Transboundary Water Assessment Programme (TWAP)
Transboundary Aquifers component

DIGITAL QUESTIONNAIRE FOR DATA COLLECTION
- USER GUIDE -

Version: v2.0_UK_ALL
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Introduction to TWAP

The Transboundary Waters Assessment programme (TWAP) is a GEF funded initiative to conduct a global baseline assessment of five transboundary water systems: groundwater, rivers, lakes, large marine ecosystems and open oceans. For more information: www.geftwap.org.

For the groundwater or aquifers component, the assessment data will be collected through networks of National Experts by means of a questionnaire. The questionnaire (excel worksheet) has been designed by the IGRAC – the International Groundwater Centre - and is based on the methodology for the TWAP Assessment of Transboundary Aquifers. This methodology has been developed by a group of international experts under the coordination of UNESCO-IHP in the preparation phase of the project. The methodology is available for download from http://www.twap.isarm.org

Who will fill out the questionnaire?

A team of National Experts will contribute to the assessment by providing data and information about groundwater resources for their national segment of the transboundary aquifers.

For the TWAP groundwater component data collection is a challenge, as data availability on a global scale is very limited in comparison to some other water systems. To improve this situation the project relies on the regional networks of partners established by ISARM and particularly on the contributions of national groundwater experts. Your role as a National Expert is therefore essential to this project. You have been engaged in the TWAP-groundwater project because of your expertise on transboundary groundwater resources. You are kindly requested to share with us relevant information about the selected important transboundary aquifers/aquifer systems in your country.

The questionnaire tackles the multidimensional nature of the Transboundary aquifers, assessing hydrogeological, environmental, socio-economical, legal and institutional aspects. For this reason the input from several experts, each with their own focal areas, might be needed to fill out the questionnaire. To acknowledge all contributors, please provide the names of all persons who assisted in compiling all necessary information for a specific aquifer (Section 3. Personal Details). Contributions will be acknowledged in the project database and documents.

What type of information has to be collected for each transboundary aquifer?

15 key parameters and variables need to be collected; these will allow for the calculation of 10 core indicators. If available 9 optional parameters and variables will enable calculation of 10 additional indicators to complement the base-line assessment.

The questionnaire has been structured in five areas of interest: Aquifer geometry, Hydrogeological aspects, Environmental aspects, Socio-economic aspects, and Legal and institutional aspects.

Where feasible the assessment also wants to give an insight into the conceptual models of the transboundary aquifers. This can be done by providing simple sketch maps and cross-sections of the transboundary aquifer depicting some of the main hydrogeological features (explained below in section on graphic information).
This is the list of parameters and variables covered in the questionnaire:

A. KEY Parameters and variables [Essential for the assessment]
   1. Geo-referenced boundary of Transboundary Aquifer / Aquifer System
   2. Depth to aquifer formation
   3. Full vertical thickness of the aquifer
   4. Aquifer hydraulic conditions
   5. Average groundwater recharge
   6. Predominant aquifer lithology
   7. Predominant type of porosity
   8. Transmissivity
   9. Total groundwater volume in the aquifer
   10. Volume of groundwater depletion
   11. Percentage of the aquifer’s area with groundwater suitable for water consumption
   12. Percentage of the aquifer’s area that is affected by pollution
   13. Mean Annual Volume of groundwater abstraction
   14. Is there any agreement (signed, draft or under preparation) between aquifer States?
   15. Is there any institution with a mandate and/or capacity for transboundary groundwater management?

B. ADDITIONAL Parameters and variables [Optional - To be filled out if data are easily accessible for the National Experts]
   16. Predominant source of groundwater recharge
   17. Predominant natural groundwater discharge mechanism
   18. Total volume of groundwater discharge by springs
   19. Percentage of the aquifer’s area where groundwater table depth is less than 5 m.
   20. Mean annual volume of groundwater abstraction per sector
   21. Mean Annual Volume of total fresh water abstraction (Blue Water abstraction)
   22. Mean annual volume of total fresh water abstraction per sector.
   23. Type of control measures for groundwater abstraction
   24. Type of control measures for groundwater quality

Do I need one questionnaire for each transboundary aquifer?

Yes, you are requested to fill out one questionnaire for each transboundary aquifer / aquifer system in your country. It is of course possible to ask different National Experts to fill out questionnaires for different transboundary aquifers / aquifer systems.

In case you are dealing with a transboundary aquifer system consisting of more than one hydraulically connected aquifer layer, you only have to fill out one questionnaire for the whole aquifer system. This means you will need to aggregate information on different aquifer layers to one value which is representative of the entire aquifer system. At the end of each section, there is space to provide additional information. Please feel free to space this to explain how you aggregated the information.
Information can be provided per aquifer layer instead of whole aquifer. This has to be previously agreed with the other aquifers states. In that case, a separate questionnaire should be filled out per aquifer layer.

**What are the software requirements for the digital questionnaire?**

*The questionnaire has been built in Microsoft Office Excel 2007 using Microsoft Windows 7 Professional. The questionnaire has not been tested on older versions of Excel nor on other operating systems like MacOS or Linux. To avoid problems of compatibility, we strongly recommend you use a computer running version of Windows 7 and a recent version of Excel.*

**Please, be aware you need to ENABLE MACROS in the excel workbook before starting to work:**

- **Enable Macros:** The questionnaire is a Windows Office Excel Workbook. For the questionnaire to function properly it is **necessary to enable Macros** in this worksheet. If you have not enabled Macros in your version of Excel, you will see a ‘Security Warning’ just below the Menu bar (see figure below). To enable the macros in the questionnaire: Press [Options …] and select [Enable this content]. For more information on how to enable macros in Excel follow the following [link]

![Security Warning](image)

If you are working with another version of Microsoft Office Excel (e.g: 2003) follow these steps:

To allow unsigned macros to run, the **Trust all installed add-ins and templates** check box must be selected on the **Trusted Publishers** tab of the **Security** dialog box. This option is selected by default.

1. On the **Tools** menu, point to **Macro**, and then click **Security**.
2. On the **Trusted Publishers** tab, select the **Trust all installed add-ins and templates** check box.

In case you encounter any problems working with the questionnaire: Please contact us via [twap.groundwater@un-igrac.org](mailto:twap.groundwater@un-igrac.org)

**Printable version of the questionnaire**

For your own reference the questionnaire can be printed. You can print multiple Worksheets by first selecting the Worksheets you want to print [Ctrl+select the worksheets you want to print] and then to select [active sheets] in the print menu and press [print].
How do I fill out the questionnaire?

To fill out the questionnaire it will be easiest if you follow the order of the sections. Fill in the data input fields by providing information which is representative of the national segment of the transboundary aquifer in your country. Please make sure to fill out all the key fields of information, including the relevant meta-information and associated references to bibliographic sources.

- **Work through all worksheets:** The questionnaire is structured in several worksheets (tabs at the bottom of the Workbook) to guide you through all the steps. It begins by asking for details about the National Specialists completing the questionnaire. Next, several worksheets request information needed for the assessment of the transboundary aquifer. The last worksheet generates the data file to be submitted to IGRAC for further processing.

At the bottom of each individual worksheet you can press to proceed to the next worksheet. You can also use the tabs at the bottom of the workbook any time to navigate back and forth. You can of course save drafts to your computer and continue work at a later stage.

- **Aggregated data:** In reality most data are spatially distributed, such as population or land use. However for this global assessment it is not feasible to capture those spatial distributions. Therefore, the assessment will be based on aggregated data. This means the questionnaire should be filled in with aggregated values representative of the entire portion of the transboundary aquifer or SIDS-aquifer in your country. This means there should be one value per parameter or variable. These aggregated ‘national data’ will later be combined per transboundary aquifer to provide information aggregated at the level of the transboundary aquifer. For most parameters and variables short definitions are given in the questionnaire to assist you in providing the right data and to assure that data between countries are consistent.

- **Key and Optional data:** Some of the worksheets have been divided into ‘Key parameters and variables’ and ‘Optional parameters and variables’. Please, make sure to at least fill in all ‘Key parameters and variables’ and associated fields of information before returning the questionnaire. Please also provide as many of the ‘Optional data’ as you possibly can. If somehow not all of the ‘Key parameters and variables’ are available for your country’s part of the transboundary aquifer please contact your regional coordinator to discuss next steps.

- **Comments:** Please, use the comments box at the need of each section to clarify the information provided. Do not hesitate to use this box to provide more detailed information about any of the questions and sub-questions of the section. Use this section as well to explain the lack of information/knowledge to answer any of the questions of sub-questions.

How do I include bibliographic references to information sources?

Enter all the references you use for the questionnaire in sheet ‘3.References.’ Then, when you want to reference a specific piece of information, simply select the references from the drop down list in each block of questions.

As TWAP aims to be a scientifically based assessment, references to literature / reports used for the assessment are of crucial importance. Therefore, we ask you to cite all literature sources you used to fill in the questionnaire. You can enter references in two ways:
• option 1) Enter your literature directly in worksheet 3. References at the beginning of the questionnaire.
• option 2) Enter your literature references one by one while working your way through the questions in the different worksheets by selecting [Click here to enter new reference]. This will take you back to worksheet 3. References where you can enter the literature reference.
To indicate which references have been used to answer a specific question you can simply select it from the pull down menus marked as <choose from list>. See figure below.

6.4. Transmissivity

*Transmissivity* is the rate at which water flows through a permeable material. This is an important parameter in groundwater studies as it helps in understanding the movement and storage of groundwater within the aquifer.


1. Fill in the (estimate) value of transmissivity for the national aquifer segment.

<table>
<thead>
<tr>
<th>Average Value of Transmissivity</th>
<th>Maximum value of Transmissivity</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>(m²/d)</em></td>
<td><em>(m²/d)</em></td>
</tr>
</tbody>
</table>

2. Choose methodological approach you have used to reach that value:

<choose from list>
What graphic information can I provide and how do I submit this information?

Please read carefully the information provided below and follow the guidelines to produce the (optional) maps and cross-sections. We would like you to send all graphic information via e-mail to your Regional Coordinator and to IGRAC (e-mail address provided below).

One of the outputs from the project will be ‘Information briefs per Transboundary Aquifer and SIDS aquifer’ (TBA-briefs in short). These TBA-briefs will not only contain tabular data but we’re also aiming to include information that will help to visualise the groundwater resource, such as (sketch) maps showing main hydrogeological aspects and schematic hydrogeological cross-sections.

**TRANSBOUNDARY AQUIFER MAP:**

As part of the assessment, the project aims to produce a simple conceptual model of the aquifer which shows some basic features of the aquifer/aquifer system. The following are the map features we aim to collect through this survey:

1. **Aquifer delineation and national boundaries:** in most cases these will already have been provided by IGRAC or have been provided by National Experts themselves in consultation with regional coordinators.
2. **General direction of groundwater flow (to be provided by National Experts):** There is no need to include maps of groundwater levels/piezometric levels. The general direction of groundwater flow can be indicated by means of arrows. In the case of aquifer systems, it might be necessary to provide different maps for different aquifer layers.
3. **Major recharge zones (to be provided by National Experts):** A (sketch) map outlining where the major recharge areas are located. In case of an aquifer system this may need to be depicted in different maps for different aquifer layers in the system.
4. **Location of groundwater dependent ecosystems (to be provided by National Experts):** A (sketch) map depicting the location of groundwater dependent ecosystems should be provided by National Experts.
5. **Zones of priority, emerging issues and concerns such as zones of major groundwater pollution and zones of large withdrawals (to be provided by National Experts):** A (sketch) map depicting zones of special interest / concern: For example zones with major groundwater pollution, zones with major groundwater abstractions, zones at risk of pollution etc.

Please have a look at ‘ANNEX 4: Example of simplified hydrogeological map’.

All graphic information (maps and figures) should be sent in together with the questionnaire. Please, provide all relevant information about the attached files with graphics in worksheet ‘10. Spatial Information’.

Please supply map information in the following format:

1. Data type: Shape file (feature class) or Personal Geodatabase Feature Class
2. Projected Coordinate System: Not projected

**Please note:** Maps which do not fulfil these requirements will only be processed if time allows, and only if information on coordinate system and projection has been provided.
CROSS-SECTION(S) OF TRANSBOUNDARY AQUIFER:

Cross-sections are powerful tools to visualise sub-surface structures and conceptual models of aquifers. So please provide one (or more) representative schematised hydrogeological cross-section. The cross-section should include features such as:

1. Main aquifer formation/layers
2. For aquifer systems: also clearly depict aquitards/aquicludes
3. General direction of groundwater flow
4. Main geological features, such as faultsLocation of country borders
5. Indicate relevant hydrological features such as:
   ▪ recharge zones,
   ▪ discharge zones,
   ▪ zones of major groundwater abstractions and/or
   ▪ zones of groundwater pollution.
   ▪ zones with natural salinity, arsenic and/or fluoride
6. In the legend: Give the name of each aquifer layer, including the lithological classification [see questions 6.2 in the questionnaire] and predominant type of porosity see question 6.3 in the questionnaire]. See tables below.

Please have a look at ‘ANNEX 5: Example of simplified hydrogeological cross-section’.

Please provide cross-sections in high resolution graphical files in one of the following formats: tiff, jpg, pdf, or Microsoft publisher / PowerPoint / word.

<table>
<thead>
<tr>
<th>Lithological classification [question 6.2]</th>
<th>Primary Porosity [question 6.3]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment – Sand</td>
<td>High primary porosity (fine/medium sedimentary deposits)</td>
</tr>
<tr>
<td>Sediment – Gravel</td>
<td>High primary porosity (gravels/pebbles)</td>
</tr>
<tr>
<td>Sediments - Silt - Clay</td>
<td>Low primary inter granular porosity</td>
</tr>
<tr>
<td>Sedimentary rocks – Shale</td>
<td></td>
</tr>
<tr>
<td>Sedimentary rocks – Sandstone</td>
<td></td>
</tr>
<tr>
<td>Sedimentary rocks – Limestone</td>
<td></td>
</tr>
<tr>
<td>Sedimentary rocks - Dolostone / Dolomite</td>
<td></td>
</tr>
<tr>
<td>Sedimentary rocks – Evaporite</td>
<td></td>
</tr>
<tr>
<td>Crystalline rocks – Granite</td>
<td></td>
</tr>
<tr>
<td>Crystalline rocks – Basalt</td>
<td></td>
</tr>
<tr>
<td>Metamorphic rocks</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Secondary Porosity [question 6.3]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary porosity: Dissolution</td>
</tr>
<tr>
<td>Secondary porosity: Weathering</td>
</tr>
<tr>
<td>Secondary porosity: Fractures</td>
</tr>
<tr>
<td>No secondary porosity</td>
</tr>
</tbody>
</table>

How should I submit the questionnaire?

Please, make sure you have filled in all required information. Once you have entered all information into the questionnaire; prepared the digital files of the map(s) and cross-section(s); and have generated the Data Submission Form, please send these files to IGRAC at twap.groundwater@un-igrac.org and also to the Regional coordinator of your TWAP region.

Once you have filled in all the required information, please go to worksheet ‘11. Check’. Check and make sure you have filled in all Key parameters and variables. Also fill in as many optional parameters and variables as you can.
Then proceed to worksheet 12. Submission to generate the Data Submission Form which will include all the data you have compiled. This document will be automatically saved in your working directory in Excel format with the filename ‘TWAP_submission_Form.xls’. This Data Submission Form, together with the map(s) and cross-section(s) and any other figures or files should be sent to the Regional coordinator in your region and to IGRAC (twap.groundwater@un-igrac.org). Please state clearly in your e-mail for which country and transboundary aquifer you are submitting information.

You do not need to send us the original Excel file with the questionnaire as this file is quite large and might be difficult to send by e-mail. You might of course want to keep the original questionnaire for your own reference.

How will the information be used?

All information submitted to IGRAC and the Regional Coordinators will be used for the TWAP project.

The information will be input for the calculation of indicators. Data provided at the national level will be aggregated to the level of the transboundary aquifer. The data provided will be made available through the Global Groundwater Information System hosted by IGRAC and the TWAP data portal on www.geftwap.org.

Who do I contact for additional support or questions?

Contact your Regional Coordinator or IGRAC (twap.groundwater@un-igrac.org). Please, do not hesitate to contact us should you have any question, problem or request related to the questionnaire or any other issue in relation to the data collection process.

ANNEX 1: List of Transboundary Aquifers in the region

This annex will be provided in a separate document with specific information about your region.

ANNEX 2: Map of Transboundary Aquifers in region

This annex will be provided in a separate document with specific information about your region.

ANNEX 3: Detailed maps of Transboundary Aquifers in region

This annex will be provided in a separate document with specific information about your region.
ANNEX 4: Example of simplified hydrogeological map

Figure 1: Fictitious example of a sketch map of the transboundary aquifer
EX 5: Example of simplified hydrogeological cross-section

Figure 2: Fictitious example of a cross-section of the transboundary aquifer