Below the radar: The boom of groundwater use in the Nile Delta

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Survey on the dynamics of groundwater use in the Nile Delta

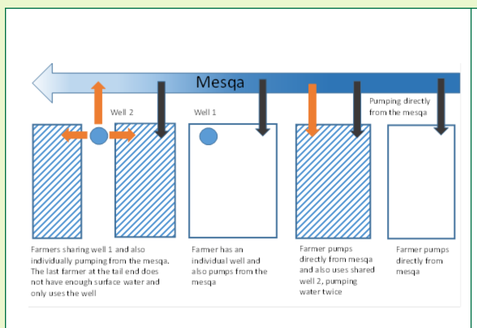
General specifications of the study area and surveyed wells

The Nile Delta aquifer is one of the largest aquifers in Egypt with a total capacity of 500BCM, roughly fifteen times the amount of water that enters the Delta annually through the river flow itself. The North part of the aquifer is subjected to seawater intrusion while the central part is considered as a transition zone between fresh (1000 ppm) and seawater (35,000 ppm). Although individual wells have been known in the delta for a long time, a survey carried out in the central part of the Nile Delta uncovered a recent and booming tubewell drilling industry.

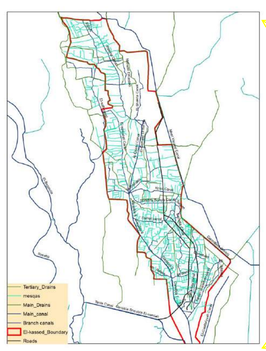
The command area of a main canal running in the central part of the Nile delta was selected to study the drivers, social arrangements, intensity of groundwater use, variability in well density, and economic and legal aspects.

A sub-area of 40,000 ha was selected to study the variability of well density. The area is served by El-Qased canal which is running from the center to the North of the Nile Delta. A set of 18 branch canals (secondary) is serving the study area. The crop pattern includes rice, maize and cotton in summer season and onion, wheat, Alfa-alfa in the winter season.

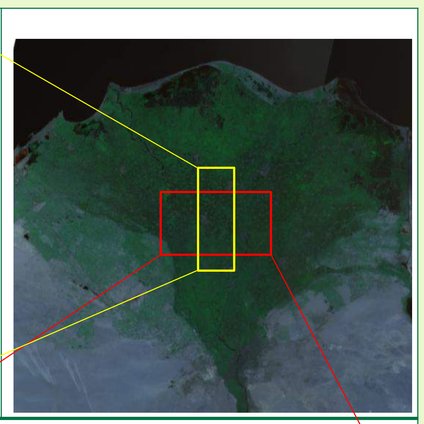
General specifications of the study area and surveyed wells



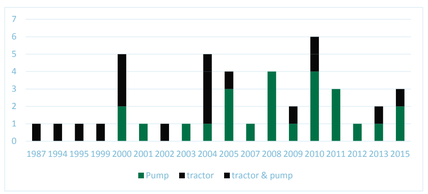
Example of collective arrangements along a mesqa



Map of the Studied area

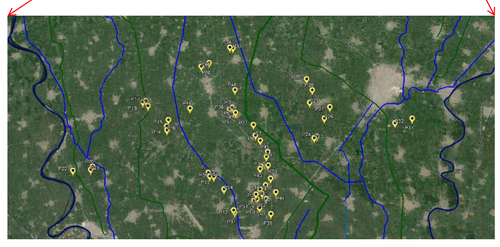


Characteristics¤	Range¤
depth (m)¤	40-95 m¤
surface irrigated (fed)*¤	1-40 feddan¤
cost of drilling + casing (LE)¤	6,000-20,000 LE¤
cost of pump (if new)¤	3,000-11,000 LE¤
consumption (of diesel per hour)¤	1.5-2.5 l/h¤



Wells characteristics and sources of Energy

Locations of the wells surveyed



Type of powering device

Drivers of groundwater-supplement irrigation in the Delta

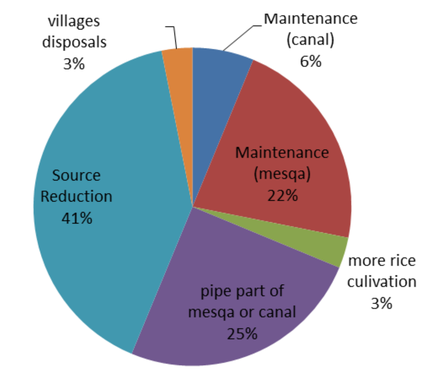
Groundwater abstraction in the Middle Delta is strongly linked to inadequate and/or untimely availability of surface water in the canals (with different factors causing this). Users with poor access to canals depend on groundwater as a complement, increasing their water security, especially during peak irrigation times (in summer). This study has shown that inadequately maintained canals is also a major driver of the development of groundwater abstraction in the Nile Delta, as well as reduction in water supply (especially for tail-end users in the canal system), and cases of conflicts (with farmers seeking independence from fellow farmers on the same mesqa).

Intensity of groundwater use by farmers in the study area

A survey was done to define the number and locations of farmer's wells in the study area using a GPS Camera. The total number of wells inventoried was about 1700 wells for 40000 ha (canal command area). A density analysis using Kernel Method in ARCGIS was done to produce density map. The highest density of wells *was 57 wells per square kilometer.* The branch canals feeding from El-Qased canal pass under the roads by pipes which cause water supply problems to these areas. Farmers interviewed after the road rely mainly on wells by a ratio of 70-100 % for irrigation in the summer season. These wells are in general only used intermittently and it is not always easy to assess the frequency of use by farmers.

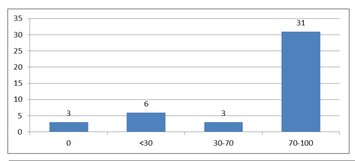
Pumping from a well requires more energy than pumping from waterways, and costs on average 2 to 3 times more than pumping from the canal, with irrigation durations around twice as long too.

Drivers and intensity of groundwater use for irrigation in the study area:

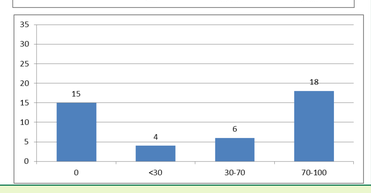


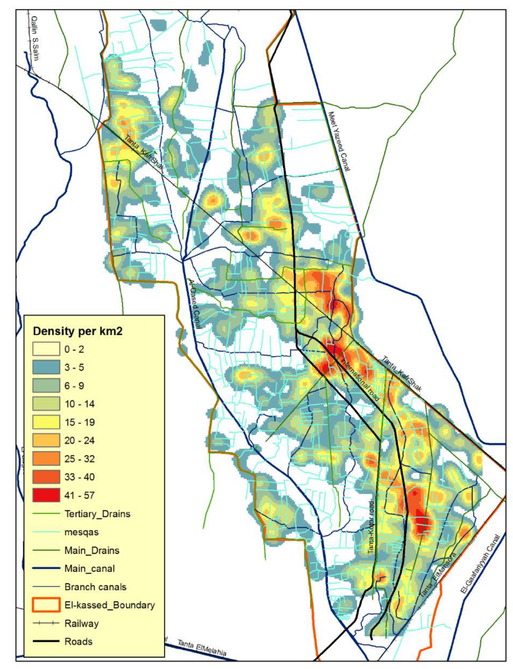
Drivers of using groundwater for irrigation

Irrigation water use from the well in the summer season



Irrigation water use from the well in the winter season





Density of farmers irrigation wells in the studied area

Collective arrangements

Social informal arrangements between farmers (those with wells and those without) ensure that most farmers can access groundwater. Most of the wells are shared between various farmers: this shows that individual needs are still limited and seldom justify individual investment in a well (although this latter case is growing). The possibility of a shared investment brings obvious economies of scale and allows for the dissemination of wells. With an average investment cost of €1300, a group of –say- over 10 farmers will have individual costs under €130 per person, which is seen as a worthwhile investment since this allows securing water supply to crops. Several mechanisms allowing occasional use of the well by farmers not originally part of the investment were also observed.

Groundwater quality of surveyed wells

Groundwater salinity is affected by a number of local variables such as, the distances between wells, the well depth, the intensity of use, soil type and infiltration rates. The North part of the studied area is affected by saltwater intrusion and no groundwater use was reported. The electrical conductivity (EC) in the wells, measured whenever possible, surprisingly showed substantial variability, with values between 485 and 2,836 µmhos. This large spatial variability contrasts with the neat salinity isolines usually exhibited in maps of groundwater salinity in the Nile delta.

Depth and Salinity of groundwater used in the study area