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IMPACTS OF INTENSIVE AGRICULTURAL ACTIVITIES ON ENVIRONMENTAL POLLUTION RISK OF PHOSPHORUS COMPOUNDS IN SURFACE AND GROUND WATERS.

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ABSTRACT

Over the last twenty years, many intensive agricultural practices have been expanded in the sandy soils of northern coastal area of Nile Delta, Egypt, but with great environmental risks. In particular, substantial surface and groundwater phosphorus pollution has resulted from the coupling of different agricultural production systems demanding large inputs and leaving large organic wastes to be disposed of in physical setting areas that consists of coarse sandy soils and shallow groundwater. Water table piezometers were installed at selected locations include all traditional crop growing sites differently fertilized with mineral fertilizers, poultry manures, fish farming wastes and farmyard manure. Water samples for phosphorus examining were collected from water table piezometers and main surface drains over one year period (4 times) in areas with different and intensive agricultural activities.

From the results of this study, it could be concluded that, based on phosphorus concentrations reported in surface and ground water, organic wastes of fish farming activity represents the highest P pollution potential to sandy soils. In contrast, the lowest risk under the conditions of the studied area was the application of organic and inorganic fertilizers in different combinations under drip irrigation systems. Surface and furrow irrigation systems are likely to show similar P leaching risk when applied to sandy soils. The results of this study indicated that there is a significant relationship between the intensive agricultural activities and water courses contamination.

In general, none of the water samples collected from all piezometers installed closer to or even inside each agricultural activity as well as from main drains had an average phosphorus concentration over 2 mg/l. Concentrations of phosphorus in most groundwater samples were below the recommended level of drinking water for human (1 mg/l). From the results of this study, it appears that P leaching from such sandy soil if managed properly is not sensitive to land management practices and reflecting the low risk of environmental contamination in the studied area.

Keywords: Groundwater, piezometers, Environmental risk, phosphorus forms, the Nile Delta.

INTRODUCTION

Application of excess phosphorus to the soil is considered a problem in countries with inland waterways sensitive to eutrophication and/or where large quantities of animal manures and fertilizers are applied to the land and controls on phosphorus inputs from all sources to land are still in operation. In Egypt, nutrient inputs to private farmland are not completely based on crop requirements but manure and fertilizer phosphorus can always be applied if there is sufficient animal manure produced on the farm. In the UK, national phosphorus balance sheet calculations indicate that about 30% of the phosphorus used in agriculture accumulates in the soil each year (Withers and Sharpley, 1994). An accumulation of phosphorus in the soil occurs where phosphorus inputs are in excess of crops requirements and this accumulation could be particularly rapid where animal manures are applied continually because manures N: P ratios are smaller than in crops at harvest (typically 6:1) (Sharpley, *et al*., 1982). On the other hand, leaching of dissolved phosphorus under normal conditions to groundwater is not recognized as a problem in the majority of soils because of the large phosphorus adsorption capacity of the subsoil (Sharpley, *et al.*, 1982). However, little research has been undertaken to establish the risk from leaching when applying different forms and quantities of organic and inorganic fertilizer products. This is important as dissolved phosphorus is considered to be totally available for algal growth and much phosphorus in the manure products can be found in the dissolved form.

In surface waters, phosphorus concentrations exceeding 0.05 mg L^{-1} may cause eutrophic conditions (Hinesly & Jones, 1990). Eutrophication of drainage ditches by overfertilization with nitrogen and phosphorus causes a shift mainly from submerged aquatic vegetation to a dominance of floating duckweeds. This results in anoxic conditions, loss of biodiversity, and hampering of the agricultural functions of such ditches (Janse & Puijenbroek, 1998). The change in eutrophic conditions is reflected in the occurrence, pattern of distribution, and diversity of the biotic community (Tiwari, 1998). If excessive amounts of phosphorus and nitrogen are added to the water, algae and aquatic plants can grow in large quantities. When these algae die, they are decomposed by bacteria. The decomposers use up the dissolved oxygen of the water body. The dissolved oxygen concentrations often drop too low for fish to breathe, leading to fish kills (Murphy, 2002).

Groundwater is a vital resource and is used for many purposes, including public and domestic water supply systems, irrigation and livestock watering, and for industrial, commercial, mining and thermo-electric power production. Groundwater serves as the only reliable source of drinking and irrigation water in many localities. This vital resource is vulnerable to contamination, and is being increasingly threatened by an array of pollutants from different agricultural activities (El Tahlawi, *et al*., 2008). Groundwater development in Egypt is not only confined to the Nile Valley and the Delta, but also extends to the desert areas where a large amount of non-renewable groundwater is stored. Measurement of the phosphorus potential availability to agricultural land and crops of different types of organic and inorganic P fertilizers produced in Egypt should be standardized. In addition, little information on phosphorus loss through leaching on different types of organic and inorganic P fertilizers amended land is available. In general, animal manure sources always contain more N than P consequently, nutrient management plans always base application rates on trying to balance fertilizer N with that removed by a crop. This management protocol will contribute to over application of P because plants have a much lower P those N nutritional requirements. Thus, research needed to be done to evaluate the transportation of P into surface and groundwater bodies in the area under investigation and with changes in manure and fertilizer products and application methods and rates it is therefore important to quantify the surface and groundwater potential risk from phosphorus leaching after application to agricultural land.

MATERIALS AND METHODS

Study site description:

This study was conducted in the 15th of May Agricultural Association near Gamasa resort, El-Dakhahlia Governorate, located in the northern coastal part of Nile Delta, Egypt. This area represents one of the cultivated reclaimed sandy soils in northern Nile Delta, Egypt. Layout of the research and distribution of piezometers in the studied area are shown in Figure (1).

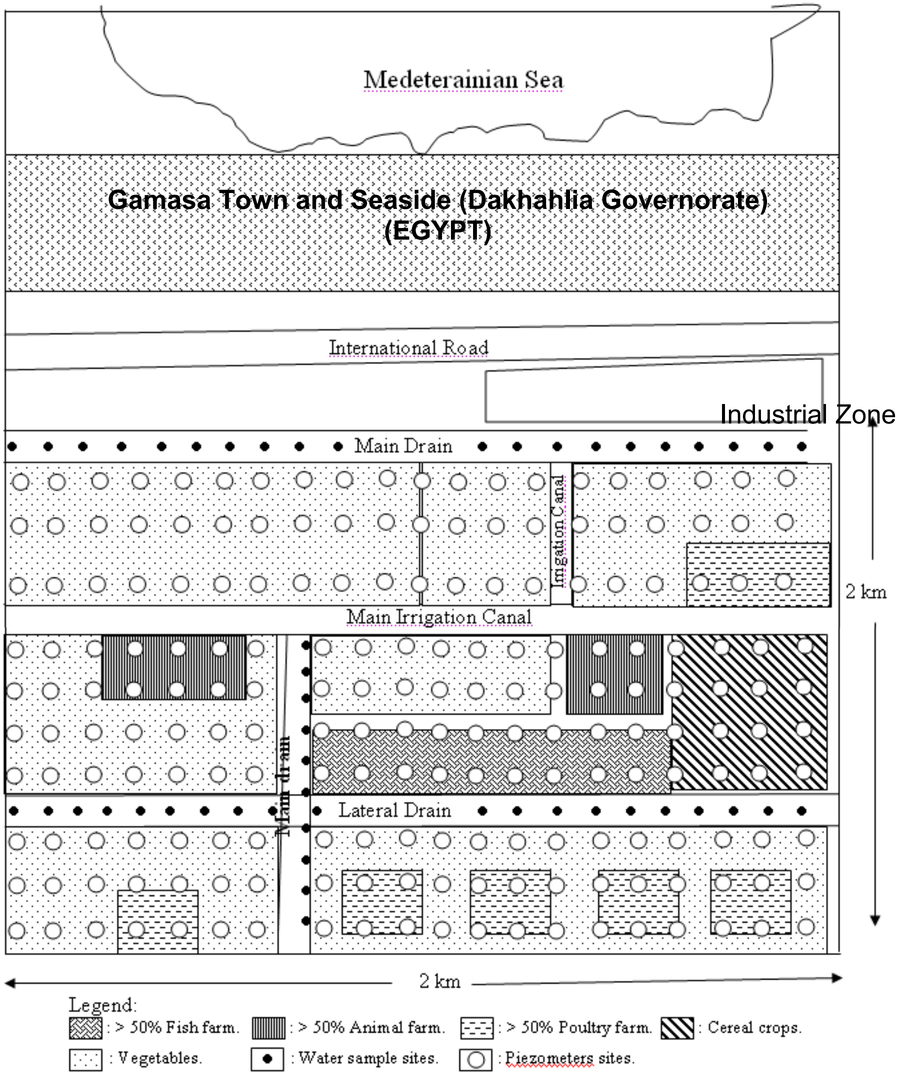

Fig. (1): Layout of the research area location and piezometers sites.

The agricultural land use is predominantly cropping, with a major portion devoted to cereal, alfalfa and vegetable production, poultry, fish and animal farming. The studied site comprises an area of about 4 km2 (approximately 1000 feddans) that its soils are coarse textured, averaging 90% sand, extremely well-drained and containing 1 to 2% organic matter in the uppermost layer. The topography of the site is level with slopes of less than 3 % (Idris, 2004; Khater, 2002).

The annual precipitation has an average of 200 mm, with rare probability of more than 250 or less than 160 mm. Approximately 100% of the annual precipitation falls in winter between November through February. The soil water table depth normally ranges from 1.5 to 2.5 m. Most of the soils are extremely sand that allows an annual ground-water recharge of approximately 40 cm (Hefny and Shata, 2004). This site was chosen after several studies have been reviewed and personal communications made with the authorities and local farmers to carry out this work and to provide an overview of the surface and groundwater quality problems in the Nile Delta, Egypt (Khater, 2002; Idris, 2004; El-Tahlawi, 2006). The studied fields were managed by their individual land owners who applied different irrigation regimes (surface, furrow and drip irrigation) and fertilization management practices. The irrigated crop rotation in the area consists of rice or corn followed by alfalfa or wheat.

The irrigated vegetable rotation in the area consists of tomatoes or potatoes twice a year depending on the market price expectations. Field operations frequently begin as early as March or October depending on the agricultural season, with broadcasting animal manures (poultry, fish farming wastes and cattle manures). Samples of the fresh manures were used to determine N, P and K using standard methods (Page, *et al*., 1982). As shown in Table 1. N, P and K vary greatly among manure sources.

Table (1). Averages of N, P and K in used animal manures (kg/ton).

Animal type	N	P	K
Cattle	13.8	1.9	3.9*
Poultry	16.6	3.6	5.4
Fish	15.5	6.3	4.4

*** Values are for fresh manures without storage, drying and handling losses.**

Mineral fertilizers are applied after planting and two to three additional times, during the growth season, by hand and with irrigation water in the case of drip irrigation. Depending on weather and type of crop, irrigation water is applied about 20 to 30 times per year. In general, plant nutrients for crops are applied as mineral fertilizers, poultry, fish farming and farmyard manures or mixtures of mineral and one of aforementioned organic fertilizers. Nitrogen application levels range from 200 to 250 kg ha^{-1} for cereal crops and 350 to 450 kg ha^{-1} for vegetables. The major used mineral nitrogen fertilizers are of ammonium nitrate (33.5% N) and urea (46% N). Phosphorus application levels range from 30 to 40 kg ha^{-1} for cereal crops and 50 to 65 kg ha^{-1} for vegetables. Phosphorus in the form of calcium super-phosphate (15.0%

P_2O_5) were always broadcasted in one dosage after soil tillage and before planting to the soil or in two equal doses, the first one after tillage and the second after thinning and before the sub sequent irrigation. Organic fertilizers application levels range from 5 to 10 ton ha^{-1} for cereal crops and 10 to 20 ton ha^{-1} for tomatoes and potatoes production. Higher levels of organic and inorganic nitrogen fertilizers were applied to vegetables under drip irrigation systems.

Experimental instrumentation, sampling and phosphorus analysis:

From September 2005 to October 2006, an intensive ground-water monitoring study was conducted to evaluate phosphorus leaching rate. Land uses in the sampling were intensive animal, fish and poultry production, cereal crops, alfalfa, tomatoes and potatoes. The studied area has at least 20 poultry houses, 20 cattle farms and 10 fish farms (at least 10 feddan each). For an area to be classified as cereal, alfalfa or vegetables grown, over 50% of the area was in this cropping system. The field area sampled, number of samples, the major added fertilizers and irrigation regime and the main agricultural activities are presented in Table 2.

Table (2): Major fertilizing regimes and main agricultural activities in the sampling areas.

Field area and samples No.	Piezometers number	Major added fertilizer	Major irrigation regime	Major agricultural activity
250 fedd. (200)*	1 – 50	Poultry and mineral	Drip irrigation	Poultry and vegetables
250 fedd. (200)	51 – 100	Fish wastes and mineral	Surface irrigation	Fish farming, field crops
250 fedd. (200)	101 – 150	Poultry, animal, mineral	Furrow irrigation	Poultry, Animal, vegetables
250 fedd. (200)	151 - 200	Animal wastes, mineral	Surface irrigation	Animal farming, field crops
Main drains (200)				

*** Samples number.**

Areas selected for sampling that had document evidence of high eutrophication in the surface water and then, piezometers were distributed almost equally inside and nearby each selected area of certain agricultural activity. The purpose of selecting these areas of certain agricultural activity was to determine the major cause of phosphorus contamination. The impact of different agricultural activities on water quality was assessed with piezometers (PVC pipe of 10 cm diameter), which permits water sampling from as many as 200 wells throughout the water table of the studied area. The study area was instrumented in September 2005 with a total of 200 piezometers to the depth of water table (1.5 to 2.5 m) in each field of sampling areas. Within each agricultural activity field, the piezometers were separated by 100 x 200 m and aligned as far as we could handle along the studied site (1000 feddan).

Groundwater was sampled 4 times a year (22nd of December 2005 after 22nd of March 2006 22nd of June 2006 and 22nd of September) at four month intervals. At the same time, additional 50 samples of surface drainage water were collected 4 times from the main drains distributed equally throughout the studied area. Water samples were collected in polythene bottles, kept on ice until they were frozen in the laboratory, then analyzed for total phosphorus, plant available phosphorus and dissolved phosphorus by automated colorimetery by the procedure of Murphy and Riley (1962) and APHA, (1995, 2005). Linear regression analyses were completed for significant effects of each agricultural activity on the concentrations of phosphorus in the surface and ground water samples.

RESULTS AND DISCUSSION

Phosphorus accumulation should be avoided in water resources because of phosphates drained into surface water bodies can cause deterioration of surface water quality, resulting in eutrophication, algal bloom, and fish poisoning. Overall the concentrations of total P, available P and dissolved P were all above the analytical limit of detection, currently 50 μg 1^{-1}. The results for total P showed that almost 85% of the groundwater samples never exceeded the permissible limits of drinking water (1 mg/L) (WHO 1993, 1996; Cotruvo, 1999), while only 15% of these samples were over the permissible limits.

Phosphorus concentrations in all ground water samples collected from piezometers show that the average total phosphorus concentrations were consistently low regardless of the agricultural activity implemented or water table depth. On the other hand, all drainage water samples showed high values of total P and exhibited higher concentrations. Of the samples, more than 76% were over permissible limits according to the World Health Organization (WHO 1993, 1996; Cotruvo, 1999).

In general, phosphorus concentrations in all surface water samples collected from main drains show that the average phosphorus concentrations were slightly over permissible limits regardless of the agricultural practice. This gives a clear indication of the impact of intensive agricultural practices executed in such areas on non-point source impacted water bodies quality. Table 3 shows the average and range of phosphorus concentrations and the associated major agricultural activity of the land use in the sampling areas and main drains.

Phosphorus is transported from agricultural land in surface run-off, erosion and soil through flow in both dissolved and particulate form. Losses of dissolved phosphorus occur as a result of the desorption and dissolution of phosphorus from a thin layer (1-5 cm) of the-surface soil (Sharpley, 1985). This then interacts with the extraction of phosphorus from growing crops and crop residues left on the soil surface (Schreiber, 1988). The amount of dissolved phosphorus loss in surface run-off and soil through leaching flow depends on the physical and chemical interaction between the incoming rain or irrigation water and the soil surface.

Table (3): Phosphorus concentrations in water samples of the studied area.

Agricultural activities	**No. of samples**	**Mean concentration (mg/l^{-1})**	**Number of samples**			
			Total Phosphorus (mg/l)			
			0.2-0.5	**0.5 – 0.8**	**0.8 – 1.1**	**>1.1**
Artificial fertilizers, Drip irrigation, poultry farming and Vegetables **ADPV)**	200	0.712	97 (48.5)	62 (31.0)	11 (5.5) *	30 (15)
Fish wastes and fertilizers, Surface irrigation, Fish farming, field crops **(FSFF)**	200	0.869	55 (27.5)	50 (25.0)	40 (20..0)	55 (27.5)
Poultry, animal wastes and fertilizers, Furrow irrigation, Poultry, animal and Vegetables **(PFPV)**	200	0.519	140 (70.0)	40 (20.0)	20 (10.0)	0.0 (0.0)
Animal wastes, artificial fertilizers, Surface irrigation, animal farming and field crops **(AASF)**	200	0.766	57 (28.5)	64 (32.0)	44 (22.0)	35 (17.5)
Main drains water samples **(MDWS)**	200	1.55	0 (0.0)	40 (20.0)	40 (20.0)	120 (60.0)
Dissolved Phosphorus (mg/l)						
Artificial fertilizers, Drip irrigation, poultry farming and Vegetables **(ADPV)**	200	0.425	150 (75.0)	37 (18.5)	13 (6.5)	0.0 (0.0)
Fish wastes and fertilizers, Surface irrigation, Fish farming, field crops **(FSFF)**	200	0.578	126 (63.0)	60 (30.0)	14 (7.0)	0.0 (0.0)
Poultry, animal wastes and fertilizers, Furrow irrigation, Poultry, animal and Vegetables **(PFPV)**	200	0.314	160 (80.0)	30 (15.0)	10 (5.0)	0.0 (0.0)
Animal wastes, artificial fertilizers, Surface irrigation, animal farming and field crops **(AASF)**	200	0.413	100 (50.0)	74 (37.0)	26 (13.0)	0.0 (0.0)
Main drains water samples **(MDWS)**	200	0.81	40 (20.0)	100 (50.0)	50 (25.0)	10 (5.0)
Available Phosphorus (mg/l)						
Artificial fertilizers, Drip irrigation, poultry farming and Vegetables**(ADPV)**	200	0.315	152 (76.0)	40 (20.0)	8 (4.0)	0.0 (0.0)
Fish wastes and fertilizers, Surface irrigation, Fish farming, field crops **(FSFF)**	200	0.412	150 (75.0)	40 (20.0)	10 (5.0)	0.0 (0.0)
Poultry, animal wastes and fertilizers, Furrow irrigation, Poultry, animal and Vegetables **(PFPV)**	200	0.213	170 (85.0)	25 (12.5)	5 (2.5)	0.0 (0.0)
Animal wastes, artificial fertilizers, Surface irrigation, animal farming and field crops **(AASF)**	200	0.313	162 (81.0)	24 (12.0)	14 (7.0)	0.0 (0.0)
Main drains water samples **(MDWS)**	200	0.74	20 (10.0)	40 (20.0)	90 (45.0)	50 (25.0)

*** Numbers between brackets represent percent of the samples under each phosphorus concentration category.**

Generally the P concentration in water percolating through the soil profile by leaching is small due to sorption of P by P-deficient sub-soils.

Exceptions occur in organic soils, where the adsorption affinity and capacity for P sorption are low due to the predominance of negatively charged surfaces (White and Thomas, 1981). Other soils that are susceptible to movement include sandy soils with low P sorption capacities, waterlogged soils where Fe(III) has been reduced to Fe(II), and well structured soils prone to preferential flow through macrospores and earthworm burrows (Sims and Sharpley, 1998; Sharpley, *et al*., 2001).

Losses of particulate phosphorus are caused by the detachment and transport of fine soil particles and associated organic matter in overland flow during storm or heavy rain events. Since it is only the silt and clay sized fractions, which are usually transported from the site of application during erosion events, particulate phosphorus loss is greater than can be estimated from the phosphorus content of the soil in situ. For example, Sharpley (1985) found that the plant-P content of eroded sediment was, on average, 3 times greater than in the original soil. Much smaller losses of particulate phosphorus may also occur in soil through flow and drains. The majority of phosphorus loss from arable land occurs as particulate flow in surface flow, but its bioavailability for algal growth on entering the water can be very variable, ranging from 10-90% (Sharpley, *et al*., 2001).

Agricultural activity impact:

Results of total phosphorus concentration confirm that significant changes in water quality brought about by different agricultural activities can be detected in surface and ground water and that the impact depth is correlated with certain agricultural activity. In general, none of the water samples collected from all piezometers installed closer to or even inside each agricultural activity as well as from main drains had an average phosphorus concentration over 2 mg/l. The results revealed that phosphorus concentrations in all ground water samples collected from piezometers show that the average concentration was consistently low and the phosphorus concentration in the deeper water table piezometers was slightly lower. The regression analyses for phosphorus concentrations in the water samples as affected by different agricultural management practices were significant ($P < 0.05$) but provided slightly low coefficient of determination (R^2) values (Table 4).

Results of this study revealed that in the areas of fish production farms and fertilized with fish wastes complemented with inorganic fertilizers and surface irrigated had high phosphorus concentrations compared to areas fertilized with mixtures of inorganic fertilizers and animal or poultry manures. These areas had an average phosphorus concentration of 0.869 mg/l for total piezometers, while the other areas had an average phosphorus concentration of 0.712, 0.419 and 0.766 mg/l for poultry, animal and both mixed manures for crop production areas, respectively. This might explain the impact depth correlated with high total phosphorus concentration and the fish farming agricultural activity.

Table (4): Relationships of phosphorus concentrations (PC) and different agricultural managements practices.

Agricultural management practices	Dependent variable	Regression equation	R^2
Irrigation Regimes (IR)	PC for piezometers	PC = 41.5 + 2.55 (IR)	0. 85*
	PC for main drains	PC = 37.0 + 1.13 (IR)	0.76*
Year Seasons (YS)	PC for piezometers	PC = 37.5 + 1.11 (YS)	0.69*
	PC for main drains	PC = 51.0 + 1.14 (YS)	0. 79*
fertilization Management (FM)	PC for piezometers	PC = 71.0 + 0.14 (FM)	0. 73*
	PC for main drains	PC = 48.5+ 0.55 (FM)	0.85*
Agricultural Practice (AP)	PC for piezometers	PC = 45.35 + 1.9 (AP)	0.75*
	PC for main drains	PC = 42.5 + 2.1 (AP)	0.65*

*** Significant at 5% probability level.**

Three explicit reasons might explain why fish farming and surface irrigated areas have the highest phosphorus concentrations compared to different agricultural activity areas. Firstly, it appears that phosphorus is moving through fish basins and soil profile to the shallow water-table and adjacent drains. Secondly, the dredges liner of the fish basins taken out at the end of the fishing season and used as organic fertilizers always contains a lot of died fish acting as a source of phosphorus. Thirdly, during cold or hot periods basin waters nearly changed everyday so that seepage may occur in the presence of high amounts of fish foods like poultry manures and factory wastes such as macaroni, biscuits carrying phosphorus compounds into water bodies.

Many samples collected from main drains had phosphorus concentrations above 1.5 mg liter^{-1}. Most of these samples were taken after the winter from drains located in the direction of the drain water flow next to field crops and fish farms where fish wastes and inorganic P fertilization under surface irrigation system were implemented. Approximately, 70% of the water samples collected from drains had an average phosphorus concentration more than 1.5 mg/l (Table 3). For all main drain surface water samples, the phosphorus concentration nearly exceeded in most cases 0.6 mg/l and this may cause eutrophication. Phosphorus concentrations exceeding 0.05 mg L^{-1} may cause eutrophic conditions (Hinesly & Jones, 1990). Eutrophication of drainage waters by overfertilization with nitrogen and phosphorus causes a shift mainly from submerged aquatic vegetation to a dominance of floating duckweeds.

Irrigation regimes impact:

In general, under different irrigation regimes, the total, dissolved and available phosphorus concentrations in groundwater samples were in most cases under the drinking water standard of 1 mg/l according to the World Health Organization (WHO 1993, 1996). In contrast, phosphorus concentrations in surface drainage water samples under different irrigation regimes were above 1 mg/l causing eutrophication in most cases of drain waters. Table 5 shows that phosphorus concentrations in water samples collected from surface or groundwater were higher for the surface or furrow irrigated areas compared to the drip irrigated areas. The results revealed that twenty five piezometers located within the drip irrigated area, which is completely vegetables, had an average phosphorus concentration of 0.534 mg/l. The average phosphorus concentrations in water samples collected from vegetable areas surface or furrow irrigated were 0.856 and 0.665 mg/l, respectively.

Table (5): Total phosphorus concentrations in water samples in areas under different irrigation regimes.

Irrigation regime	Number of samples	Concentration (mg/l)			
		Mean	Standard deviation	Range	
				Low	High
Surface irrigation	25	0.856	0.015	0.621	0.924
Furrow irrigation	25	0.665	0.022	0.567	0.701
Drip irrigation	25	0.534	0.131	0.511	0.583

The area under investigation was subject to different moisture conditions because of the influence of different irrigation regimes upon changes in soil moisture contents over passing time (A pilot study was conducted for differences in moisture). Consequently, micro-organisms responsible for mineralization are subjected to different moisture conditions. Therefore, the amount of total phosphorus subjected to leach from the applied fertilizers was expected to differ as a result of different irrigation regimes. Large concentrations of dissolved phosphorus may arise when rain falls or irrigation water applied soon after phosphorus application or where the flow of phosphorus is accelerated in sandy and fissured soils'. The magnitude of the phosphorus loss for any soil position, land use and rainfall pattern is most dependent of the amount of residual phosphorus which has accumulated in the soil. Lysimeter and field experiments indicate that the amounts of phosphorus lost by leaching from agricultural land receiving manures are small and usually < 1 % of the phosphorus applied (Mostaghimi *et al*. 2006).

Year seasons impact:

The area under investigation has an average of 200 mm/year of annual precipitations over winter. At this time under these conditions, the high rainfall rate and additional irrigation for these sandy soils, excess water could drain from the soil profile or cause water run-off only in November, December, January, and February. For phosphorus leaching to occur, more water must infiltrate through the soil than it lost from the soil by evapotranspiration. Another crucial factor controlling phosphorus leaching is rainfall timing with respect to the dissolved P content present in soils when drainage occurs (Sharpley, *et al*., 2001).Amount and intensity of rainfall, slope, soil type, soil phosphorus content, soil tilth, vegetative cover and the rate, method and timing of phosphorus applications in manures all have an influence on the losses of total, particulate and dissolved phosphorus from agricultural land. Most phosphorus loss occurs as particulate phosphorus from cultivated land during intense storm events of short duration (Sharpley, *et al*., 2001). Although comparatively small and dominated by dissolved phosphorus, loss of phosphorus from cultivated land areas may also be sufficient for symptoms of eutrophication to occur.

Over winter, total P concentrations were the highest in the drainage water samples, indicating that rainfall plus irrigation water or water run-off had flushed most of the mobile P from the root zone into drains. Peak total P concentrations were pronounced in winter beneath surface irrigation fields and in the water samples from adjacent main drains. Over spring, total P concentrations were the lowest in the ground and drainage water samples, indicating that the active plant absorb most of the available P from the root zone. Intermediate values were recorded for autumn and summer seasons (Figure 2).

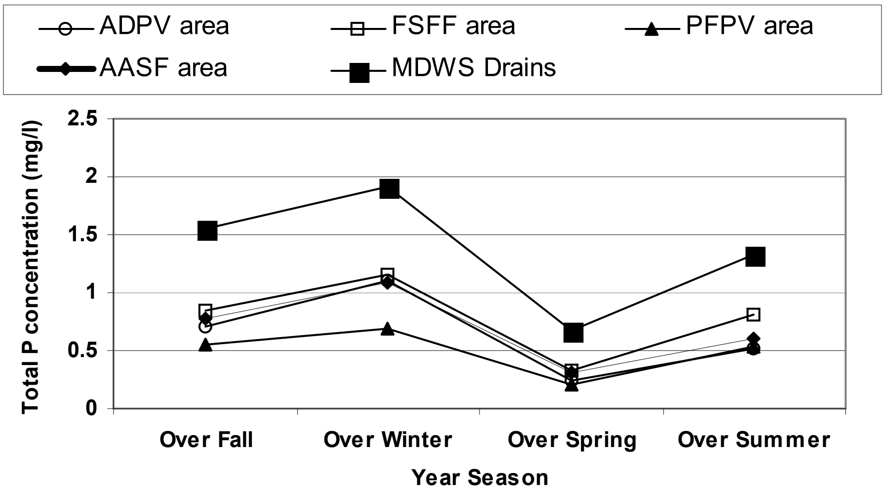

Figure (2): Seasonal means of surface and ground water phosphorus concentrations as affected by different agricultural activities.

The actual impact of agricultural phosphorus loss on water quality is dependent on bioavailability of the phosphorus transported, the time of year, the natural background phosphorus status of the receiving water, the amount and form of phosphorus from other sources and the complex cycling of phosphorus within both the river and the final receiving water. Numerous studies have indicated that losses of phosphorus after fertilizer and organic manure applications represent only a small proportion < 5 %) of the annual amount of phosphorus applied (Sharpley, *et al*., 2001).

Conclusion and Recommendations

Intensive, long-term application levels of manures and inorganic fertilizers to soils in these regions have contributed to frequent assurance that the quantity of nutrients relative to the assimilative capacity of the cropping systems have grown out of balance. The unutilized P may accumulate in the soil profile and become a contaminant causing eutrophication in streams. The results revealed that phosphorus concentrations in all surface and ground water samples collected from piezometers or main drains show that the average phosphorus concentrations were consistently low regardless of the agricultural activity implemented. Fish farming may represent the highest P leaching potential in sandy soils and peak P concentrations were pronounced in winter beneath surface irrigation fields and in the water samples from adjacent main drains.

Under the conditions of the studied area, if fish farms and surface irrigated fields are not operated properly they will have a serious impact on surface and ground-water pollution with phosphorus compounds in sandy soils. From the results of this study, it could be concluded that phosphorus concentrations in all groundwater sample fractions were well under the recommended level of 1 mg/l in drinking water for human. In contrast, phosphorus concentrations in surfacewater samples under different agricultural activities were above 1 mg/l causing eutrophication in most cases of drainage waters. Eutrophication of surface and drainage waters by overfertilization with nitrogen and phosphorus causes a shift mainly from submerged aquatic vegetation to a dominance of floating duckweeds. There is, thus, a need for environmentally sound information on the processes controlling the build-up of P in soil, its transport in water bodies in different phosphorus forms, and their biological availability in freshwater systems.

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REFERENCES

APHA, American Public Health Association (1995). Standard Methods for The Examination Of Water And Wastewater. 17th ed. American Public Health Association

APHA (2005). Standard Methods For The Examination Of Water and Wastewater. 21st edition. American Public Health Association.

Cotruvo, J.A. (1999). Guidelines for Drinking Water Quality: Assessment Methodologies. Unpublished report to World Health Organization on a comparative analysis of risk assessment methodologies used for development of drinking water standards and guidelines. WHO, Geneva, Switzerland.

El-Tahlawi, M.R. (2006). Mining geology. Assiut University Press, Assiut, p 246.

El Tahlawi ,M. R; Farrag ,A. A. and Ahmed, S. S. (2008). Groundwater of Egypt: An Environmental Overview. Environ Geol (2008) 55:639-652.

Hefny,K. and Shata, A. (2004). Underground Water in Egypt. Ministry of water supplies and irrigation, Cairo, Egypt, p 295 (in Arabic).

Hinesly, R. L. and Jones,T.D. (1990). Phosphorus in waters from sewage sludge amended lysimeters. Environmental Pollution, 65:293 309.

Idris, H. (2004). Groundwater provinces in Egypt. Annual meeting, Egypt, Commission on mineral and thermal waters, handouts, 25 September-4 October, Cairo, pp. 11-23.

Janse, J. It. and Puijenbroek.P. J. (1998). Effects of eutrophication in drainage ditches. Environmental Pollution, 102: 547-552.

Khater,A.R (2002).Evaluation of the current practice of groundwater monitoring and protection in Egypt. Submitted to the Arab Center for the Study of Arid Zones and Dry Lands (ACSAD). ACSAD-BGR Technical Cooperation Project, Vol. 5, Annex C-2.

Mostaghimi ,S., Mishr .A. and Benham, A. B.L. (2006).Sediment and nutrient losses from field-scale cropland plots treated with animal manure and inorganic fertilizer. Water, Air. and Soil Pollution, 175,P 61-76.

Murphy, J.,& Riley, J. (1962). A Modified Single Solution Method for the Determination of Phosphate in Natural Waters. Analytica. Chimica. Acta., *27*, 31–36

Murphy, S. (2002).General Information on Phosphorus. City of Boulder / USGS Water Quality Monitoring.
<http://bcn.boulder.co.us/basin/data/ NUTRIENTS/info/TEhtml>.

Page, A.; Miller, R.H. and Keeny, R. (1982). Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties, Agron. Monogr. 9 ASA and SSSA, Madison, WI.

Schreiber, J.D. (1988). Estimating Soluble Phosphorus (PO4-P) in agricultural runoff. J. Miss. Acad. Sci., 33:1-15

Sharpley, A.N.; Reed,L.W and Simmons,D.K. (1982). Relationships Between Available Soil Phosphorus forms and their Role in Water Quality Modeling. Okla. Agric. Expt. Sta. Tech. Bull. T-157. Oklahoma State Univ., Stillwater, OK. 40 pp

Sharpley, A.N. (1985). The Selective Erosion of Plant Nutrients in Runoff. Soil Sci. Soc. Am. J., 49:1527-1534

Sharpley, A.N.; McDowell, R. W. and Kleinman, P. J. A.(2001). Phosphorus loss from land to water: integrating agricultural and environmental management, Plant and Soil, 237: 287–307.

Sims,J.T. and Sharpley, A.N. (1998). Managing agricultural phosphorus for water quality protection: future challenges. In Soil Testing for Phosphorus: Environmental Uses and Implications. Ed. J. TSims. pp. 41–43. Southern Cooperative Series Bulletin No. 389,SERA-IEG 17, University of Delaware, Newark, DE.

Tiwari, A. (1998). Rotifers as Indicators for Assessment of Water Quality. Proc. Acad. Environ. Biol., 7:161-166.

White, R.E. and Thomas, G.W. (1981). Hydrolysis of Aluminum on Weakly Acidic Organic Exchangers: Implications for Phosphorus Adsorption. Fertil. Res., 2: 159–167.

Withers, J.A. and Sharpley, A.N. (1994). The Environmentally-sound Management of Agricultural Phosphorus, USDA-ARS, National Agricultural Water Quality Lab., P.O. Box 1430, Durant, OK 74702-1430 and ADAS Bridgets Research Centre, Martyr Worthy, Winchester, Hampshire S021 IAP, United Kingdom.

World Health Organization (WHO). (1993). WHO Guidelines for Drinking Water Quality, Vol.1.WHO, Geneva, Switzerland.

World Health Organization (WHO). (1996). WHO Guidelines for Drinking Water Quality, Vol. 2.WHO, Geneva, Switzerland.

تأثير الأنشطة الزراعية المكثفة علي خطر تلوث المياه السطحية والجوفية بالفوسفور

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خلال العشرين سنة الماضية كثير من الأنشطة الزراعية توسعت في الاراضى الرملية للمنطقة الساحلية بدلتا مصر وكانت متزامنة مع حدوث مخاطر بيئية. خصوصا تلوث المياه السطحية والجوفية بالفسفور التي نتجت عن الجمع بين الكثير من أنظمة الإنتاج الزراعية والتي تتطلب مدخلات كبيرة وتترك مخلفات عضوية يجب التخلص منها في مناطق رملية بطبيعتها وخشنة في قوامها وكذلك تتميز بارتفاع الماء الارضى.

فقد جمعت عينات من المياه لاختبار الفسفور فيها من بيزومترات وكذلك من المصارف الرئيسية في خلال عام من مساحة بها أنشطة زراعية مختلفة ومكثفة. فقد دقت البيزومترات في مواقع الأنشطة الزراعية المختلفة التي تشمل مناطق لكل المحاصيل التقليدية المسمدة بأسمدة معدنية وبمخلفات الدواجن ومخلفات المزارع السمكية وسماد المزرعة .

من نتائج هذه الدراسة يمكن استخلاص أن استعمال المخلفات العضوية للزراعة السمكية تمثل أعلى نسبة فسفور ممكن أن تغسل إلى داخل الاراضى الرملية. والخطر الأقل من هذه الناحية كان بإضافة الأسمدة العضوية والغير عضوية في وجود الري بالتنقيط. الري السطحي والري في خطوط أعطوا نتائج متشابهة من ناحية الخطر الناتج عن غسيل الفوسفور.

نتائج هذه الدراسة أكدت انه توجد علاقة معنوية بين الأنشطة الزراعية المكثفة وتلوث المجارى المائية.

عامة تركيز الفسفور الكلى في عينات الماء الارضى وكذلك ماء الصرف لم يزيد بأى حال من الأحوال عن ٢مجم/لتر. تركيز الفسفور في اغلب عينات الماء الارضى كانت اقل من المستوى الموصى به في مياه الشرب للإنسان (١مجم/لتر)

يتضح من نتائج هذه الدراسة أن غسيل الفسفور في مثل هذه الاراضى الرملية لن يحدث إذا أديرت العمليات الزراعية بشكل جيد وهذا يعكس قلة الخطر البيئي في المنطقة تحت الدراسة.

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