

Notes of the Plenary of IAH Commission on Managing Aquifer Recharge

Monday 10 Sept 2018, 18:00-19:00 in Room 105, Daejeon Convention Centre

Attendees (22 from 10 countries):

Tao, Cui, Andrew Ross (WG leader-economics), Simon Higginson, Peter Dillon (co-chair IAH-MAR) (Australia), Xue Yan Lee, Ya Lin Song, Sida Gia, Xiang Qin Lu, Ruijuan Cui (China), Jose Bonilla (Costa Rica), Maike Groeschke, Uwe Troeger, Catalin Stefan (Germany), Agnes Tahy (Hungary), Ittai Gavriale, Avivh Burg (Israel), Yongcheol Kim, Ragh Wendra (Korea), Manuel Sapiano, Michael Schembri (Malta), Boris Matti (Switzerland), Dave Kreamer (IAH Science VP) (USA).

Apologies: Weiping Wang (co-chair), Enrique Fernandez Escalante (co-chair and WG leader – MAR to MARKET), Yan Zheng (WG leader –sustainability), Russell Martin (WG Leader –clogging), Arnaud Sterckx (IGRAC), Antonio Chambel (IAH President), Alice Aureli (UNESCO), Aurélien Dumont (UNESCO), Karen Villholth (GRIPP), Basant Maheshwari (Western Sydney University)

Agenda:

1. Welcome and Introductions
2. Objectives of Commission / UNESCO IHP VIII 2014-2021 context for IAH-MAR role
3. Progress reports and plans of Working Groups
 1. MAR for Development – Yan Zheng Martin
 2. Global MAR Inventory – Catalin Stefan and Nienke Ansems
 3. Economics of MAR – Andrew Ross
 4. 60 years history of MAR – Peter Dillon and Pieter Stuyfzand
 5. Management of clogging– Russell Martin
 6. MAR to MARKET – Enrique Fernandez Escalante (PPTs)
 7. MAR Regulations and Guidelines – Manuel Sapiano
 8. MAR opportunity mapping (proposal) – Catalin Stefan/ Jose Bonilla
4. Outcomes of ISMAR9
5. ISMAR10 Invitation Madrid – Enrique Fernandez Escalante
6. Process for bidding to hold ISMAR11.
7. Next election of IAH-MAR Co-chairs is at ISMAR10
8. Information Sharing (4 x 3 +1 = 13min)
 1. GRIPP – Groundwater Solutions Initiative for Policy & Practice – Karen Villholth/Andrew Ross/Catalin Stefan
 2. MAR-NET activities in China – / Germany / Denmark – Yan Zheng
 3. MARVI project – village interventions India- Peter Dillon
9. Information sharing on MAR (not covered elsewhere) - anyone
10. Suggestions for new activities – anyone
11. Volunteers to participate in existing and new activities – anyone
12. Sessions on MAR in Congress - Peter
13. Close of Plenary (Next Plenary at ISMAR10, Madrid, May 2019)

Notes of meeting

1. Welcome and Introductions - Peter Dillon

Peter welcomed all to the meeting and conveyed apologies for IAH-MAR co-chairs absent. Many attendees were at their first meeting of the Commission, and were especially welcome. Our hope is that all will find the meeting informative and useful and creates opportunities for involvement in productive activities.

2. Objectives of Commission - Peter - as per our web site: <https://recharge.iah.org/>

- to promote the securing and expanding of water resources and improving water quality in ways that are appropriate, environmentally sustainable, technically viable, economic and socially desirable.
- to encourage research, development and adoption of improved practices for management of aquifer recharge
- to improve knowledge, skills and capabilities of practitioners, water resources managers and regulators.
- to facilitate international exchange of information between members (e.g. via a web page and an email list), by disseminating results of research and practical experience (e.g. via conferences and workshops), raising awareness of MAR among IAH members, related professions and the community, and its members undertaking projects and activities identified in plenaries as important.

UNESCO IHP VIII 2014-2021 context for IAH-MAR role

IAH-MAR aligns with Strategic Plan of UNESCO IHP-VIII (2014-2021) "WATER SECURITY: RESPONSES TO LOCAL, REGIONAL, AND GLOBAL CHALLENGES" Specifically:

Focal Area 2.2 - Addressing strategies for management of aquifers recharge

<http://en.unesco.org/themes/water-security/hydrology/ihp-viii-water-security>

3. Progress reports and plans of Working Groups

These working groups are described on the IAH-MAR web site: <https://recharge.iah.org/working-groups> Brief descriptions of activities were presented by working group leaders.

1. MAR for Sustainable Development – Yan Zheng (SUSTech) (who provided slides)

Collective Role was discussed in a workshop at ISMAR9, 2016. ISMAR9, 2016

As agreed at a workshop in ISMAR9, this working group aimed to develop a set of fact sheets (initially say about 5) on a variety of successful MAR projects that have been in operation for say >15 years, of different types in varied settings, covering developing and developed countries. Yan aims to develop a matrix of measures of success of MAR projects, to include in these fact sheet stories of success. These may be embedded in IGRAC MAR Portal on the web (see Global Inventory Working Group Report) and other formats with some or all linked with GRIPP. Help individual hydrogeologists to raise awareness

Dissemination tool-kit:

Define metrics for successful MAR projects

Identify successful MAR projects

Develop factsheets of successful MAR projects

A recent request has been received from UNESCO to produce a set of example projects for a UNESCO publication by Nov 2019. – we suggest selections aim to account for demonstration of sustainability and hence this become the output delivered by this working group, in association with GRIPP.

Possible Metrics:

- ✓ Duration of Operation (> 10 years)
- ✓ Reduction of Human Health Risks Compared to Alternative Water Solutions at the Same Unit Cost
- ✓ Enhancement of Ecosystem Protection Compared to Alternative Water Solutions at the Same Unit Cost

An issue to address is : How to Balance Risk Reduction and Affordability?

eg:

Climbing the ladder: a step by step approach to international guidelines for water recycling

J. Anderson¹, A. Adin², J. Crook³, C. Davis⁴, R. Hultquist⁵, B. Jimenez-Cisneros⁶, W. Kennedy⁷, B. Sheikh⁸ and B. van der Merwe⁹

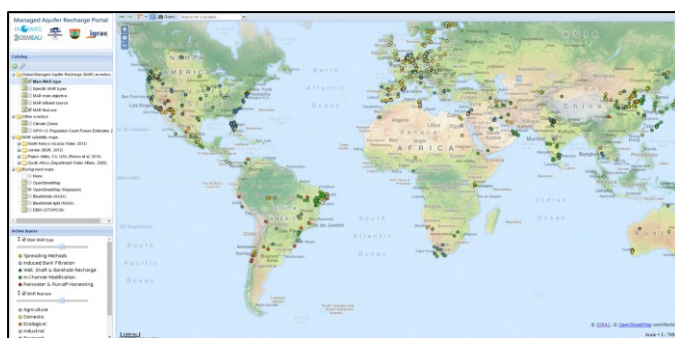
Water Science and Technology Vol 43 No10 pp 1–8 © IWA Publishing 2001

Volunteers with access to MAR site information will be needed to write the case studies when criteria and format have been set. These case studies could be presented at ISMAR10 and authors become co-authors of the UNESCO report.

ACTION: Volunteers are sought to write site descriptions or provide information or existing papers on specific sites. Any volunteers to contact Yan

2. Global MAR Inventory – Catalin Stefan (TU Dresden) and Arnaud Sterckx (IGRAC)

[IGRAC MAR Portal](#) – The MAR Portal contains detailed information on 1200 Managed Aquifer Recharge sites around the world as well as regional MAR suitability maps. Outputs of the working group activities are uploaded and maintained here. It is intended to overlay the MAR layer on other thematic maps such as groundwater stress.



ACTION: Volunteers are sought to register some basic details on their MAR site(s) via the portal which has an upload form that is easy to complete. . Check first on the portal to see whether your site is already included. <https://marportal.un-igrac.org>

Two summary papers were produced and both are now available from:

<https://recharge.iah.org/swarm-vol-4-issue-2-june-2018> :

Stefan, C and Ansems, N. (2018). Web-based global inventory of managed aquifer recharge applications. *Sustain. Water Resour. Manag.* Vol 4 (2) p153-162. <https://doi.org/10.1007/s40899-017-0212-6> (open access) - 300 reads a month since published on line !!!!!

Bonilla Valverde, J.P., Stefan, C., Palma Nava, A., da Silva, E.B. and Pivaral Vivar, H.L. (2018). Inventory of managed aquifer recharge schemes in Latin America and the Caribbean. *Sustain. Water Resour. Manag.* Vol 4 (2) 163-178 <https://doi.org/10.1007/s40899-018-0231-y>

3. Economics of MAR – Andrew Ross (Aust. National University)

The Working Group program is being developed in two stages:

Stage 1: 2016-18: Collection & analysis of financial (cost) data for selected MAR schemes

Stage 2: 2018 onwards: Cost effectiveness and cost benefit analysis of selected MAR schemes

Outputs: Financial analysis of MAR costs of 21 schemes in 6 countries completed and published:

Ross, A and Hasnain, S (2018) Factors affecting the cost of managed aquifer recharge schemes, *Sustainable Water Resources Management* 4:179-190

<https://recharge.iah.org/swarm-vol-4-issue-2-june-2018>

Next steps: Extension of existing work to cover a wider range of schemes more MAR types and regions/countries (including developing countries), and to analyse cost effectiveness of specific cases

where benefit data exists or where alternatives to MAR have been costed to inform about the competitiveness of MAR compared with other techniques
Analysis of CBAs from specific cases to provide further insights on the value and benefits of MAR

ACTION: Volunteers are needed to provide economic information for MAR case studies that could be brought into the synthesis in this working group.

4. 60 years history of MAR – Peter Dillon (CSIRO/NCGR Aust) and Pieter Stuyfzand (KWRWater and Delft UT, Netherlands)

On 7 September 2018 a global summary was published on line in the Hydrogeology Journal as an open access paper supported by UNESCO as a contribution to IHP VIII.

Dillon, P., Stuyfzand, P., Grischek, T., Lluria, M., Pyne, R.D.G., Jain, R.C., Bear, J., Schwarz, J., Wang, W., Fernandez, E., Stefan, C., Pettenati, M., van der Gun, J., Sprenger, C., Massmann, G., Scanlon, B.R., Xanke, J., Jokela, P., Zheng, Y., Rossetto, R., Shamrukh, M., Pavelic, P., Murray, E., Ross, A., Bonilla Valverde, J.P., Palma Nava, A., Ansems, N., Posavec, K., Ha, K., Martin, R. and Sapiano, M. (2018). **Sixty Years of Global Progress in Managed Aquifer Recharge**. Hydrogeology Journal
<https://doi.org/10.1007/s10040-018-1841-z> .

At this address you can download the paper, national summaries for 16 countries, and pictures and descriptions of MAR examples. All free thanks to UNESCO covering open access charge. Also this is the subject of a talk tomorrow.

Further national/regional contributions will be uploaded at the IAH-MAR web site along with a web-link to the paper when published. Current reported annual volume of MAR is 10 cu.km which is about 1% of total annual groundwater extraction but only 0.07% of natural recharge. Countries whose history of development of MAR have been documented in <https://recharge.iah.org/60-years-history-mar> are: Australia, China, Croatia, Finland, France, Germany, Israel, Italy, Jordan, Korea, Latin America & Caribbean, The Netherlands, Qatar, South East Asia, Southern Africa and Spain. A common element is a table of average MAR annual volumes by decade since the mid 1960's.

ACTION: Volunteers who can write national summaries for countries not yet covered are needed. These will be mounted on IAH-MAR web site.

5. Monograph on clogging and its management – Russell Martin (Wallbridge Gilbert Aztec, Australia)

First monograph was published in 2013 (see <https://recharge.iah.org/working-groups/clogging-and-its-management>). Second volume is underway and more contributions are needed. Aim to have Volume 2 ready for ISMAR10 – Madrid May 2019

Option 1 : New material seeking papers on

- Low cost low tech applications to reduce/manage clogging

- MAR clogging indicators

- Standardization of investigation methods

- Case studies on management of clogging during MAR operations

Option 2 Synthesis of clogging papers from previous ISMAR proceedings.

ACTION: Papers or reports on management of clogging are invited in 2017 and 2018 for consideration for inclusion in Volume 2. Please contact Russell if you wish to contribute, or are aware of relevant open access material: rmartin@wga.com.au

6. MAR to MARKET – Enrique Fernández Escalante

Details of many activities in Europe and South America are described in <https://recharge.iah.org/mar-to-market>

7. MAR Regulations and Guidelines – Manuel Sapiano (Malta Energy and Water Agency)

Manuel had made a contribution to the governance part of the 60 year history of MAR paper. He is preparing a paper for ISMAR10 to list and compare existing state and national water quality guidelines and regulations for MAR.

ACTION: Volunteers are invited to inform Manuel concerning the existence of such a guideline in their country to send him the web link or a copy to add to those on the web site, to allow a comparative analysis: <https://recharge.iah.org/mar-regulations>

8. MAR suitability mapping - Jose Bonilla (AyA Costa Rica) and Catalin Stefan(TU Dresden)

This is a newly formed working group whose initial membership is Arnaud Sterckx (IGRAC), Daniel Goode (USGS), and Jana Sallwey (TU Dresden), and seeks to grow by being joined by all those with an interest in this topic.

It seeks to initiate a network of scientists and stakeholders to share experiences on MAR suitability maps (criteria, scales, objectives, applications etc.)

It will evaluate the range of methods in use, many of which are multi-criteria analysis of mapped parameters, each with a range indicative of suitability and with a weighting factors. There is considerable subjectivity and apparently inconsistent methodology for GIS-based selection of suitable sites for MAR. The group will consider primarily hydrogeological suitability and also availability of source water and demand for water. Maps have different purposes, scale, and are based on a range of data types and densities, and there are different requirements for different MAR methods. There will be an effort to put this onto a scientific footing, which may result in different types of maps under different settings, but useful for the purpose intended, able to be validated, and ideally also capable of international comparison.

As a starting point an initial review paper is : Sallwey et al. 2018. Suitability maps for managed aquifer recharge: a review of multi-criteria decision analysis studies. *Environmental Reviews*, *accepted*

A workshop will be held at ISMAR10 to allow the dialogue to be progressed and specific targets set for the outputs of the working group.

ACTION: Volunteers are invited to inform Jose and Catalin of their interest, whether they have case studies, concerning the existence of such maps in their country to send him the web link or a copy to add to those on the web site. Volunteers may receive a copy of the paper when published, and can contribute to formation of the ISMAR10 workshop.

4. Outcomes of ISMAR9, Mexico City, June 2016

2 special issues of journals each with 18 papers- all papers downloadable at no cost from <https://recharge.iah.org/thematic-issues-journals> and links within:

Water quality considerations for MAR systems - MDPI *J Water* 2017 eds: Pieter Stuyfzand and Niels Hartog.

MAR in Integrated Water Resources Management - Springer *J of Sustainable Water Resources Management*, Vol 4 (2) eds: Peter Dillon, Paul Pavelic, Weiping Wang and Adriana Palma Nava. Journal format from <https://link.springer.com/journal/40899/onlineFirst/page/1> and with Springer's permission, in author-format as open access from IAH-MAR web site above.

Poster papers on IAH-MAR Spanish website www.dina-mar.es/

'A Call to Action for Groundwater Management' based on workshops at ISMAR9, from Wkg Gp led by Tim Parker, & communicated through IAH-MAR and GRIPP. <https://recharge.iah.org/call-to-action-on-groundwater-management>

5. ISMAR10, Madrid 20-24 May 2019 – Invitation - Enrique Fernández (PPT)



**** URGENT ****

This is the leading global symposium on Managed Aquifer Recharge and Enrique sends a warm invitation to **submit abstracts for papers now**. This will be the best possible audience to give exposure to your best work.

Abstracts selected for presentation or poster will be asked to write a very brief paper (3p) to go in the conference proceedings

Based on presentations and papers, 18 papers will be selected at the Symposium for extension (~12p) and open access publication in J Water (citation index 2.1) without author charges for a special issue in J Water. (CI >2). Others may submit with reduced author charges for same issue.

ACTION: go to <http://www.ismar10.net/> get abstract template, write abstract, submit using the submission platform: <https://www.ismar10.net/en/submission-platform/> by 10 November.

6. Process for bidding to hold ISMAR11.

Peter advised that anyone wishing to form a team to host ISMAR11 in 2022 should contact him to advise of their interest and to receive details on information requirements of proposals that would need to be received by January 2019. All proposals would be examined by a panel comprising IAH, UNESCO and ASCE (the partners to the series) for announcement at ISMAR10 in May 2019.

ACTION: Any interested in proposing to host ISMAR11 contact Peter

7. Next election of IAH-MAR Co-chairs is at ISMAR10

2 of the 3 current co-chairs are stepping down at ISMAR10 (Weiping and Peter)

We need volunteers to nominate for these positions, prior to elections at ISMAR10 and decide whether to stand.

Wonderful non-monetary remuneration - you can make a difference!

ACTION: Anyone interested is suggested to discuss with Peter to find out what is involved

8. Information Sharing

1. GRIPP - Groundwater Solutions Initiative for Policy & Practice – led by Karen Villholth (IWMI) hosted a workshop at Stockholm World Water Week on Groundwater Based Natural Infrastructure. A series of case studies was prepared and many members of IAH-MAR developed these. See list below and these can be accessed from : www.gripp.iwmi.org

Framework/introduction	Framework/introduction	General/global
Water storage	MAR in rice fields with payment for ecosystem services	Japan
	MAR with desalinated water in LIWA Desert	Abu Dhabi
	MAR through Village Level Intervention (MARVI)	India
	MAR for multiple purposes in Nebraska	Nebraska
	Sand dams in Kenya	Kitui, Kenya
Water retention	Water for Roads	Kenya and other
	Underground Taming of Floods for Irrigation (UTFI)	India
Water quality	MAR in coastal areas	Netherlands
	River Bank Filtration (RBF) for drinking water	India
	Urban stormwater recharge to freshen brackish aquifers	Adelaide, Australia
	Low-cost aquifer storage and recovery in coastal areas	Bangladesh
	Accidental MAR	India
Environmental support	MAR for biodiversity (birds)	California
	Bore capping and environmental remediation	Australia
Tools	Global MAR Portal/MAR modelling tool	Global

2. MAR-Net China (from Yan Zheng)

A MAR in the North China Plain Workshop, will be held in Beijing, 17 September 2018 by Danish and Chinese collaborators in a DANIDA project : <http://www.mar-china-gues.dk>

Sino-German MAR Workshop, 23 June 23 2017 –MARCHing a project to initiate cooperation on MAR, and enable Ph.D. student and post-doctoral trainee exchanges

3. MARVI - MAR and Village level interventions for sustaining livelihoods – Rajasthan and Gujarat, India (from Basant Maheshwari)

MARVI was one of the topic areas presented last week at the World Water Forum 2018 in Stockholm, Sweden You can see the MARVI case study at the following link: <http://gripp.iwmi.org/natural-infrastructure/water-storage/>

MyWell version 2.0 is under development: - a mobile phone ap for crowd sourcing rainfall, groundwater level and check dam water level measurements. Will allow eg calculation of infiltration rates, cropping areas based on post-monsoon groundwater levels.

Several journal papers included in SWARM Special Issue on MAR in Integrated Water Management. Farmer training completed and village groundwater cooperatives have been formed and regarded as a model for participatory gw management : See <https://recharge.iah.org/marvi>

9. Information sharing on MAR (not covered elsewhere) - anyone

- Maike Groeschke – with BGR starting investigations for a MAR pilot project in Chad – seeking guidance, and will aim to use ISMAR10 for communicating and capacity building
- Boris Matti – six MAR techniques are to be piloted in Kabul, Afghanistan – will aim for papers in ISMAR10 and bringing local staff
- Agnes Tahy – spoke of gross expansion of irrigation in Hungary and potential depletion – would like to map where MAR is possible, and link up with new WG. Also a Water Summit in Hungary next year gives a possibility to highlight riverbank filtration, what contributes 90% of water supply.
- Simon Higginson (Australia) – mentioned the Perth Groundwater Replenishment Scheme (4 papers tomorrow) with extensive deep drilling underway now – Andrew asked if cost information could be provided
- Tao Cui (CSIRO, Australia) - asked whether anyone else had used modelling to plan locations of MAR sites – and Catalin Stefan responded saying they have added optimization to this and Ralph would be talking on this.

- Yongcheol Kim (Kigam) reported that there were many examples of MAR in Korea, that he had pioneered the Jeju- friendly MAR there, Prof Ha was giving a summary talk of six types of MAR, also including the oldest riverbank filtration site which is a feature of tour no 5 on Wednesday.

10. Suggestions for new activities – Anyone

There was considerable interest in the new working group focusing on methodology for mapping MAR opportunities. IAH-MAR needs to advise this is happening to give voice to those who wish to contribute to scoping a workshop at ISMAR10, that will then determine next steps

11. Volunteers to participate in existing and new activities – anyone

All working groups are looking to assimilate information globally on well-defined topics to help answer questions and improve MAR design and operation. If you have information that you think could be useful to any working group, please send it to the WG leader. Their emails are listed on the website under: <https://recharge.iah.org/working-groups>

12. Sessions on MAR in IAH 45th Congress

Rm 107: 11:30am - 12:30pm	Mon 10 th	(4)
Rm 106: 11:15am - 12:30pm	Tues 11 th	(3)
Rm 107: 4.00pm - 5.45pm	Tues 11 th	(7)
Rm 101: 11:15am- 12:30pm	Fri 14 th	(2)
Plus MAR papers in other sessions		(8)
	Total	(25)

Plus 2 poster papers on MAR, and a number of papers closely related to MAR (eg ATES and injection induced seismicity keynote address).

This is a likely a record for the number of MAR papers in an IAH Congress.

13. Close of Plenary (Next Plenary at ISMAR10, Madrid, Spain, 20-24 May 2019)

Peter thanked all for attendance in a lively meeting that demonstrated how fortunate the commission is to have dynamic and persistent working group leaders and continual innovation and growth in knowledge through a wide range of activities described by those present.