Methodology for Assessment of Transboundary Aquifers (TBA)

TBA Assessment in Central Asia

Dr Neno Kukuric

Almaty, 2010
What is IGRAC?

- **IGRAC - International Groundwater Resource Assessment Centre** is an UNESCO and WMO groundwater centre.

- IGRAC facilitates and promotes global sharing of information and knowledge required for sustainable groundwater resources development and management.

- Focused on information and knowledge management, transboundary aquifer assessment and groundwater monitoring.

- Receives financial support from the government of The Netherlands.

- Hosted by the DELTARES in Utrecht, The Netherlands.
TBA Activities at IGRAC

- A map Transboundary Aquifers of the World
- ISARM Portal ([www.isarm.net](http://www.isarm.net))
- UN ILC assistance: International Legal Agreement on groundwater
- TBA Methodology and a Course
- GEF (Global Environment Facility) projects
- ISARM Regional Activities
  - (cooperation with OAS, SADC, INWEB, UNECE, OOS, GWP-MED, GEF, UNEP, UNDP..).
ISARM Portal

www.isarm.net
Transboundary Aquifers Assessment

- Transboundary aquifer or transboundary aquifer system means, respectively, an aquifer or aquifer system, parts of which are situated in different States;
Transboundary Aquifers Assessment

- The fact: many aquifers cross the political borders

- Potential cross-boundary problems: changes in groundwater flows, levels, volumes (quantity) and dissolved substances (quality).

- Actions: TBA characterisation and an appropriate management.

- Benefits: eliminating potential sources of conflict and improving the overall benefit from groundwater.
TBA Assessment Rationale

- What does a TBA assessment encompass?

- ISARM programme: hydrological, legal, socio-economical, institutional and ecological aspects/facets of TBAs and suggested guidelines

- In practice, mostly a hydrogeological assessment (to incorporate info on other aspects as well)

- There is still no elaborated guidelines for TBA assessment but UN, EU and GEF have already accumulated some valuable experience.
TBA assessment steps

- **Delineation and description**
  - “inventory” or “characterisation” (stage and scale dependent)
  - chiefly about collecting, combining and interpreting the field information

- **Classification, diagnostic analysis and zoning**
  - information necessary for decision-making (problems, opportunities, most responsive aquifers and aquifer zones)

- **Data harmonisation and information management**
  - Extra dimension in an international context (more difficult, more elaborated and politically sensitive)
Delineation and Description

- chiefly about collecting, combining and interpreting the field information
- “inventory” or “characterisation” (stage and scale dependent)
Standardised TBA Delineation

(TBA Activities Americas)
## Standardised TBA Delineation

### Legend for boundary

<table>
<thead>
<tr>
<th>Type of unit</th>
<th>Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Real’ aquifer</td>
<td></td>
</tr>
<tr>
<td>Hydrological catchment</td>
<td></td>
</tr>
<tr>
<td>Geological formation</td>
<td></td>
</tr>
<tr>
<td>Other system/unknown</td>
<td></td>
</tr>
</tbody>
</table>

Tested in the Atlas of transboundary aquifers of Americas
Delineation and Description

- A TDA description should a.o. include info recharge/discharge mechanism and hydraulic properties of aquifer to:
  - determine direction and velocity of groundwater flow and its interaction with other water bodies (rivers, lakes, seas).
  - to assess aquifer’s vulnerability to overexploitation and pollution.

- Superimposed on these hydrogeological characteristics are the anthropogenic influences such as abstraction and pollution from various sources.

- ISARM and UNECE TBA have lot of resemblances but they are not identical.

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**Aquifer Nr. 1: Osh Araval**

<table>
<thead>
<tr>
<th>Area (km²)</th>
<th>Uzbekistan</th>
<th>Kyrgyzstan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinking water supply (25-50%), irrigation, mining, livestock (&lt;25%)</td>
<td>Drinking water supply (25-50%), irrigation</td>
<td></td>
</tr>
</tbody>
</table>

**Pressure factors**

- Agriculture, industry, waste disposal
- Agriculture

**Problems related to groundwater quantity**

- Polluted water drawn into aquifer
- Lack of relevant data to be quantified

**Problems related to groundwater quality**

- Serious problems with pesticides, moderate problems with heavy metals, slight problems with hydrocarbons and radioactive elements
- Lack of relevant data to be quantified

**Transboundary impacts**

- Decline of groundwater level, groundwater pollution
- Lack of relevant data to be quantified

**Groundwater management measures**

- Need to be improved: transboundary institutions, monitoring of groundwater quantity and quality, need to be applied: abstraction management, efficiency of use, mapping, good agricultural practices, integrated river basin management, treatment of industrial effluents, data exchange
- Need to improved: transboundary institutions, monitoring of groundwater quantity and quality

**Status and what is most needed**

- Improvement of the monitoring of groundwater quantity and quality
- Improvement of the monitoring of groundwater quantity and quality

**Future trends and prospects**

- Expected pressure on the water resources due to economic growth and climate change
- Expected pressure on the water resources due to economic growth and climate change
Standardised TBA Description

(TBA Activities Americas)

- Physiography, Demography & Water Use
- Geological Setting of Aquifer
- Water Quantity & Quality
- Importance and need for TBA
- TBA cooperation
- References
- Authors
Classification, Diagnostics and Zoning

(1) State border follows surface water catchment and groundwater divide, little transboundary groundwater flow.

(2) Surface water and groundwater divides separate from state border, recharge in one country, discharge in adjacent.

(3) State border follows major river or lake, alluvial aquifer connected to river, little transboundary flow.

(4) Large deep aquifer, recharged far from border, not connected to local surface water and groundwater.
Classification, Diagnostics and Zoning

- **Input for classification:**
  - aquifer size and hydraulic properties,
  - vulnerability,
  - current functions,
  - observed or perceived stresses,
  - Possible groundwater interferences, etc.

- **Input for diagnostics:**
  - inventory of major perceived issues and problems;
  - overview of possible actions
  - Priority and feasibility study, stakeholders and institutional analysis.
Activities at location 2 in country B will be much less risky for the aquifer in country A than activities at location 1.

Effects resulting from causes at larger distance will be smaller and come with more retardation.

General flow direction does matter.

Zoning: e.g. based on isochrones of propagation of the effects (may contribute to a realistic picture of the transboundary risks).
Activities at location 2 in country B will be much less risky for the aquifer in country A than activities at location 1.

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Harmonisation & Info management

- **Rationale**
  - **Assessment:** availability and quality of data
  - Internationally – also data harmonisation & info management
- **Technical activity**
  - **Basically** harmonisation of formats, classifications, terminologies, reference systems, levels, software and hardware specific, etc.
  - Heavily **influenced** by political, organisational, legal, cultural and economical situation and agenda
- **Objectives**
  - Depend on **scope and scale:** visualisation, textual/spatial/temporal data, web-based, common processing, real-time
Harmonisation & Info management

- **Current situation**
  - Mainly simple GIS-based databases (GEF projects)
  - Developed databases or systems are (according to the available information) neither web-based, nor real-time
  - Databases available via IGRAC and INWEB portals contain meta information on transboundary aquifers.
  - No cases have been reported of harmonisation going beyond items such as reference levels and measurement scales.
  - WISE accommodates delineated ‘groundwater bodies’, no observations are available yet

- **Ideally,** on-line synchronised access to distributed information services (data and information remain at the source!)
Harmonisation & Info management
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Almaty, 2010
TBAs of the World: Details
State of info in Caucasus & C. Asia

- Transboundary Aquifers in Asia with Special Emphasis to China
State of info in Caucasus & C. Asia

- First Assessment of TBAs from 2007 (UNECE led)
  - Scale & scope, Pressure factors, Status, trends, impacts and Management responses
A Map: TBAs of the World

- Shows the present state of information regarding the occurrence and extent of TBAs world-wide.

- The intention of the map is to provide a global overview of these important shared water resources and to encourage their further assessment.
State of info in Caucasus & C. Asia

- First Assessment  Fact & Figures

<table>
<thead>
<tr>
<th>Aquifer No. 18: Chhatkal-Kurman</th>
<th>Shared by: Kazakhstan and Uzbekistan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 4, Weak link to surface waters, groundwater flow from Kazakhstan to Uzbekistan</td>
<td></td>
</tr>
<tr>
<td>Area (km²)</td>
<td>20,000</td>
</tr>
<tr>
<td>Water uses and functions (percentage of total abstraction)</td>
<td>Drinking water (100%)</td>
</tr>
<tr>
<td>Pressure factors</td>
<td>Water abstraction</td>
</tr>
<tr>
<td>Problems related to groundwater quantity</td>
<td>Reduction of borehole yields, decline of groundwater level</td>
</tr>
<tr>
<td>Problems related to groundwater quality</td>
<td>None</td>
</tr>
<tr>
<td>Transboundary impacts</td>
<td>Decline of groundwater level</td>
</tr>
<tr>
<td>Groundwater management measures</td>
<td>Effective: protection zones, mapping. Need to be improved: quantity and quality monitoring, abstraction management. Need to be applied: transboundary institutions.</td>
</tr>
<tr>
<td>Status and what is most needed</td>
<td>Joint monitoring programme</td>
</tr>
<tr>
<td>Future trends and prospects</td>
<td>Lack of information to make predictions</td>
</tr>
</tbody>
</table>
State of info in Caucasus & C. Asia

- UNESCO/IGRAC assessment 2009
State of info in Caucasus & C. Asia

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State of info in Caucasus & C. Asia

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How to proceed?

- **Material**
  - The First Assessment Map
  - The First assessment Fact & Figures
  - The World Map & Methodology
  - The UNESCO/IGRAC map update 2009
  - UNECE datasheets
  - Other material

- **Procedure**
  - Synthesis of the material
  - Further filling the groundwater datasheets
  - Further delineation of the aquifers
  - Wrapping up
Thanks