Executive Summary

Pollution Prevention in India: HyWaMIS (Hyderabad Water Management Information System)

Background

The City of Hyderabad, India with its 5.2 million inhabitants - that is a quarter of the population of the Federal State Andhra Pradesh - and a population growth of about 10% per year, is not only an important centre for the Federal State but also for India. Uncontrolled industrial growth in the past in and around Hyderabad (combined with the specific topographical situation of the city) have already led to significant environmental contamination especially in the Industrial Development Areas of Patancheru and Bolaram. Because of this complex and urgent situation, the city would greatly benefit from an efficient environmental management and information tool, in order to explore and decide upon appropriate planning measures.

The Hyderabad Water Management Information System (HyWaMIS) being developed in this project is a planning tool that will serve as a comprehensive information system providing information on water quality and industrial wastewater emissions. It will also help local government bodies and policy makers to integrate information about the water management situation and related socio-economic issues.

The HyWaMIS prototype focuses on pollution prevention in the Industrial Development Areas of Patancheru and Bolaram (IDA) where there are more than 400 big and small pharmaceutical and chemical industries (particularly bulk drugs and pesticides production). The effluents generated by various processes are discharged mostly untreated (some are treated), into various unlined channels and streams. Some industries even discharge their effluents in low lying areas or ponds dug within their own sites. Therefore the initial “Industrial Module” predominantly concentrates on providing information on industrial effluents and their effects on ground and surface water bodies as well as assessing remediation and pollution prevention strategies.

In order to design and develop the system in a way that meets the needs of the people concerned with water management in Hyderabad, the project activities involved representatives from seven different stakeholder groups. By engaging these participants in considering the challenges of water management in the case study of Patancheru, the foundations have been laid for a continuing process through which the actors may negotiate through some of the conflicts of interest which currently make collaborative efforts extremely difficult.

The application of a Water Management Information System in Hyderabad aims to increase the quality of municipal planning and thus contribute to improvements in the efficiency of industrial and agricultural activities and domestic water supply, the information available to governmental and non-governmental organisations and citizen’s quality of life.

HyWaMIS is a cooperative project involving the Cities of Mödling (Austria), Venice (Italy) and Hyderabad (India), supported by the knowledge of ARC Seiersdorf research GmbH, ETECH Consult, Fondazione Eni Enrico Mattei, International Council for Local Environmental Initiatives (ICLEI) and Birla Science Centre, and funded under the EU Asia Urbs Programme.

Objectives

The conception and development of this water information system, as an overall objective, is providing the city of Hyderabad with a tool for the integration of existing data. This approach is intended to contribute to meeting the manifold objective functions for different stakeholders aiming at sustainable regional water management.

The main specific project objectives lie in the achievement of

- The general design of an integrated Water Management Information System
- The establishment of a stakeholder platform for conflict resolution
- Comprehensible and transparent presentation of industrial emissions and water quality
- Recommendations for pollution prevention and control
Raised public awareness on water pollution and quality

Project Results

Stakeholder Process
Generally the HyWaMIS initiative seeks to open participatory ways of information gathering, and conflict resolution through stakeholder platforms for building civil-society capacities for integrated water management. A questionnaire was developed and distributed to local stakeholders in Hyderabad in order to identify information needs, technical constraints, and expectations of the stakeholder groups for a water management information system as well as to learn about their views on water management issues in Hyderabad. Subsequently, over the last two years three stakeholder workshops were hosted by the Birla Science Centre and the Hyderabad Metro Water Supply and Sewerage Board in Hyderabad with the aim to discuss user interests and objectives and to establish a joint information basis for water management issues. These workshops contributed to improving the social and political climate between the stakeholders involved, and in particular the residents of Patancheru and the public authorities concerned with water management in that area. Furthermore, a group of experts formed an advisory panel to give direct feedback to the development of the Information System and to help formulate recommendations for the project’s case study, Patancheru. This advisory panel met six times and is a forum for debate, information sharing and conflict resolution. The members are experts from authorities, industry, and citizen groups who previously had not had the opportunity to meet around one table to discuss the management of Patancheru’s water supply.

During the stakeholder workshops stakeholders were offered the opportunity to engage in discussion through facilitated working groups. In each of the workshops, the stakeholders contributed information through working group activities or through open form discussion. The primary workshop outputs that were produced over the course of the project are the following:

1. “HyWaMIS - a co-operative Vision” which has three main sections that were produced by the respective working groups: Problems and Solutions for Patancheru; Information Needs and Sources, System Structure & Functionality; and Public Participation in HyWaMIS. This document is annexed (IV) to the first workshop report. The document is a brainstorming of relevant issues for the project and would be useful material for focusing future stakeholder interactions.

2. Chronology of important events, defining a historical skeleton for the Patancheru case study. These events were elicited in the working groups in the second workshop and the list can be found in the workshop report. This information could be used as a framework to develop a participatory case study profile in the ongoing stakeholder process.
3. List of state variables, also elicited from the participants of the second workshop in the working group exercises. The 28 variables are grouped under the headings “environmental” “economic” and “social” and information sources are given for each. In a participatory decision process this information (documented in the second workshop report) could be used to define decision criteria, and elicit the priorities and preferences of the different stakeholder groups.

4. A set of recommendations for action in the Patancheru area and for continuing the project activities which are reported in the third workshop report.

During the final workshop the recommendations for system extension and water management strategies were presented by advisory panel members. These activities have brought together institutions, independent experts, and local people suffering from the situation to support the development of the Information System. The stakeholder process will be continued under the title “Hyderabad Environmental Stakeholder Platform”.

**Data Collection**
The project started in March 2003 with a survey of the existing water supply and sewerage treatment situation. Main problems are water scarcity and increasing demand as well as different types of contamination. Data collection and analysis concentrated on the industrial area of Patancheru and Bolaram focusing on industrial wastewater emissions and contamination of water bodies.

During campaigns in May 2004, samples were taken from different surface water bodies and groundwater wells. The samples have been analyzed for major ions as well as trace element concentrations. Spatial inconsistencies in sampling locations make it difficult to interpret temporal changes in water quality. Nevertheless, trend analyses for neighboring sampling sites can be used to reveal positive or negative changes in water quality.

The collection of industry data has proven to be difficult as the required information is scattered among various institutions and agencies. Complete information about industrial effluents is rarely available and mostly inconsistent. Of the 1166 industries registered at the Andhra Pradesh Pollution Control Board (APPCB) only 140 had complete information about products, water consumptions, effluent discharge and the type of waste water treatment that is used. For 377 industries only partial information was available and 649 of the industries provided no information at all. Spatial information was available only for 314 industries. For these georeferenced objects the branch and partially the effluent discharge could be extracted from the database to be used for thematic maps.

**Design and Implementation of the HyWaMIS Information System**
Originally, HyWaMIS was planned as a web based tool with access to distributed data sources. However, limitations in the local IT network infrastructure led to its development as a standalone application. Available data and databases were reformatted and collected on one central host which is located at the Hyderabad Metropolitan Water Supply and Sewerage Board (HMWSSB). Nevertheless, the system is designed for online data access of distributed data and databases.

HyWaMIS was implemented based on Microsoft Visual Studio VB.Net framework as a 3-tier application using an Oracle Database. It is a Windows explorer kind of a tool for easy access of information and consists of a switchboard with an explorer tree for intuitive data access. The tool offers basic functions to insert, update, delete, query, and export/save data along with some analysis, summary and reporting facilities. Users can customize the application to suit their specific needs / frequently used queries. Access restrictions were also implemented in HyWaMIS using Oracle Database User Roles by which only authorized users can access the information. Based on the assigned privileges, different functions of the Information System have been enabled /disabled. A GIS viewer is integrated in the application for visualisation of the data in the form of thematic maps.
Focussing on pollution prevention in the industrial development areas of Patancheru and Bolaram, the first development stage concentrated on the establishment of an “industrial module” for the information system which provides harmonised data on industrial effluents and their effects on ground and surface water bodies. For each company at least the following pieces of information, if available, have been registered:

- Location
- Products
- Size (employees)
- Water demand (amount, water supply by private wells or central water supply system)
- Water relevant processes
- Amount of wastewater production
- Wastewater pre-treatment processes (if applicable)
- Wastewater composition (environmentally relevant parameters)
- Point of wastewater discharge (receiving water body)

This module has been linked with a GIS-platform which allows user-, region-, parameter- and/or branch-specific queries. The application of the industrial module furthermore provides the possibility of pollutant-specific analysis and assessment as well as its graphical presentation and visualisation (e.g. thematic maps). This enables a transparent overview of the current status of wastewater emissions and water quality which, by identifying the key pollution sources, essentially contributes to the required pollution prevention approach.

Furthermore it is intended to future link the industrial module to surface and groundwater modelling components in order to analyse and assess different water management scenarios.
The prototype of the Information Systems provides data about industries and water quality in a central database. Through the industrial module interface the users can display industry information ordered by geographical extent and completeness of the available information, define own queries and generate charts. Additionally, if spatial information is available, sampling sites and industries can be visualized and browsed through the integrated AlovMap GIS Viewer. Predefined thematic maps offer rapid access to relevant water quality parameters and industries. Further results include different maps of the water quality situation around Patancheru and Bollaram Industrial Development Areas that were created with ArcGIS and presented to the stakeholders in January 2005 during the HyWaMIS Final Workshop Open Day event.

Scenario Analysis and Environmental Impact Assessment

Scenario analysis aims at performing an assessment of different strategies/water management measures for environmental protection as well as pollution reduction and prevention. Scenario analysis and environmental impact analysis were based on the selection of relevant criteria and the identification of water quality hazards. Different assessment criteria (environmental, economic and social variables) and options (scenarios) were defined during the Stakeholder Advisory Panel Meetings and the Stakeholder Workshop in Sept. 2004. The applied approach considers multi-criteria aspects of the problem and makes an assessment of the impacts of various development and operational scenarios (composite programming). This method allows the assessment of individual remedial and/or technological measures considering their different environmental and cost-related effects and even hard-to-quantify aspects. Analysis of cost effectiveness and other important criteria like indirect economic, environmental and social impacts of measures and their accordance with other social objectives and strategies have been included in setting up a multi-criteria assessment structure. The objective function of this approach generally lies in the achievement of positive effects on drinking water quality (e.g. reduction of contaminants by simultaneously improving surface and groundwater quality). The selection of relevant assessment criteria and the structure focuses on the key function of long-term and efficient implementation of sustainable water management measures within the case study area Patancheru IDA.

Conclusions and Recommendations

Currently water management authorities are challenged to combine the required traditional objectives of water quality and supply with socio-economic needs, such as maintaining and upgrading the landscape, generating income, health issues as well as general environmental protection. In the case study Patancheru/Hyderabad, India, the administrators of the Hyderabad Metropolitan Water Supply and Sewerage Board possess experience and knowledge of managing the waters in the area, supported by suitable technical-engineering know-how. However, in case of complex decisions these cannot be taken by one institution without taking into account the opinions of others involved in the effects of that decision. This signifies that different criteria and objectives have to be taken into consideration, evaluated, weighted and integrated by
methods that are relatively new for the water management sector, such as the multi-criteria analysis methods used in this case study.

For this reason the development of the HyWaMIS water management information system prototype as a tool for decision-support has a great potential to form the basis for multi-criteria analysis aiding the choice between alternative solutions. The used methods can be documented, and are therefore clear and can be understood by the different players involved in the decisional process (authorities and other stakeholders).

Future efforts shall be taken to extend the HyWaMIS prototype for the case study area as well as for a broader urban area by including additional modules covering other related thematic sectors (e.g. agriculture, land use, ecology) to better deal with multi-dimensional problems and to develop increasingly advanced interfaces that are effective for the end-users. Furthermore, the industrial module could be linked to surface and groundwater modelling components in order to analyse and assess different water management scenarios. The detailed model selection would be based on scenario simulation applicability. Selection criteria would include result-oriented relevance, required input parameters, interoperability and operating efficiency (economic and algorithmic aspects). These models could be used to simulate the implications of the defined scenarios and give forecasts on environmental conditions. As a result of scenario simulation, patterns for groundwater and surface water flow as well as pollution by specific contaminants could be calculated and visualised.

Furthermore, it is strongly recommended to set up a regular monitoring network to provide current information about surface and ground water quality and other environmental parameters.

An important step in future developments will be the improvement of communication between industries, agencies and institutions to agree on a common data exchange policy for environmental and industrial data.

During the Final workshop it has been announced by the Hyderabad Metropolitan Water Supply and Sewerage Board (HMWSSB) that the stakeholder process initiative will be continued by establishing a “Hyderabad Environmental Stakeholder Platform”. This platform will accompany and advise the further extension of the information system as well as the development and priority setting of water management strategies.