

Environmental Assessment of using Shallow Hand Pump Systems as a Drinking Water Source in Development Communities: A Case Study

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Abstract

Safe, clean drinking water and sanitation are a human right. Improved drinking water for human consumption should be free from pathogens such as bacteria, viruses, protozoan parasites and chemical contaminants to meet biological, physical and chemical criteria. However, inadequate sanitation, waste treatment and disposal are responsible for pollution of water resources. The large proportion of the population in developing countries, especially in villages where there is no safe drinking water supply and suffering from water-borne diseases, especially diarrheal diseases. Egypt has made significant progress in terms of direct access to safe drinking water at the household level (92.4%) and basic sanitation (92.9%). Unfortunately, there are many rural villages in Egypt that are still dependent on water delivery and waste disposal systems are outdated, unhealthy and therefore unsafe, and as a result, the situation with regard to safe drinking water. The objective of the research is to assess the water supply especially by hand pump system in rural communities within the Nile Delta region in order to protect the water quality at the hand pump. Also highlights the areas that have a problems related to the bad sanitary conditions around hand pumps used for drinking purposes in urban and rural areas through monitoring the deep and shallow wells near to sanitation systems may affect by it. The selected governorates are: (El Sharkya – El Menofya and El Gharbya). Laboratory analytical procedures will include chemical, biological, and microbiological, these analyses will carried out on a number of up-to-date and fully automated analytical instruments that are capable of handling large number of environmental parameters. A socio economic survey will implement from the three governorates will study by Meeting s (local community, students, women, and men), Formulation of an action group, and Questionnaire-based analyses. It concluded that rural communities within the selected pilot areas provided with an environmentally safe, socially accepted, and sustainable water supply source through shallow ground water hand pumps. In addition, public awareness within the pilot areas rural communities improved regarding the environmental aspects and safety protection measures for the hand pumps installed on the top of shallow groundwater wells.

Introduction

In Egypt, the percentage of population serving water supply and sanitation is generally higher in urban areas than in rural areas. About 20 per cent of Egypt's total population lacks access to safe drinking water supplies. In those communities that do not have access to water supply, the main source of fresh water supplied is from shallow hand pumps that may contaminated by poor protection. On the other hand, 23 per cent of the urban population and 74 per cent of the rural population have no access to public sewerage systems or disposal of health waste. The recharge of the Nile Delta water layer occurs mainly through direct leakage from irrigation channels and banks. In the central and southern parts of the Nile Delta flood plains, leakage to groundwater is between 0.25 and 0.80 mm / day (RIGW 1980). In desert margins, high leakage rates of 1-2.5 mm / day recorded for basin irrigation while rates of 0.1-0.5 mm / day were low for drip irrigation (RIGW 1980). Groundwater discharged through four components: flow to the drainage system, direct evaporation, and extraction of groundwater from groundwater. The discharge of groundwater into the drainage system in the northern parts of the delta occurs through an upward leakage at a daily rate of 0.2-0.9 mm / day (RIGW 1980). Groundwater discharges can occur through evaporation in lowlands with a shallow groundwater table. In Wadi Al Natroun, Depresses, Lakes and Sebhas, groundwater naturally discharged by evaporation. The flow of groundwater is a small component of discharge, which occurs between the aquifer in the Nile Delta on the one hand, and the seductive groundwater and the Natroun Valley on the other. In 1957, the first reservoir of the well released and revealed that 0.2 billion cubic meters pumped annually from the aquifer through 5,600 wells GWR (1966). In addition, most of the production wells are 70 meters deep and the screen length is between 20 and 30 meters. Shallow wells run by hand pumps are still widely used for domestic purposes especially in rural communities in the Nile Delta.

Table 1. Drinking water at some localities in the Nile Delta

Governorate	Source %		Wells %	
	Surface water	Groundwater	Deep	Shallow
Gharbia	31	69	60	40
Qalubiya	40	60	65	35
Menoufia	11	89	50	50

Research problem

The objective of the research is to assess the water supply especially by hand pump system in rural communities within the Nile Delta region in order to protect the water quality at the hand pump. Also highlights the areas that have a problems related to the bad sanitary conditions around hand pumps used for drinking purposes in urban and rural areas through monitoring the deep and shallow wells near to sanitation systems may affect by it. The selected governorates are: (El Sharkya – El Menofya and El Gharbya). Laboratory analytical procedures will include chemical, biological, and microbiological. These analyses will carried out on a number of up-to-date and fully automated analytical instruments that are capable of handling large number of environmental parameters. A socio economic survey will implement from the three governorates and studied by Meeting s (local community, students, women and men), also, formulation of an action group, and questionnaire-based analyses. Based on these various implemented activities within this research, several outputs produced that can listed as follows:

Identification of demonstration sites where hand pumps and groundwater affected by pollution from septic tanks & surrounding drains. Public awareness on the relation between water and human health. Suggest mitigation measures

Expected Outputs

Several outputs, expected as follows:

Improve national informational experience for shallow groundwater pollution and social behavior regarding drinking water supply utilizing hand pumps within different areas in the Delta Region.

Development of sustainable scientific applied and environmentally sound procedures for shallow ground water hand pumps within the Delta Region.

Public awareness within the pilot areas rural communities improved regarding the environmental aspects and safety protection measures for the hand pumps installed on the top of shallow groundwater wells.

Materials, Methods, and Discussions

It has been visiting different areas in El Sharkya governorate, including the village of Meet El Ezz – Faqous. it shown that the village used drinking water from the station Al Abash, as it is one of the largest stations in the Delta. It has proposed drilling water wells is online to feed the village in case of shortage of water from the station Al Abash. it is decided to search in other villages, which are in bad need to safe drinking water.



Figure 1: Map of Delta Egypt / Photo of Meet El Ezz Village

El Haswa and Awlad Moussa Village – Abou Kbeer – El Sharkya Governorate

It has been oriented to El Haswa and Awlad Moussa Village – Abou Kbeer – El Sharkya Governorate and found that the people in the village Awlad Moussa transported water from different places and it found that the quality of water was very bad and really needs another source of water. There was an old well with a depth of about 70 meters at village El Ghaba – El Sharkya Governorate and the water quality for this well is not fit for human consumption. Therefore, it decided to drill a well with depth more than 150 meter to serve the area of Meet El Haswa and Awlad Moussa villages. In addition, it has been taking water samples for chemical analysis, as well as full bacteriological analysis at central laboratory for environmental quality monitoring NWRC, MWRI.

El-Gharbya Governorate Data Collection and Analysis

A survey was done in El-Gharbya Governorate, and collect a data from a local unit of the village Nahtai and other villages including the village of (Kafr Aish (about 7 thousand people) and Kafr El Deeb, kafr Noway (about 10 thousand people), Kafr Shaheen (about 7 thousand people)) which need to clean waters.

El-Menofya Governorate data collection and analysis

The governorate of Menofya is one of the governorates of the Central Delta region. It is located in the middle of the delta between the two Nile branches (Rasheed and Damietta). Figure 19 shows El Menofya governorate map. The total area of El- Menofya Governorate is 2760 km². The governorate population is 3365057 inhabitants. Agriculture is the main activity of the governorate's population; a total cultivated area is 326046 feddans. The governorate also known for its variety of agricultural crops, vegetables and fruits. The industrial activity is currently one of the components of economic and social development. There are major industries such as spinning, weaving, iron, steel and ceramics. Many small industries that are unique to Menofya, such as the psoriasis industry and the silk carpet industry in the village of Saqiet Abu Shaara that exported abroad. The main sources of pollution in the villages are "sewage waste, garbage, solid waste and industrial waste disposal".

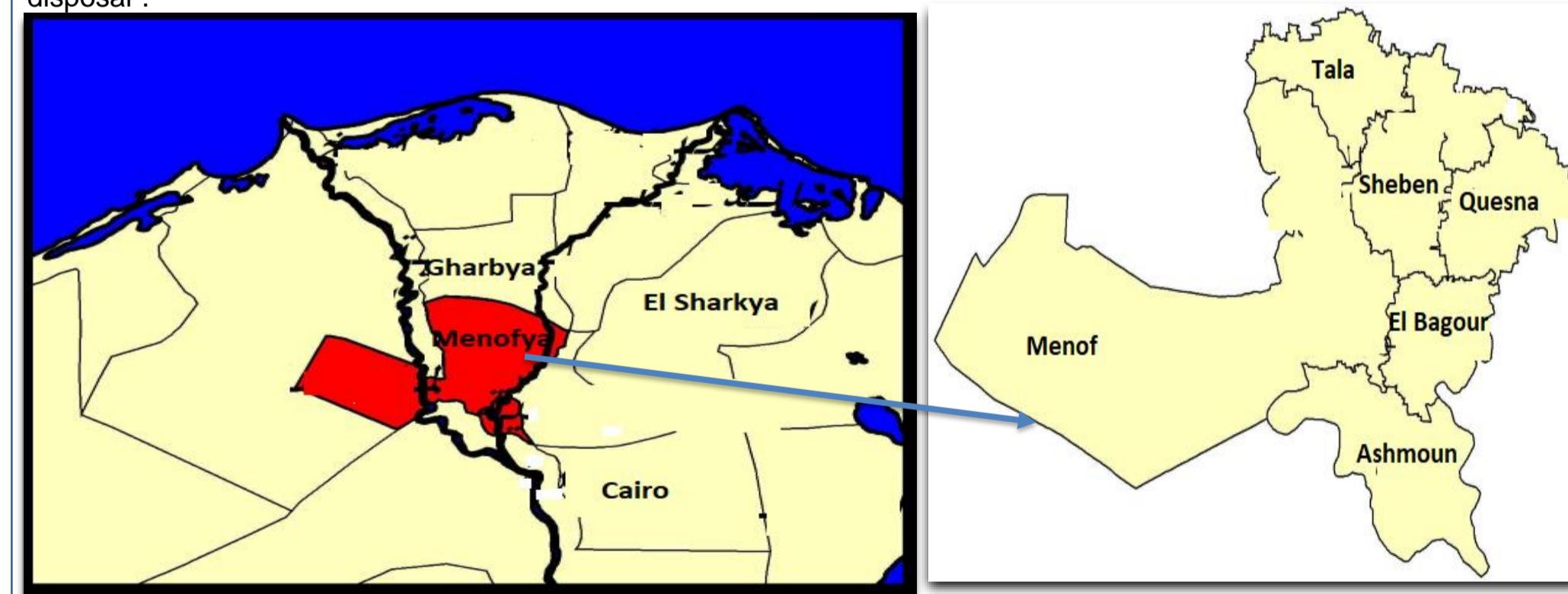


Figure 2 : El Menofya Governorate Map

Shnway and Kafr Hamma – Menofya Governorate

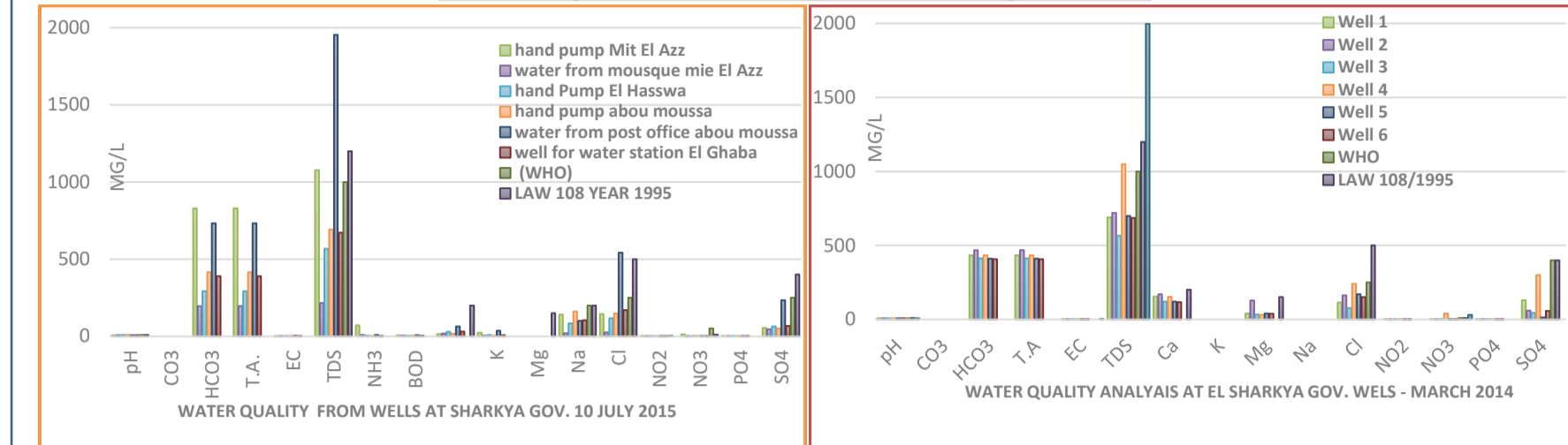
During the survey at El Menofya Governorate, we study Shnway and Kafr Hamma Villages as shown in figure 3 that represents the map of El Menofya Governorate, and photos from these villages. A water sample taken during the period



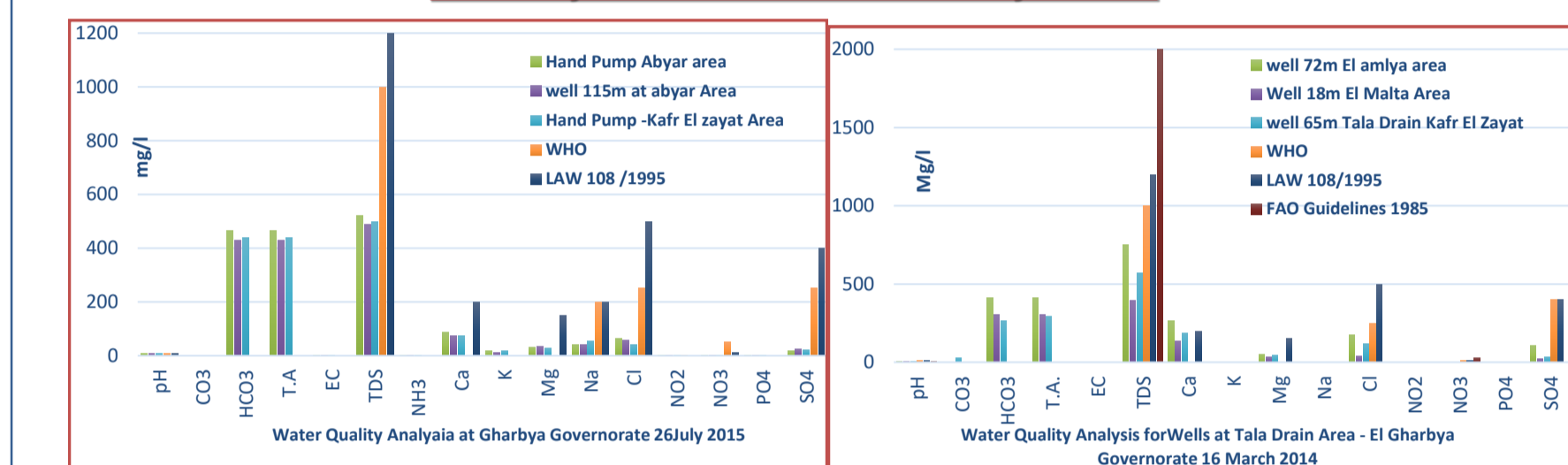
Figure 3 : Map of El Menofya Governorate – Photo Shnway Village – Drilling well at Shnway

Results

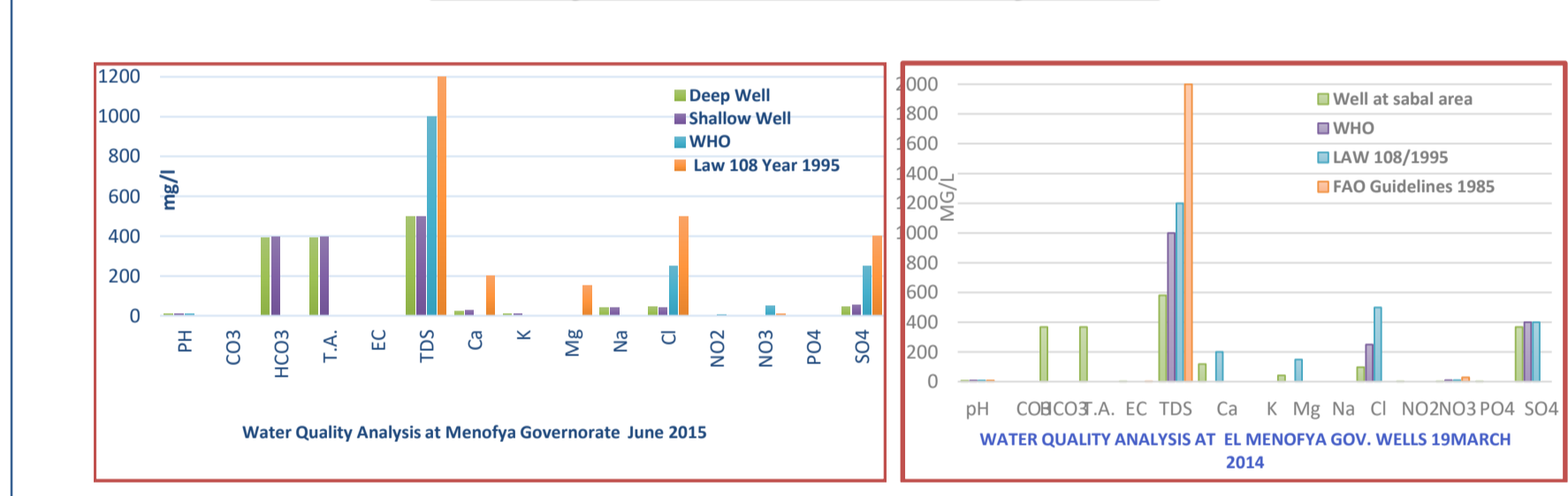
El Sharkya Governorate Water Quality Results



El Gharbya Governorate Water Quality Results



El-Menofya Governorate Water Quality Results



Conclusions

El Sharkya Governorate

By studying the water use of agriculture by applying the SAR ratio, water samples in the central and western parts of the governorate, it concluded that it is cultivable for all types of soils and plants. While about 56.5% of water samples, need good treatment and drainage as well as adding some organic materials for use in agriculture. Samples of the eastern and northern parts characterized by high salinity, and required their use in special soils and plants with the ability to cultivate in highly saline water. The distribution of water samples also indicated that most of them are within the acceptable range for drinking and daily purposes except three wells in the eastern part where the salinity ratio (TDS) increases from 1500 ppm.

El Menofya Governorate

Ground water Salinity of this water reaches its lowest levels in the governorate of El Menofya, which is 320-ppm increases as we go to the middle of the delta where it reaches 640 ppm and salinity increased to its highest rate in the north, reaching 45000 ppm. That the decline in the level of groundwater as a result of excessive clouds in the desert areas, "the province of Sadat" will have a causal effects in the rate of salinity.

General Conclusion and Recommendations

The objectives of environment assessment of well-hand pump community water supply system in developing countries should state in terms of quantitative targets relating to intended consumption, time and effort spent in water collection, quality at point of use, source reliability, and cost.

In order to achieve such objectives, water supply systems should include the following activities: well site selection, drilling and well completion, establishment of maintenance and cost recovery systems, health and hygiene education, and monitoring. It should realize that health and hygiene education and other community work aspects have to operate on a significantly longer time scale than the engineering aspects of such systems. Beneficial impacts of well-hand pump system in public health and time saving can be expected, but the level of expectations should be realistic. Family, and especially child, health should improve, and the burden on women should reduce; nevertheless, water and excreta-related disease will still be prevalent, and women will continue to use significant amounts of time and energy on water collection. Rapid evaluations of well-hand pump water supply system should : (a) measure the extent to which the quantified targets set out in this paper have been achieved, and (b) observe, and attempt to quantify, behavioral changes in water use brought about by the provision of improved water supply.

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