STUDY ON RATIONALISING GROUNDWATER USE BY ELECTRIFICATION OF SHALLOW WELLS[1] - May 1990

Al'atiri Boutiti Raqya
Rural Development and Irrigation Department
Ministry of Agriculture, Tunisia

1. INTRODUCTION

Groundwater is being over-exploited both by electrification and by illegal digging of shallow wells. In light of this, the Ministry of Agriculture set up a study to review options for rationalising groundwater use. Controlled electrification seems to be the best means available, allowing precise monitoring and evaluation of water consumption.

2. PRESENT SITUATION OF GROUNDWATER RESERVES

The electrification of water-pumping in shallow wells by STEG (Electricity and Gas Department - Societe d'Electricite et du Gaz) has been placed under the authority of the Water Resources Administration (Direction Générate des Ressources en Eau) in an attempt to reduce over-exploitation. Zoning has been introduced; in the prohibited areas electrification for pumping has been forbidden and in the 'safeguard' zones electrification is only permitted under certain conditions. Only in areas where groundwater reserves do not seem to be in imminent danger of over-exploitation is electrification proceeding without restriction.

Despite these protective measures, proliferation of electrified pumping has not been slowed. This situation prevails even in the prohibited areas where groundwater continues to be more and more dangerously over-exploited.

The strategy adopted to safeguard groundwater evidently requires revision, especially since it has been rejected both by farmers and by development and finance organisations. Farmers, who know the difficulties and handicaps created by diesel pumps and who are aware of how the electricity

[1] A 'shallow well' is no deeper than 25 m.

grid is developing in rural areas, constantly ask for their wells to be electrified.

It is already a fact that Tunisia's groundwater is over-exploited. This stems directly from increased withdrawals from electrified wells. The annual increase in the discharge of electrified wells is greater than that of wells equipped with diesel pumps. On average, electrified wells now discharge twice the average annual volume pumped by wells equipped with diesel pumps.

3. RESULTS AND INTERPRETATION OF STUDY

According to the results obtained from the study carried out in the provinces of Bizerte and Nabeul and after comparing real water consumption rates with theoretical plant needs, the following conclusions can be drawn:

- Water consumption rates tally with the theoretical level of crop needs for shallow wells which are equipped with diesel pumps;
- Whichever pumping equipment is used, electrical or diesel, water consumption rates on shallow wells are double those of deeper wells for the same irrigated area and cropping pattern;
- Holdings where shallow wells are electrified pump twice as much as those where the wells are equipped with diesel pumps (because electric pumps can be operated longer or more frequently);
- Large holdings (greater or equal to 4 hectares) use smaller amounts of water than in theory they need because farmers do not cultivate the full area under irrigation. Typically one family can irrigate 1 hectare depending on water availability, water wastage and intensity of land use. This can equally be the case of shallow wells with small pump yield. The following is an example: 972 metres^3/hectare (m^3/ha) in summer for a surface of 4 hectares;
- On the other hand consumption is clearly increased for a small area. This can be explained since pumped discharge is greater than the theoretical design flow which will provide the water requirements of a small plot.

Real examples:

12,150 m^3/ha during the summer for a parcel of 0.4 hectares
11.097 m^3/ha during the summer for a flow of 5 litres/second (l/s) and a surface of 1 hectare.

In general, water consumption in winter exceeds plant water needs. Water wastage occurs during this time of year. *(However, some of this water may he important for leaching purposes. Editor)*

- Water consumption is correct regardless of holding size and flow rates, where water-saving systems are in use (those encountered include sprinklers and mobile tubing).

A certain caution should be exercised over these findings since they are drawn from a study of only 36 surface wells. They also need to be checked against the results of studies which will be sent in by all the Regional Agricultural Development Offices (CRDA - Commissariat Regional au Developpement Agricole). These results, though, do seem valid, and even predictable. The main point to note is the tendency to over-exploitation by a shallow well or farm with certain characteristics. A well or farm with these characteristics could be identified and studied over the longer term to see how extension advice can increase an owner's awareness of the various ways in which the resource may be exploited.

Certain practical proposals, based on these conclusions, are now presented, to reduce groundwater use while at the same time permitting electrification of shallow wells.

4. CRITERIA FOR EVALUATING GROUNDWATER OVER-EXPLOITATION

Agricultural production in the private sector is relatively well developed, primarily in those irrigation schemes where the rate of intensification is highest. From time to time, nevertheless, anomalies in water resources use are noted.

The illicit creation of shallow wells, electrification in prohibited areas or 'safeguard' areas or, quite simply, water consumption exceeding

requirements (see study results), demonstrate how ignorant farmers are of basic technical ideas necessary for good management of water resources.

Once these basic ideas have been grasped at the popular level, they could help reduce groundwater depletion and saline water contamination. The aim is for farmers to pump only what they need for a given area of crops and reduce wastage. However, the danger is that these efficiency measures may encourage farmers to pump the same amount and irrigate a larger area proportional to waste water 'saved', which must be avoided.

The criteria which need to be defined to act on water consumption are:

- water needs in the private sector
- specifications of equipment to be installed
- corresponding energy needs.

It should be borne in mind that each shallow well represents a unique case and so generalising one piece of information or one result is problematic. The present study can only be a framework within which to place shallow wells which have similar characteristics. Therefore the characteristics of the irrigated parcel and of the shallow well must be known and indicated on the form requesting electrification. This must first be filled in by the person concerned, then by the Administration.

The parameters to be ascertained for a farm requesting electrification are:

- the number of the well
- the hydrogeological formation tapped
- the depth of the static and dynamic levels of the well
- the total surface area of the farm
- the crops to be irrigated

Then, with this information, the parameter limits to be calculated are:

- the theoretical water needs of the holding
- the maximum power of pump to be installed
- the maximum energy consumption for the year and for different periods of the year (winter, summer and peak times winter and summer).

5. PROPOSALS

Bearing in mind that energy conservation as well as water conservation is now of concern, an improved gravity irrigation system would be most appropriate for water distribution after pumping, especially since most of the underground reserves are relatively saline and require an extra quantity of water to flush out the salts.

By the same token, before any final decision is taken on electrification the possibility of equipping wells with renewable energy should be studied. 'Drip irrigation might be appropriate.

(a) The minimum tariff in Kwh as for improved gravity-fed systems should be applied up to maximum consumption levels. For any volume pumped which is greater than this, a penalty tariff will be applied. This will be the case if the infringement takes place for the whole winter, for the whole summer or for two consecutive months in the winter or the summer.

(b) Since total water use depends on the volume and duration of pumping,it is imperative to reduce pumping times, which should be carried out by STEG.

(c) Piezometers ought to be installed as an extra precaution in critical zones where saline water contamination threatens a groundwater reserve and also where there are concentrations of shallow wells. These would enable effective monitoring of changing water levels and water quality, of both shallow and deeper aquifers.

6. CONCLUSION

The findings of this study on electrification ought to be put into effect at the regional level by water resources technicians from the CRDA, and by regional district level technicians from STEG. On one hand this would fix the maximum energy requirement in relation to the depth of the dynamic level of the groundwater reserve and on the other would fix the length and timing of electrical supplies corresponding to the pump yield from that reserve.

A copy of the table (or the graphs) of the maximum energy requirement for a given region ought to be handed over to each District in the region so that tariff scheduling bands based on energy consumption can be worked out.

A standardised form ought to be drawn up for each hydrogeological formation in each province. Each time a request for electrification was made, such a form would have to be filled out by:

(a) the farmer, who would note down all the specifications of the holding and the well;

(b) CRDA personnel, who would add the characteristics of the groundwater reserve and the maximum water requirements in power and energy per hectare.

STEG, for its part, in collaboration with the Administration, would prepare a proposal for new tariffs based on the degree to which power and energy are overused, and also a proposal for power supply timings.

A 'STEG information sheet' ought to be produced for each province and given to any farmer who wants well electrification so that the farmer is aware of procedures.

A case study is now underway to gauge the economic and financial effects of this electrification project, with a view to its being implemented as soon as is best. New laws are now being drawn up in line with this study to determine how electricity is to be used. It is also intended to create farmers' associations for managing the system and implementing the guidelines.

DEVELOPING VILLAGE LIFT IRRIGATION IN MALI

Souleymane Dembeley
Chargé de projets, GUAMINA (ONG/NGO), Bamako, Mali

GUAMINA is an NGO undertaking development actions in response to the needs identified by local people and making use of their full participation. Our actions are strongly focused on food self-sufficiency through small-scale irrigation schemes for rice and market gardening. At the moment GUAMINA is involved in four main irrigation scheme projects. In this paper we discuss the project in Boya, 60 km from Gao in the seventh region of Mali.

From the outset, though, it must be stated that rice or market garden irrigation schemes cannot be undertaken in isolation or they are bound to fail. Other components are necessary, such as small farmer organisation around the scheme and training in rehabilitation and management techniques (which consist of small farmer organisation, literacy training, natural resource management and environmental protection).

Earlier the Boya scheme was under flood recession agriculture. The rising of the River Niger, which flows near the village of Boya, inundated that part of the plain and the local people made use of this to grow rice. With the drought of recent years and the very low level of the rise in the river, the plains were no longer sufficiently inundated to guarantee a good rice harvest. This situation led the local people to develop the plain, seizing upon GUAMINA and another Canadian NGO for this work.

A preliminary study was conducted to discuss the development plan and how the work would be carried out. This was followed by the project document worked out on the basis of the preliminary study and with the full participation of the people concerned. The project outline is as follows:

1. GOAL AND OBJECTIVES

The project is aimed at increasing agricultural production by controlling and using efficiently the river waters in order to meet the needs of the people of Boya in relation to food self-sufficiency (development of a small-scale