Water Pollution in Relation to Agricultural Activity Impact in Egypt

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Abstract: The present study was carried out in two Governorates in Egypt, Dakahlia (North Delta) and Sohag (Upper Egypt) for developing a system of good agricultural practice in Egypt. The study included 400 farmers (200/each governorate) were chosen randomly from different villages to answer questions concerning field work survey. Collected data from field work survey were analysed for interpreting the facts and cause of water pollution in selected sites. It was clear that most of the farmers practice bad habits particularly with water resources and urgently need improvement to change their farming practices. Deduced results proved that there are two critical points in agricultural lands i.e. salinization and water pollution, both were caused due to poor irrigation and drainage management. According to obtained results, it has been proved that surface type of irrigation system covered more than 60% in Sohag, while in Dakahlia surface and flood systems were the dominant. The rate of irrigation was decided according to plant need in Dakahlia, while in Sohag was regularly every two weeks. About 98% of farmers are not aware to the importance of drains. A positive correlation was found between the depth of water table and each of source of irrigation and crop rotation and also between the source of irrigation and drainage discharge in Dakahlia and Sohag.

Key words: Irrigation, drainage, water table, salinization, pollution, agriculture practices, survey, Dakahlia, Sohag, Farmers

INTRODUCTION

Water problems are emerging as the most compelling sets of issues facing production agriculture in the 1990s. Egypt, hide acute water shortages in localities, resulting from rapid population increase or natural scarcity World Resources Institute[1]. For agriculture, water quality issues are more pervasive than water quantity problems. Farmers are a significant polluting source in some areas.

Agriculture impacts heavily upon water use and thus ultimately upon water quality. Agricultural production processes generate residuals which can be grouped into six major categories: soil sediments, nutrients, pesticides, mineral salts, heavy metals, and disease organisms. Georgescu-Roegen[2].

Nutrient levels in excess of crop uptake are potential sources of pollution of both ground and surface waters. Agricultural production practices to control nutrient losses include modifying the amount, timing, form and placement of fertilizers or livestock manures applied to agricultural lands. Also, numerous chemical compounds are used in agriculture to inhibit growth of various organisms that otherwise would reduce agricultural yields. These compounds, commonly referred to as pesticides, include herbicides, insecticides, nematicides and fungicides used to control weeds, insects nematodes and diseases respectively Wischmeier and Smith[3].

Application of waste water in irrigation purposes has been increased over the past years. The waste waters for irrigation proved to be toxic to plant, animals and humans Kanwer and Sandha[4]. Also it has been noticed in Egypt that industrial wastes considered to be the major polluting source in Egypt Abdel-Shafy and Aly[5].

The purpose of this study is to provide a framework for environmental and management in relation to agricultural activities, to achieve a good practical guide specifically with water resources. Also to evaluate alternative water quality protection policies.

MATERIALS AND METHODS

A fieldwork survey was carried out in Dakahlia (North Delta) and Sohag (Upper Egypt) Governorates to collect data of questionnaire which covered different fields soil, air and water pollution in addition to farming system, waste management, health and safety. Two hundred farmers were interviewed in each governorate, to ensure complete randomization, ten farmers/week were interviewed in different villages of Dakahlia Governorate and similarly in Sohag.

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A questionnaire was used for collecting information about farming system, drainage, irrigation, fertilizers, pesticides management, waste management, health and safety issues, Khalaf[6]. In the present study the drainage and irrigation section of questionnaire were concentrated on methods and scheduling of irrigation, water resources, agricultural impact and water pollution.

Statistical analysis (frequency distribution and correlation coefficient) was carried out for all chosen parameters concerning water pollution study, according to Snedecor and Cochran[7].

RESULTS AND DISCUSSIONS

Collected data from field work survey concerning water pollution covered variety of questions mainly drainage and irrigation management and some other agricultural practices.

It was clear that the type of irrigation method in Upper Egypt (Sohag) was surface one which used in more than 60% of the cultivated lands, and no definite clear relation between education and of irrigation methods. While, in Dakahlia (North Delta) main types of irrigation systems were surface and flood. However, the correlation between type of irrigation and literacy did not show any effect on the farmer’s choice for the irrigation method (Fig. 1). Similarly relating the type of irrigation method to tenure of farm (owing or renting lands) showed the same attitude as forementioned, except for rentals who care much more than owners about the irrigation methods their lands need (Fig. 2).

Regarding the irrigation frequency needed by farmers to cultivate their lands Fig. (3), literacy showed a positive effect on farmers’ attitude, as in Dakahlia it was noticed that irrigation scheduling was decided according to plant need while in Sohag it was regularly every two weeks without any consideration to the plant need, also the relation between the percentage of farmers, irrigation scheduling and tenure of farm Fig. (4), gave similar results as previously mentioned in Fig. (3).

The type of drainage system in Sohag depended mainly on the open one while in Dakahlia it depended on both the tile and open systems which were not related to education Fig. (5). While the farm tenure revealed that the land owners in Dakahlia cared about constructing a tile drainage system, while in Sohag the open one is the most available and common type of drainage used (Fig. 6).

It is also, worthy to mention that in Sohag, main drains were not available for drainage discharge, while in Dakahlia mainly discharging takes place in main drains. This is more related to literacy as about 98% of farmers in Dakahlia were aware to the importance of drains (Figures 7 & 8).

Farmers in both governorates (Dakahlia and Sohag) were so certain about absence of accumulated salts in their lands whether they are owners, rentals, educated or non educated as shown in (Figures 9 & 10), although some of the farmers about 14% especially the land owners and the well educated ones approve that there is an accumulation of salt in their lands.

The correlation coefficient between different parameters about agricultural practices in Dakahlia site and each other (Table 1). There was no significant correlation between literacy and other recorded parameters such as drainage, irrigation frequency, salt, accumulation… etc. It was also recorded that there was no significant correlation found between crop rotation and other parameters, however there was a positive correlation between the depth of water table and each of crop rotation and source of irrigation (Table 1). Highly positive correlation was also found between the source of irrigation and drainage system or discharge.

It is worthy to notice that a significant negative relationships were observed between drainage and literacy as well as between drainage and crop type. Similar, negative correlations were also recorded between depth of water table and each of literacy and type of crop, moreover a negative association was found between irrigation frequency and each of literacy, drainage discharge system, salt accumulation in farm lands and source of irrigation, although there was a positive correlation between land salt accumulation and each of depth of water table and drainage type.

In Sohag, to some extent, different agricultural practices were recognized by farmers, this was investigated when a correlation coefficient was carried out to correlate between different practices and each other (Table 2).

Highly positive correlations were recorded between drainage type and each of crop rotation and drainage discharge. Also, a positive correlation was found between crop rotation and farmers’ satisfaction with drainage system and also between the source of irrigation and each of drainage type and irrigation method (Table 2). Furthermore positive correlations were observed between drainage type and depth of water table, method of irrigation and each of drainage discharge, depth of water table and farmers’ satisfaction with their drainage system. Moreover, positive correlation was recorded between irrigation frequency and literacy (Table 2).

In contrast, negative correlations were found between depth of water-table and source of irrigation, crop rotation and depth of water table, the type of irrigation and each of literacy, drainage type and rate.
Table 1: Correlation coefficient between different agricultural activities and each other in North Delta (Dakahlia).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Education</th>
<th>Crop type</th>
<th>Rotation</th>
<th>Drainage type</th>
<th>Drainage Discharge</th>
<th>Drainage satisfaction</th>
<th>Depth of water table</th>
<th>Source of irrigation</th>
<th>Type of irrigation</th>
<th>Rate of irrigation</th>
<th>Salt of accumulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>1.00**</td>
<td>-0.06</td>
<td>-0.05</td>
<td>0.108</td>
<td>0.053</td>
<td>1.00**</td>
<td>0.016</td>
<td>1.00**</td>
<td>0.119</td>
<td>0.116</td>
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</tr>
<tr>
<td>Crop type</td>
<td></td>
<td>1.00**</td>
<td>0.016</td>
<td>1.00**</td>
<td>0.016</td>
<td>1.00**</td>
<td>0.011</td>
<td>1.00**</td>
<td>0.08</td>
<td>0.07</td>
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<tr>
<td>Rotation</td>
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<td></td>
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<td>0.016</td>
<td>0.050</td>
<td>1.00**</td>
<td>0.037</td>
<td>1.00**</td>
<td>0.08</td>
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<tr>
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<td>0.016</td>
<td>1.00**</td>
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<td>0.116</td>
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<td>0.093</td>
<td>-0.042</td>
<td>0.119</td>
<td>1.00**</td>
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<tr>
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<td>0.006</td>
<td>-0.972**</td>
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<td>-0.050</td>
<td>0.146*</td>
<td>0.019</td>
<td>-0.143*</td>
<td>0.001</td>
<td>0.037</td>
<td>0.031</td>
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<td>0.007</td>
<td>0.047</td>
<td>0.016</td>
<td>0.050</td>
<td>1.00**</td>
<td>0.08</td>
<td>0.07</td>
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<tr>
<td>Type of irrigation</td>
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<td>0.019</td>
<td>0.020</td>
<td>-0.653**</td>
<td>0.013</td>
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<td>1.00**</td>
<td>0.137</td>
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<tr>
<td>Rate of irrigation</td>
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<td>0.043</td>
<td>0.133</td>
<td>0.080</td>
<td>-0.041</td>
<td>-0.087</td>
<td>0.07</td>
<td>-0.036</td>
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<tr>
<td>Salt accumulation</td>
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<td>0.001</td>
<td>0.164*</td>
<td>0.160*</td>
<td>-0.047</td>
<td>0.179*</td>
<td>0.169*</td>
<td>0.124</td>
<td>0.013</td>
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</table>

P<0.05 significant, ** P<0.01 highly significant

Table 2: Correlation coefficient between different agricultural activities and each other in Upper Egypt (Sohag).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Education</th>
<th>Crop type</th>
<th>Rotation</th>
<th>Drainage type</th>
<th>Drainage Discharge</th>
<th>Drainage satisfaction</th>
<th>Depth of water table</th>
<th>Source of irrigation</th>
<th>Type of irrigation</th>
<th>Rate of irrigation</th>
<th>Salt of accumulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
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<td>0.062</td>
<td>0.047</td>
<td>1.00**</td>
<td>0.221**</td>
<td>0.491**</td>
<td>1.00**</td>
<td>0.050**</td>
<td>0.183</td>
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<td></td>
</tr>
<tr>
<td>Crop type</td>
<td>-0.042</td>
<td>1.00**</td>
<td>0.047</td>
<td>1.00**</td>
<td>0.221**</td>
<td>0.491**</td>
<td>1.00**</td>
<td>0.050**</td>
<td>0.183</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotation</td>
<td>-0.063</td>
<td>0.047</td>
<td>1.00**</td>
<td>0.047</td>
<td>1.00**</td>
<td>0.050**</td>
<td>1.00**</td>
<td>0.050**</td>
<td>0.183</td>
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<tr>
<td>Drainage type</td>
<td>-0.016</td>
<td>0.061</td>
<td>0.221**</td>
<td>1.00**</td>
<td>0.491**</td>
<td>1.00**</td>
<td>0.050**</td>
<td>1.00**</td>
<td>0.183</td>
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<tr>
<td>D. Discharge</td>
<td>-0.124</td>
<td>-0.087</td>
<td>-0.030</td>
<td>0.491**</td>
<td>1.00**</td>
<td>0.050**</td>
<td>1.00**</td>
<td>0.050**</td>
<td>0.183</td>
<td></td>
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</tr>
<tr>
<td>Drainage. S</td>
<td>-0.062</td>
<td>-0.062</td>
<td>0.223**</td>
<td>-0.093**</td>
<td>-0.500**</td>
<td>1.00**</td>
<td>-0.183**</td>
<td>1.00**</td>
<td>-0.160**</td>
<td></td>
<td></td>
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<tr>
<td>Depth of water table</td>
<td>0.090</td>
<td>-0.021</td>
<td>-0.012</td>
<td>0.177**</td>
<td>0.058</td>
<td>-0.183**</td>
<td>1.00**</td>
<td>0.050**</td>
<td>-0.160**</td>
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<tr>
<td>Source of irrigation</td>
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<td>-0.050</td>
<td>-0.026</td>
<td>0.236**</td>
<td>-0.129</td>
<td>0.239**</td>
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<td>Type of irrigation</td>
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<td>0.004</td>
<td>0.045</td>
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<td>0.753**</td>
<td>0.593**</td>
<td>-0.198**</td>
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<tr>
<td>Rate of irrigation</td>
<td>0.171*</td>
<td>0.068</td>
<td>0.021</td>
<td>0.083</td>
<td>0.110</td>
<td>-0.037</td>
<td>0.506</td>
<td>0.126</td>
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<tr>
<td>Salt accumulation</td>
<td>0.018</td>
<td>0.047</td>
<td>-0.165*</td>
<td>0.074</td>
<td>-0.193**</td>
<td>0.077</td>
<td>0.023</td>
<td>0.272**</td>
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</tr>
</tbody>
</table>

P<0.05 significant, ** P<0.01 highly significant

Fig. 1: The relation between the education of farmers and methods of irrigation.
Fig. 2: The relation between tenure of farm and the type of irrigation methods.

Fig. 3: The relation between the education of farmers and irrigation frequency.
P.R. = Plant requirement

Fig. 4: The relation between tenure of farm and irrigation frequency.

Fig. 5: The relation between the education of farmers and drainage system methods.
Fig. 6: The relation between tenure of farm and drainage methods.

Fig. 7: The relation between tenure of farm and the drainage discharge.
Fig. 8: The relation between literacy and drainage discharge.

Fig. 9: The relation between literacy and land salt accumulation in the farm.
Fig. 10: The relation between farm tenure and land salt accumulation.

irrigation frequency. Overall, negative correlation was recorded between land salt accumulation and crop rotation and drainage discharge (Table 2).

In Egypt, as a whole, the lower efficiency of the surface method (<50%) irrigation had led to the water logging and widespread salinization of about 80% of the total agricultural area. The situation had much improved due to more attention to drainage and better water management Barrow[8].

In Dakahlia and Sohag a significant amount of salinization resulted from mismanagement of soil-irrigation water and lower irrigation efficiency and/or bad irrigation supply. This had led to an excessive application of exceeding the drainage capacity. All of these factors could cause rising of land water-table. Hamdy et al., 1997[9].

In developing countries poor designed or managed irrigation is the major cause of salinization. According to obtained results about irrigation and environmental awareness are recommended. In conclusion, more educational efforts towards more environmental awareness are recommended. In conclusion, more educational efforts are needed to improve farmers’ agricultural environmental awareness, also governmental efforts are needed for managing of good irrigation and drainage systems and codes of good agricultural practices should be imposed to address water pollution problems in Egypt.
The conclusion was supported by Scheierling[17] who mentioned that mandatory codes of good agricultural practices should be imposed to address water pollution problems.

REFERENCES