

# **Drinking Water Resources in the Mekong Delta - Field Investigations and GIS Visualization**

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## **ABSTRACT**

*Within the last few years there was a rapid economical growth in the Mekong Delta, Vietnam. An increase of domestic and industrial water demand as well as an increase of the use of ground and surface water was observed. Thus especially in the rural areas water supply is a problem of increasing significance. Surface water for instance which is often used for drinking water purposes is highly polluted by agrochemicals and other organic pollutants (e.g. inflow of untreated waste water). Implementation of decentralized water management systems in rural areas is the main topic of an interdisciplinary project.*

*One part of this project is the depiction and appraisal of the potential drinking water resources. Ground water, rain water and surface water are used for drinking water purposes. The main objective of this research is the development of a method to identify problems related to the water supply situation.*

*Therefore it was necessary to evaluate the potential drinking water sources. Field investigations regarding yield, quality and usability as well as demand and actual use of ground water, surface water and rain water are carried out at two selected study sites in the Mekong Delta. Hydrogeological methods as well as self-developed methods to evaluate the technical conditions of water supply facilities (wells, pumps, etc.) were developed and adapted to the local boundary conditions. Additionally, water samples were taken and analyzed on chemical and microbiological parameters. Based upon those results a sustainable water supply concept including technical solutions (e.g. water treatment) should be developed.*

*All data were evaluated and visualized by a geographical information system (rivers and canals, hand pumps, water quality, ground water flow, irrigated fields, etc.). The GIS is linked to an Access Database using the ArcView extension "Access Link".*

# **1 INTRODUCTION**

## **1.1 Water Supply Situation in the Rural Areas of the Mekong Delta**

The Mekong Delta, Vietnam, is the most downstream part of the Mekong River basin with a population of 17 million inhabitants living in 4 million hectares of land. It is the most important agricultural production region for Vietnam with more than 50 % of staple food and 60% of fish production of Vietnam. It is contributing 27% of the total GDP of Vietnam (Le Quay An, 2000). Besides a rapid agricultural growth a fast growth of the industrial sector can be observed.

In the rural areas of the Mekong Delta surface water, rain water and ground water are the main sources for drinking water. 75 % of the urban population and 35 % of the suburban and rural population have access to clean water. In remote and deep areas this figure can drop down to 20 %. In the last 20 years many wells and drinking water plants have been built, mostly in cities, small towns and suburban areas. In rural areas which are not accessed to those facilities, farmers still get their water directly from rivers, canals, ponds or shallow wells. Untreated domestic and industrial waste water is often led into the canals directly.

Besides pollution due to industrial and agricultural activities, including soil reclamation (Le Quang Minh et al, 1997) as a consequence of the fast-growing economy the region is facing also severe water related problems such as floodings (Nguyen Viet Pho, 2000), acidification due to acid sulfate soils (Le Quang Minh, 1996), saltwater intrusion (SIWRMP, 1995). Thus, water supply of the rural people is still an unsolved problem.

## **1.2 Goals and Objectives**

The object of an interdisciplinary project is the exemplary development of a concept for the improvement of the drinking water supply for two selected study sites in the rural areas of the Mekong Delta Vietnam. In this research project - which is funded by the German Federal Ministry of Education and Research (BMBF) - field experiments are performed to appraise the natural resources of ground water, surface water and rain water on availability, chemical and hygienically conditions as well as regarding technical and economical aspects.

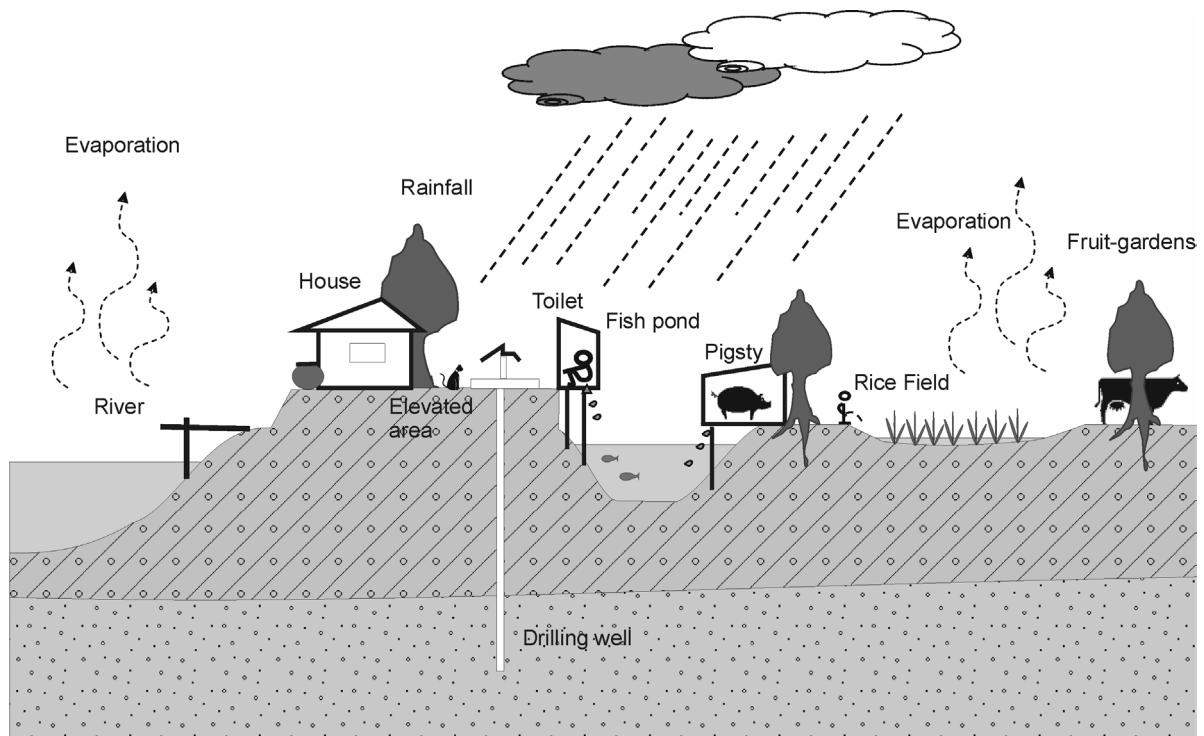
The goal of the geographical information system which is described in this paper is the documentation and the visualizing of the results of the project. In this GIS all the researched data and the results of the conducted field experiments are included and also should serve as a base for the evaluation of the data.

# **2 Study Approach**

## **2.1 Study Areas**

The rural areas of Can Tho province are characterized by an agricultural land use with farms cropping rice and fruits mostly irrigated by canal water. The connection of the rice-fields to the canals is often realized by concrete pipes or ditches. Some of these farms are

maintaining pigsties and/or fishponds. Domestic waste water and waste water from pigsties are led into rivers and canals or ponds directly (Figure 1).



**Figure 1. Setting of rural areas in Can Tho Province (Le An Tuan, 2003)**

Surface water, rain water and ground water are used for drinking water supply. Many farms and house-holds have small scale tube wells to withdraw ground water. The small scale tube wells have diameters around 45 mm and are equipped with handpumps or electric motor-pumps.

## 2.2 Field Investigations

For both study sites two investigations steps are performed. The first step includes research on existing topographical maps and facts as well as a mapping of all water related facts (e.g. wells, irrigated fields, canals) within the study sites. After the first investigation a report was written including a GIS using the software ArcViewGIS 3.3. Regarding the mapping results the GIS is containing the following themes: landuse, irrigation ditches, buildings, canals, paths, bridges and wells. For the themes various attributes were defined to describe the specific characteristics of the study sites.

The second phase was the actual performance of field experiments to determine the usability and yield of the water resources. Decisions about sampling points and the experimental set up were made with help of the GIS which was built after the first step.

The field experiments and their aims are listed below:

- slug tests to determine the hydraulic conductivity of the aquifer
- self-developed functioning tests of handpumps to determine the technical conditions of the water supply utilities
- water and soil sampling to determine the chemical and microbiological conditions of all water resources and river sediments

### **2.3 Documentation and Visualization of the results using a GIS**

Based upon the geographical information system which was built after the first investigation step decisions about the field experiments were made. Queries for the performance of the experiments were defined and according to the results of the queries the experiments were performed.

The results of the field experiments are documented in a MS-Access Database. The Access Database was also used for evaluating the results. For each field experiment a new theme in the ArcView Project was added. Those themes are linked to the appropriate table in the Access Database with the Extension “Access Link “(Jack, 2000). Figure 2 shows an example of a link between ArcViewGIS and the Access Database. Here it shows the link for “the functioning tests of the handpumps”.

## **3 RESULTS AND DISCUSSION**

Using the ArcView Extension “Access Link” an interactive link between Access and ArcView GIS is realized. With this approach it is possible to make good use of the Microsoft Database and the GIS-Software at the same time. Live links from various theme-maps in ArcView to a form in Access with all the functionalities of Access (e.g. use of the relational facility of Access) is possible. One of the big advantages is the direct updating and editing of the attribute data into the Access tables. Also, there’s no need to have large dbf-files as part of the shape files. At the same time various theme-maps of the study areas can be generated by using ArcView GIS.

Using this system and its advantages it is possible to determine the characteristics of the water resources for each study site. It is a powerful tool for the documentation, visualization and reporting. This GIS is an essential and important tool to achieve the objectives of the project.

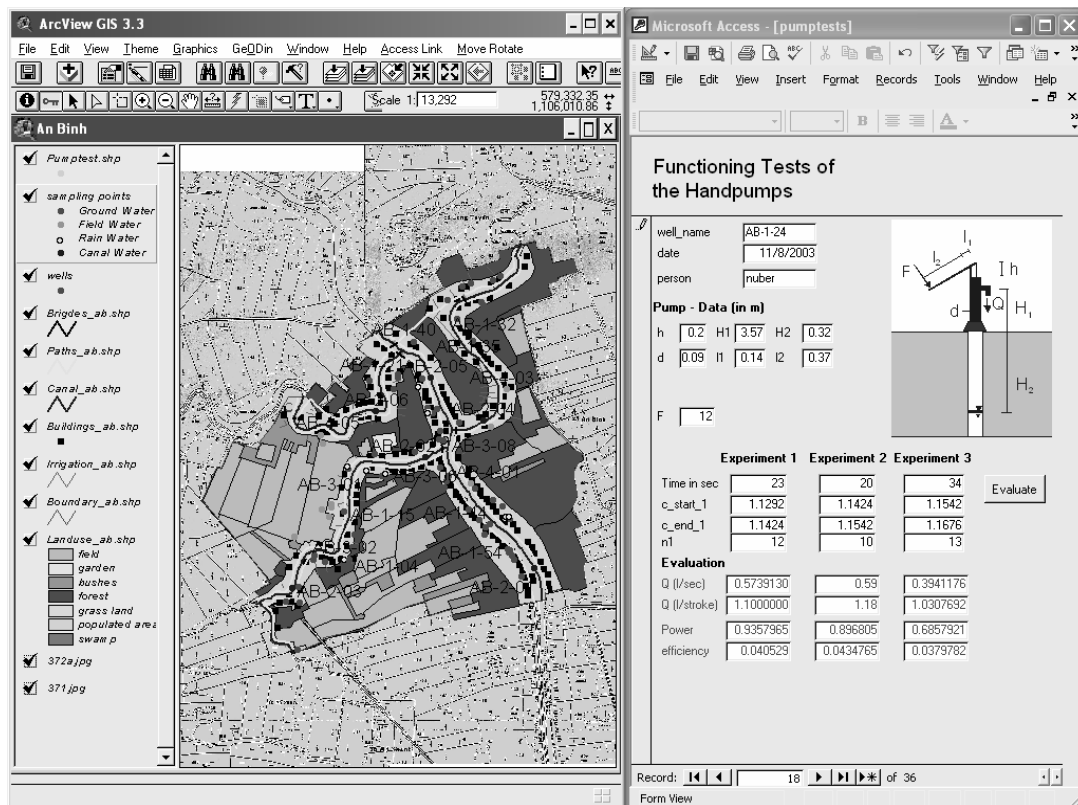


Figure 2. Link between ArcView GIS 3.3 and MS-Access.

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