

Saph Pani

Saph Pani is an EU funded collaborative research project which started in October 2011 with duration of three years involving a consortium of 20 partners from India, European Union, Switzerland, Sri Lanka and Australia. Its full name is "Enhancement of natural water systems and treatment methods for safe and sustainable water

supply in India" and it addresses the water challenges of the 21st century. Saph Pani builds on already existing Indian projects for natural treatment and storage of water identifying potential for their improvement by applying high-tech measurement equipment and conducting field trials. For more information, visit: www.saphpani.eu

Special Feature WP5

The Work Package 5 of Saph Pani is called "Modelling and system design". In this WP hydrodynamic and hydrochemical modelling will guide the different steps of development of natural water treatment systems. In seven of our study sites water flow and quality models were developed for the different NTSs studied in Saph Pani.

Interview with Wolfram Kloppmann

Wolfram Kloppmann is leader of WP5, and has been working with French Geological Survey BRGM in Orléans, France for 18 years. He holds a PhD in isotope hydrogeochemistry from Paris XI University. Working in the fields of chemistry and isotope characteristics of natural fluids, water-rock interaction, and environmental issues related to groundwater quality and non-conventional water resources, he is in charge of the BRGM isotope laboratory.



systems, the functioning of NTSs need to be understood first to be able to predict their performance. And when it comes to prediction, modelling comes in. Once a conceptual model of their behaviour has been established on the basis of a variety of measurements, analytical or numerical models can be set up. Such a model can then test diverse scenarios so that it can be used to optimise implementation of NTSs within a watershed. At local scale, models also may be useful for improving any individual NTS by fine-tuning technical options. Overall, they are management tools that may avoid costly real-size trial and error testing of NTSs and also may avoid surprises with respect to the expected impact of NTSs on water quantity and quality.

What was the biggest challenge within Saph Pani?

Integration! When looking on NTSs like constructed wetlands or percolation tanks (soil-aquifer treatment) we need to take into account surface runoff, the unsaturated soil zone, complex but crucial for water purification, the saturated groundwater flow and even the density driven saltwater flow in coastal aquifers. Water flow is a continuum but most currently available models are not yet able to treat it as such. A huge work was done in Saph Pani to establish integrated models that take into account the whole water cycle at watershed scale from surface over

How can modelling help in the development of natural treatment systems?

The specificity of natural treatment systems is that they rely on natural processes depending on complex interactions of surface and groundwater and the contaminants they may contain with the aquifer matrix, with microorganisms and plants. Contrarily to completely engineered

unsaturated to saturated and density driven flow. We also integrated scales: Modelling NTSs needs a close look on their behaviour at a very local scale but also a much wider look on what would happen if a large number of them were implemented in a watershed. A typical example is percolation tanks. Our observations at the Maheshwaram site showed that their extension in all three dimensions varies widely with rainfall. They “breathe” in the rhythm of seasons: shrink to a tiny puddle during dry season and become lakes when monsoon starts. Treating their geometry as constant over time is an oversimplification that can lead to erroneous results if we want to estimate their real impact on groundwater recharge. For this reason, a specific module was developed for the MARTHE software, already completely integrated with respect to all flow types I have listed, able to simulate the “breathing” of infiltration tanks from rainfall and evaporation data and surface topography, simulating infiltration.

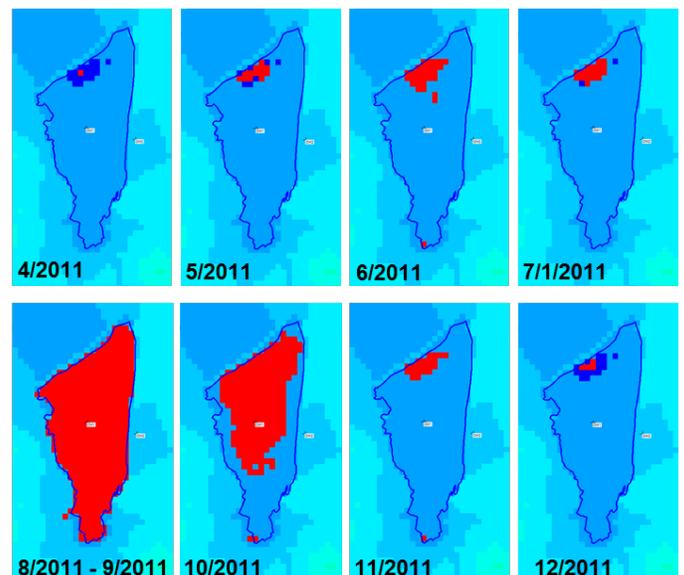
Another type of integration that revealed to be crucial, was that of water flow with water quality changes. Here the nicest example from the Saph Pani project is the simulation of ammonium transport from the heavily polluted Yamuna River, across the alluvial aquifer before reaching the wells that pump river bank filtrate. Ammonium breakthrough was first measured and modelled at laboratory scale, through percolation experiments in sediment columns, then up-scaled to aquifer scale through reactive transport modelling. An important result is the considerable residence time of several decades of ammonium in the aquifer due to sorption onto the aquifer material.

How are the research results that were achieved in Saph Pani taken further?

Models have been developed for all three types of NTSs studied in Saph Pani, managed aquifer recharge combined with soil-aquifer treatment, constructed wetlands and river bank filtration. This has demonstrated how these approaches can be used for understanding, planning and optimising NTSs. The modelling tools used are widespread and accessible (e.g. MODFLOW, MARTHE, MIKE-SHE,...). Even though, integrated modelling of complex systems like NTS on different scales up to basin scale needs specialists trained in the application of those tools on the specific problems of NTS implementation in the Indian context. I am confident that the knowledge and knowhow created in the project will be transmitted widely to young scientists and engineers through training programmes organised by the Indian institutions who were involved in the development of those methods within Saph Pani

Case study: Local modelling of a percolation tank on weathered crystalline bedrock

To cope with groundwater over-exploitation due to intensive exploitation for irrigation, managed aquifer recharge (MAR) is an attractive concept for increasing the groundwater resource. The number of recharge structures such as percolation tanks, check dams, dug-wells, is increasing in the context of the Indian crystalline basement under semi-arid climate. To assess the performance of MAR, the three-dimensional transient state numerical groundwater code MARTHE was optimized by implementing three-dimensional non-perennial surface water bodies in continuity with groundwater via an unsaturated zone. Implementation included the spatiotemporal evolution of the natural percolation tanks (i.e., volume and geometry) linked to topography, taking into account heavy rainfalls during monsoon, evapotranspiration, infiltration, runoff, and groundwater dynamics. Part of the rain water stored in such a tanks during the monsoon season infiltrates into the soil (variably-saturated media) and reaches the aquifer whereas part is evaporated. Theoretical simulations show that the new module is able to simulate the relation between surface water and groundwater while respecting the water balance. The three-dimensional MARTHE model is now ready to be applied to MAR systems in order to demonstrate its use as decision-making tool for assessing the quantitative effects of MAR on groundwater resources at the watershed scale (Picot-Colbeaux et al., submitted)



Simulated variable extension of the Tumulur tank surface over a monsoon season in 2011, Maheshwaram study site near Hyderabad, Telangana, India

The final conference of Saph Pani was a full success

On 17th and 18th of September the final conference of Saph Pani was held at the Indian Habitat Centre in New Delhi.

As a great honour Sushri Uma Bhati, Union Minister for Water Resources (WR), River and Development (RD) and Ganga Rejuvenation (GR) opened the conference in the inauguration session followed by Amarjit Singh Addl Secretary of Water Resources, Thomas Wintgens, Project Coordinator, R. D. Singh, Director of NIH, Rajendra Prasad, Andhra University.

The two days of the conference were filled with informative presentations on the outcomes of Saph Pani. Valuable recommendations could be given to Senior-level Policy and Decision Makers and networking was done extensively during the breaks. Additionally three other EU-India projects with a focus on natural treatment systems were presented, namely SWINGS, Saraswati and Na-WaTech.

Besides the filled programme, a poster session was conducted where students could present their work setup and results within Saph Pani. Around 100 participants in addition the Saph Pani consortium attended the conference.



Inauguration Session of the final conference



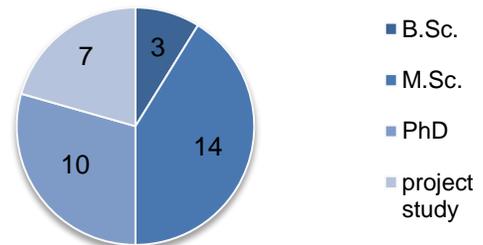
Poster exhibition

Students within Saph Pani

Within Saph Pani also many young researchers have been involved and have gained experience in different research fields. In this article we would like to give a short overview on the numbers.

39 students wrote a thesis or a part of their thesis on a Saph Pani topic. In the graphic below it is shown that most of the theses were Master theses. Project studies were carried out in groups of 2 students. In 13 cases students were sent for their research to an Indian partner organisation in the consortium. 18 of the theses or student projects were carried out by European partners and 16 theses were carried out by Indian partners. We are proud and thankful that so many studies could be carried out with the support of FP7, DST and other funding bodies.

Type of thesis



Wetlands as natural treatment systems for safe agriculture production: stakeholder surveys on the reuse of treated wastewater

Stakeholder surveys were conducted to assess the perception of farmers, consumers and government officials on the use of treated wastewater for agriculture production. The specific treatment process suggested was a low-cost natural/engineered wetland system that farmers can use either at a community level or individually. Mahesh Jampani of IWMI and S. Sonkamble of CSIR-NGRI conducted a farmer and consumer survey in July 2014, and found that both farmers and consumers were willing to pay extra for cleaner water and produce that was safe for consumption respectively. A one day stakeholder workshop on "wetlands as natural treatment systems for wastewater reuse" was held on 12th of September 2014, jointly organized by International Water Management Institute (IWMI), National Geophysical Research Institute (CSIR-NGRI), Indian Institute of Technology Bombay (IITB) and Centre for Environmental Management and Decision Support, Austria (CEMDS) at the CSIR-NGRI campus as part of work package 6 of Saph Pani. The

workshop was aimed at obtaining the views of various government stakeholders on the use of natural wetland systems for wastewater treatment for agriculture in the Musi catchment.

About 40 participants including fourteen Telangana state and central government representatives from various organizations such as Telangana State Groundwater Department, Central Groundwater Board (CGWB), National Remote Sensing Centre (NRSC-ISRO), Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad Metropolitan Development Authority (HMDA), Telangana state Commissionerate of Agriculture, Water and Land Management Training & Research Institute (WALAMTARI), Irrigation and Command area development (CAD) Department (I&CAD), Government of Telangana, Department of Rural Development of Telangana and Department of Geochemistry of Osmania University attended the workshop. Dr. Y. J. Bhaskara Rao, Director of CSIR-NGRI welcomed the guests and chaired the session. The chief guest Srimathi Gayatri Ramachndran, IAS, Former Principal Secretary, delivered the inaugural speech and emphasised that this intervention was timely as in many parts of the country irrigation water is polluted and causes tremendous health risks to people. Dr. Priyanie Amerasinghe of IWMI presented the concept of using natural wetland systems for wastewater treatment for agriculture and the field experiences of the Saph Pani project and later solicited the views of the audience. Dr. S. Sonkamble (CSIR-NGRI) and Dinesh Kumar (IITB) also presented the field and laboratory experiences of Natural Treatment Systems. The participants were of the opinion that a pilot system should be adopted involving all the actors – farmers, consumers, service providers (government institutions and NGOs) to assess the adoptability and sustainability. A vibrant discussion that ensued highlighted the importance of awareness raising, responsibility of producing safe food crops, subsidies for wetland construction and capacity building. Of the three scenarios that were presented, the mini-wetlands for single farms were thought of as more practical and feasible. Drs. Shakeel Ahmed and Markus Starkl stressed that the workshop provided a platform for different government organizations to discuss options for wastewater treatment and its importance in sustainable and safe food production.



Participants discussion in the stakeholder workshop at CSIR-NGRI, Hyderabad

The Saph Pani Handbook

The Saph Pani consortium is preparing a Handbook where the contents and the outcomes of the project are compiled. The book will be published by IWA Publishing in February/March 2015 under the title "Natural Water Treatment Systems for Safe and Sustainable Water Supply in the Indian Context: Saph Pani"

The book will include overviews on BF, MAR and CW and some of our case sites will be explained more in detail. Management and quality issues will also be addressed as well as pre- and post- treatment for natural water treatment systems. It will be demonstrated how modelling can help as a planning and optimisation tool for natural water treatment systems

We will inform you on our Saph Pani website once the book is available.

Dissemination

Asia pacific info day at the University of Applied Sciences and Arts Berne

Saph Pani was presented at the info day on the 20th of October 2014 by Anders Nättorp

MAR-SAT Workshop and expert forum

The workshop will take place on 3rd - 4th December in Tel Aviv, Israel. Saph Pani will be presented by Christoph Sprenger

The parched planet: Water on tap

Saph Pani was highlighted in the [Nature Journal](#) 510, Issue 7505

Final Saph Pani Newsletter

This is the last Saph Pani newsletter and we want to thank you for your interest during these last three years. We have informed you about what has been going on: the persons, the events, the results. The project duration just officially finished. We have felt a great interest and recognition for our work and we are convinced that natural water treatment techniques will play an even more important role in India in the future. The Saph Pani partners will contribute as best they can by completing the project reports and making them available for you as stakeholders in the water sector on the [website](#) which serves as a point of information for another five years. The most important findings will be presented in the upcoming Saph Pani Handbook. We are also giving our recommendations to the ministries and administrators and we will strive to include project findings in the education and in advanced training courses (see for example [D7.3](#)). The National Institute of Hydrology has agreed to take a lead in this. And last but not least the Saph Pani partners will still be active in the field. We are glad to be of service and open to future collaborations so feel free to contact us.

The editors
Julia Plattner and Anders Nätörp



Greetings from the Saph Pani Consortium!



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