give them all the same size, eg 15.

13. Click OK to return to previous menu and OK again to return to the map. You should see the REMO data displayed in 5 ranges with pie-charts.

**Note:**

Given the number of pre-defined pie-charts, the ranges can easily be refined to allow the best display as possible of the data.
6.4 Estimation of the number of villages and the total population requiring CDTI

6.4.1 Use of population or village databases from other sources

1. Overlay of village point data and treatment areas

2. Select all the villages that are within the treatment areas.

This is done by Query/Select by location /Inside
In the "Select Features From" box, choose the layer "Villages".
In the "Locate Inside Features From Layer" box, choose the layer that contains the treatment areas. Depending whether you have or not selected some features in this layer, check or not the box "Selected features only".
Click on OK.

On the map, Atlas*GIS will select all the villages that are within the treatment areas. At the bottom of the windows you can see how many villages have been selected.

You can then make the calculation of the population to be treated, based on the estimation of the average population in a village (for example 700 for Cameroon).
6.4.2 Use of population data for administrative divisions of the country

The objective is to overlay the administrative boundaries linked with population data on top of the treatment areas and to split the treatment areas on the basis of the administrative areas. Atlas will create a new layer and a new table. In the new layer, the treatment polygons will be split into smaller polygons according to the administrative boundaries. The new table will contain for each of the new polygon the population calculated on the basis of the proportion of the administrative areas.

1. Go to Map/Split

![Map/Split interface]

2. Go to the Split Features From window
You want to split features from the layer containing the treatment areas (ie. NGLASTZO: defin ttt zones.
3. Go to the window Split by Regions in
The layer needs to be split by the regions in the administrative layer (ie. NGADMIN2: LGA)
4. The results will be copied to a New layer and a New Table.
5. Click first on New layer and fill on the screen as follows:

![New Layer interface]

Use the file name of the file containing the layer on treatment areas, but type in a new name and description for the new layer.

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Click on OK

6. You are back to the previous screen, but the name of the layer has been updated.

7. Click now on New Table and fill on the screen as follows:

Enter the name of a new DBF table that will contain the population data.

Check the option Copy Column from Table and scroll to select the table that contains the data on population per administrative area.

In the Link to Geo Layer box, scroll to select the name of the new layer that you have just created.

Click on OK.

The screen "Split" comes again, just click on OK.
The computer works and gives the message "Splitting features..."

You get a map that should look like the following:

The treatment areas have been split into smaller polygons with the related population figures.

If you want to have the total population to be treated in the country, go to Select by Layer and select the new layer.

Then go to Statistics.

The Statistics window will give you the sum of all the variables stored in the database. In the field related to the rural population you will see the total population to be treated.

You can also select only the polygons for a limited zone and you will get the population for the zone.

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Count</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>AREA</td>
<td>110</td>
<td>152617</td>
</tr>
<tr>
<td>LENGTH</td>
<td>110</td>
<td>14275.5</td>
</tr>
<tr>
<td>P50</td>
<td>71</td>
<td>6681</td>
</tr>
<tr>
<td>U50</td>
<td>71</td>
<td>2212</td>
</tr>
<tr>
<td>R90</td>
<td>71</td>
<td>3470</td>
</tr>
</tbody>
</table>
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References


