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Impact of Fish Farm Management on Physico-chemical Properties of Water and Sediments in earthen ponds

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Abstract

The study was conducted in two fish farms located at El-Rayed area, Kafer El-Sheikh governorate, Egypt, to assess the impact of management on water and sediments characteristics. The two farms had different feeding regimes; the first farm uses pelleted feed, while the second one receives organic fertilization, was replicated in four ponds (8400m^2 each). Water samples were collected monthly and sediment at the beginning and the end of experimental period to determine both water and sediment quality. The results revealed that there were no differences in water in temperature, electrical conductivity and total hardness between the two farms. While, noted significant differences were observed in water pH, dissolved oxygen (DO), secchi disk, total alkalinity, orthophosphate, nitrogen component (ammonia, nitrate and nitrite) and chlorophyll "a". Concerning physical parameters of sediment, an increase in organic matter content in surface layer was observed compared the subsurface layer especially in fertilizer fish farm. The differences in sediment pH were insignificant. The changes in sand and clay percentage in surface layer were higher than the subsurface layer. Chemical properties of sediment changed in terms of salinity and ions content, leaching from the surface to the subsurface layer. Salinity and different ions were decreased in the surface layer of the two fish farms by the end of the experiment. The surface layer in the fertilizer fish farm contained a higher percentage of nutrients nitrogen, phosphorous and potassium compared the feed fish farm. Water quality in fish farms is greatly influenced by feed management and fertilizer inputs which in turn affect sediment quality in ponds.

Key word: Fish farms, water quality, sediment quality, physical-chemical properties.

INTRODUCTION

Decisions regarding fertilization and supplementary feeding are especially important because they are major determinants of nutrient for fish growth and major causes of water quality problems. Fish ponds have resulted in increase in nutrient and organic wastes through feeding inputs leading to general deterioration of water and sediment quality. Pond management is regarded as the most important aspect of fish culture. Physical and chemical properties of bottom soil have a great impact on water quality of surface water in earthen ponds especially the exchange of ions between surficial sediments and water.

Sediments and water quality parameters of fish ponds has a great influence on enhancing pond productivity, supplying partial feeding for cultured fish maintaining healthy environment needed to increase fish production in culture ponds (Nagargoje and Bhosle, 2012). Sediments quality plays a vital role in controlling pond productivity since it affects the chemical composition of overlying layer in terms of salinity, pH and organic solution (Boyd, 1995 and Boyd, 2000). Chemical and physical parameters of pond sediments have a great influence on properties and quality of pond water (Boyd, 1995). Pond sediments have several functions including food supply and shelter for benthic organisms as well as controlling the buffer and storage and release of nutrients into overlaying water (Kumar *et al,* 2012).

Surface layer of pond sediments have a buffer capacity in aquatic habitats against high and low pH, moreover, it supplies essential nutrients to the overlying water and as a biological and mechanical filter of organic matter that sediments to the surface layer (Townsend, 1982; Boyd, 1995). Site selection for fish culture pond demand good sediment quality as regards to moderately heavy sediments, natural pH suitable organic matter content and low salinity levels (Hubert *et al.*, 1996). Good information should be available on chemical composition of surface layer of pond sediment since levels of inputs needed during pond preparation depend on soil quality data; moreover, activities during culture period are dependent on chemical composition of surface layer (Ekubo and Abowei 2011). It is common consensus that the feeding materials (pelleted feed or organic fertilizers) should supply good and healthy growth for fish.

These materials may increase nutrients and organic matter in water and sediments. So, the present study was conducted to evaluate the effect of different management systems on physical and chemical properties of water and bottom sediments of earthen ponds.

MATRIALS AND METHODS

Study area and experimental design

The present study was conducted in Kafer El-Shikh Governorate. Two fish farms located in the area between El-Moheet Drain and El-Burullus Lake. Four earthen ponds of 8400 m^2 each. All ponds had 1.25 m water depth. Fish were stocked in first of July 2014 and harvested at the end of June 2015 passing the wintering period.

1- Pond management

The feed fish farm depended on commercial pelleted diet (25% crude protein) as feed input for the cultured fish, while the fertilizer fish farm used both organic fertilizer (Chicken manure) and crushed macaroni as supplementary feed (Crushed macaroni) (Table, 1).

The feed fish farm adopted feeding fish with pelleted diet (25% crude protein) at the rate of 25 kg/feddan/day, 6 days a week at the start of the production cycle which were gradually increased to 50kg/feddan/day by the end of October. Feeding was stopped during the overwinter period for four months (from November to end of February). Feeding was resumed in March 2015 at 25 kg/feddan/day and gradually increased to 35 kg/feddan/day by the end of the production cycle in June 2015.

The fertilizer fish farm adopted supplementary feeding with crushed macaroni (Table, 1) at 25 kg/feddan/day, six days a week at the start of the experiment, which was gradually increased to 50 kg/feddan/day by the end of October. Feeding with crushed macaroni was stopped during overwinter period and resumed in March 2015 at 25 kg/feddan/day. Feeding rate was gradually increased to 40 kg/feddan/day by the end of the production cycle in June 2015. Fertilization with chicken manure was applied at the rate of one ton/feddan/10 days (equivalent to 100 kg/feddan/day) during the whole experiment including the overwinter period.

Table 1. Chemical composition of the commercial diets and crushed macaroni (on dry matter basis).

Chemical analysis (%)	Commercial diet (25%)	crushed macaroni
Dry matter	91.25	90.40
Crude protein	25.04	14.32
Crude fat	5.94	3.50
Ash	5.73	2.9
Fiber	6.11	0.9
NFE	57.18	77.38
GE (kcal/kg)	4425	3946

NFE (nitrogen free extract)=100−(protein%+lipid%+ash%+fiber%).

GE (gross energy): calculated after NRC (1993) as 5.64, 9.44, and 4.11 kcal/g for protein, lipid, and NFE, respectively.

Sampling and laboratory analysis

Water samples were taken monthly from each pond during July 2014to June 2015 and analyzed for physical and chemical properties of water. Samples were taken with a water sampler from at least three spots at each pond at a depth of 30 cm below the water surface and mixed together in a plastic container according to Boyd and Tucker (1992). Then one liter of water was taken for water analysis. All water samples were put in plastic bottles and kept in ice box until transferred to Centeral Laboratory for Aquaculture Research (CLAR) for analysis during 24 hour. Analysis of water temperature °C, dissolved oxygen DO mg/l, secchi disc cm, pH, total ammonia nitrogen, ammonia, ammonium, nitrite, nitrate, orthophosphate mg/l, salinity g/l, electric conductivity mS/cm and chlorophyll "a" µg/l were conducted at the filed according to APHA (2000).

Fig.1. A map showing of Kafr El-Sheikh governorate and two fish farm

Sediments samples

In the current study sediments samples were taken once at the beginning and end of the study to study the physical and chemical properties as well as practical size distribution. Surface and subsurface samples (3 samples) from each pond were collected using a core sampler (surface layer 0-15 cm and the subsurface layer 15-30 cm) as described in (Boyd and Tucker, 1992) and kept in cleaned plastic bags. The three samples from each pond were combined. In the laboratory, the samples were air dried, followed by grinding and sieving through a 2 mm sieve and kept in polyethylene bags for analysis.

Particle size distribution was determined by the hydrometer method (Weber, 1977) using sodium hexameta phosphate as dispersing agent. Organic matter content was determined using Walkley and Blacks method (Jackson, 1967).

pH value was measured by pH meter (Thermo Orion pH Meter model 420 A) in 1: 2.5 soil to water suspension (Jackson, 1967). Soil water extract (1: 5) was prepared according to the method of (Jackson 1967) and the following parameters were measured as follows:

Electric conductivity "EC" was determined electrometrically in mS/cm by using a salinity-conductivity meter YSI Environmental (model, EC 300). Cations and anions were measured according to (Soil analysis book, 1982). Total nitrogen was estimated using micro-Kjeldahl method, (APHA, 2000). Soil available phosphorus was determined according to Boyd and Tucker (1992).

Statistical analyses:

One-way ANOVA was used to evaluate the significant differences of the concentration of different parameters studied with respect to sites and seasons. A probability at level of 0.05 or less was considered significant. Standard errors were also estimated. All statistics were using the SAS program (SAS, 2000).

RESULTS AND DISCUSSION

Water

The annual averages of water quality parameters in earthen ponds under different managements are shown in Tables (2) and Fig. (2 and 3).The annuals average values of water temperature were 23.8°C being similar in both the feed and fertilizer fish farm. The annual average of pH in the fertilizer fish farm (8.4) was significantly higher ($P<0.05$) compared to the feed fish farm (8.0). This may be due to the higher photosynthetic activities of algae resulted from the high organic fertilizer inputs and reflected in shallower secchi disk reading. Increased phytoplankton population lead to increased photosynthesis and subsequently increased carbon dioxide (CO_2) consumption. These results are harmony with those obtained by Shaker *et al.*, (2015a).

The annual average dissolved oxygen concentrations were slightly higher in the fertilizer fish farm compared to the feed fish farm (6.55 versus 5.95mg/l). These results may be due to the presence of higher phytoplankton density in the fertilizer fish farm (secchi disk = 12.6 cm) induced by organic fertilization and accompanied by higher photosynthetic rate of oxygen production. Algal density in the feed fish farm as indicated by secchi disk visibility was significantly ($P<0.05$) lower (18.4 cm). These results are good agreement with those obtained by Shaker *et al.,* (2015b). Bacterial degradation of organic matter in the soil and subsoil release substantial amounts of CO_2, nitrogen salts and little of orthophosphate which are considered as algal nutrients (Boyd, 2000).

The salinity, conductivity and total hardness of surface water were stable measurements. The average values of salinity (g/l), EC (mS/cm) and total hardness (mg/l) were not significantly different between the two fish farm. These results showed that salinity, EC and total hardness were not affected by pond management. These results are good agreement with those obtained by Shaker *et al.,* (2013). Concerning the annual average of total alkalinity, there is a significant ($P<0.05$) differences between feed and fertilizer fish farm. The values were increased in fertilizer fish farm compared to feed fish farm. The results clarify that the degradation of chicken manure may produce more CO_2 in bottom sediment compared to CO_2 results in feed decomposition. Chicken manure was applied at higher rate (100kg/feddan/day) compared to feed inputs (30-50kg/feddan/day). These results in agreement with Raju *et al.*, (2014) who reported that alkalinity increased due to aquaculture between 435 to 450 ppm, was an indication of increase in concentration of carbonates and bicarbonates of sodium and magnesium.

The average values of nitrogen components ammonia NH_4-N, NH_3-N, NO_2 and NO_3 (mg/l) were significantly ($P<0.05$) increased in fertilizer fish farm than feed fish farm. These results show that the organic fertilization leads to increased production of ammonia, nitrite and nitrate due to decomposition processes. These results are in good agreement with those obtained by Stone and Thomforde (2004) who observed that the favorable level 0-2 $mg/l^{-1}$of total ammonia nitrogen (TAN). NO_3-N concentrations 0.078 and 0.26 mg/l in feed and fertilizer fish farm compare to Nakashima *et al.*, (2007) who reported that NH_3-N range between 0.09 - 1.27 mg/l^{-1}throughout all the year. The average values of orthophosphate and chlorophyll “a” had the same trends of nitrogen compounds.

Sediments

Agriculture drainage water carries huge amount of allochthonous sediments into earthen ponds which are deposited and incorporated into total

Table.2. Annual average of water quality parameters in feed and fertilizer fish farms during the experimental period from July 2014-June 2015.

Items / Location	Temp. (°C)	pH	DO mg/L	SD Cm	Salinity g/L	EC mS/cm	T.Alk mg/L	T.H mg/L	O.P mg/L	TAN mg/L	NH_3 mg/L	NH_4 mg/L	NO_2 mg/L	NO_3 mg/L	Chl a µg/L
Feed Fish Farm	23.8 ± 0.3^{A}	8.0 ± 0.2^{B}	5.95 ± 0.4^{B}	18.4 ± 0.5^{A}	2.76 ± 0.1^{A}	5.44 ± 0.13^{A}	349.9 ± 14^{B}	298.2 ± 13^{A}	0.170 ± 0.011^{B}	1.26 ± 0.016^{B}	0.078 ± 0.013^{B}	1.18 ± 0.013^{B}	0.04 ± 0.001^{B}	0.07 ± 0.001^{B}	22.80 ± 1.3^{B}
Fertilizer Fish Farm	23.8 ± 0.3^{A}	8.4 ± 0.3^{A}	6.55 ± 0.3^{A}	12.6 ± 0.5^{B}	2.78 ± 0.1^{A}	5.42 ± 0.12^{A}	434.7 ± 15^{A}	303.2 ± 12^{A}	0.369 ± 0.014^{A}	1.63 ± 0.015^{A}	0.263 ± 0.018^{A}	1.44 ± 0.015^{A}	0.13 ± 0.011^{A}	0.29 ± 0.021^{A}	55.06 ± 4.5^{A}

Letters (A and B) show column vertical differences between feed and fertilizer fish farm during the experimental period. Data shown with different letters are statistically different at $P < 0.05$ level.

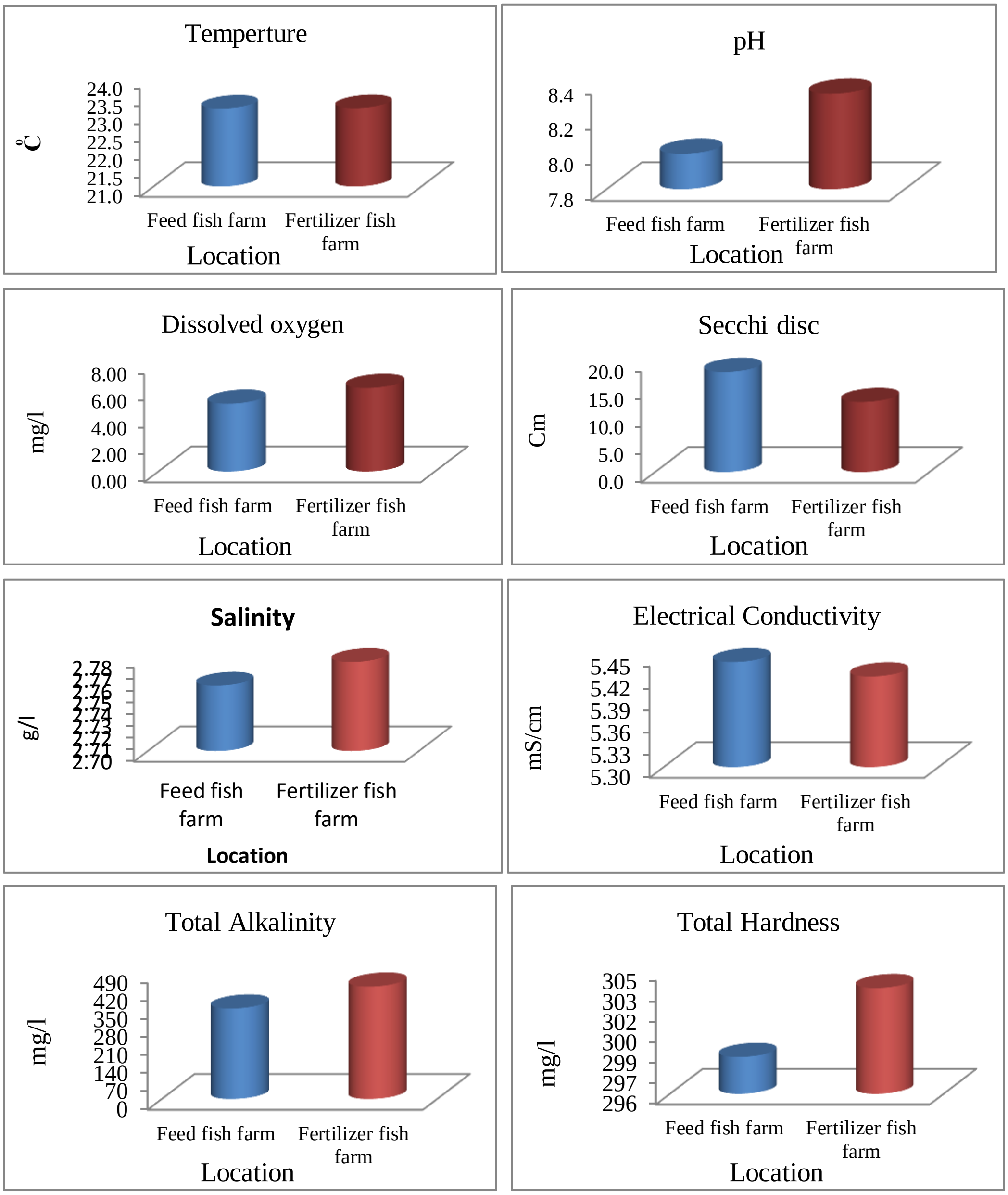


Fig.2. Annual average of Temperature, pH, Dissolved oxygen (D.O), Secchi disc (SD), Salinity, Electrical conductivity (EC), total alkalinity and total hardness in feed and fertilizer fish farms during the experimental period (July, 2014- June, 2015).

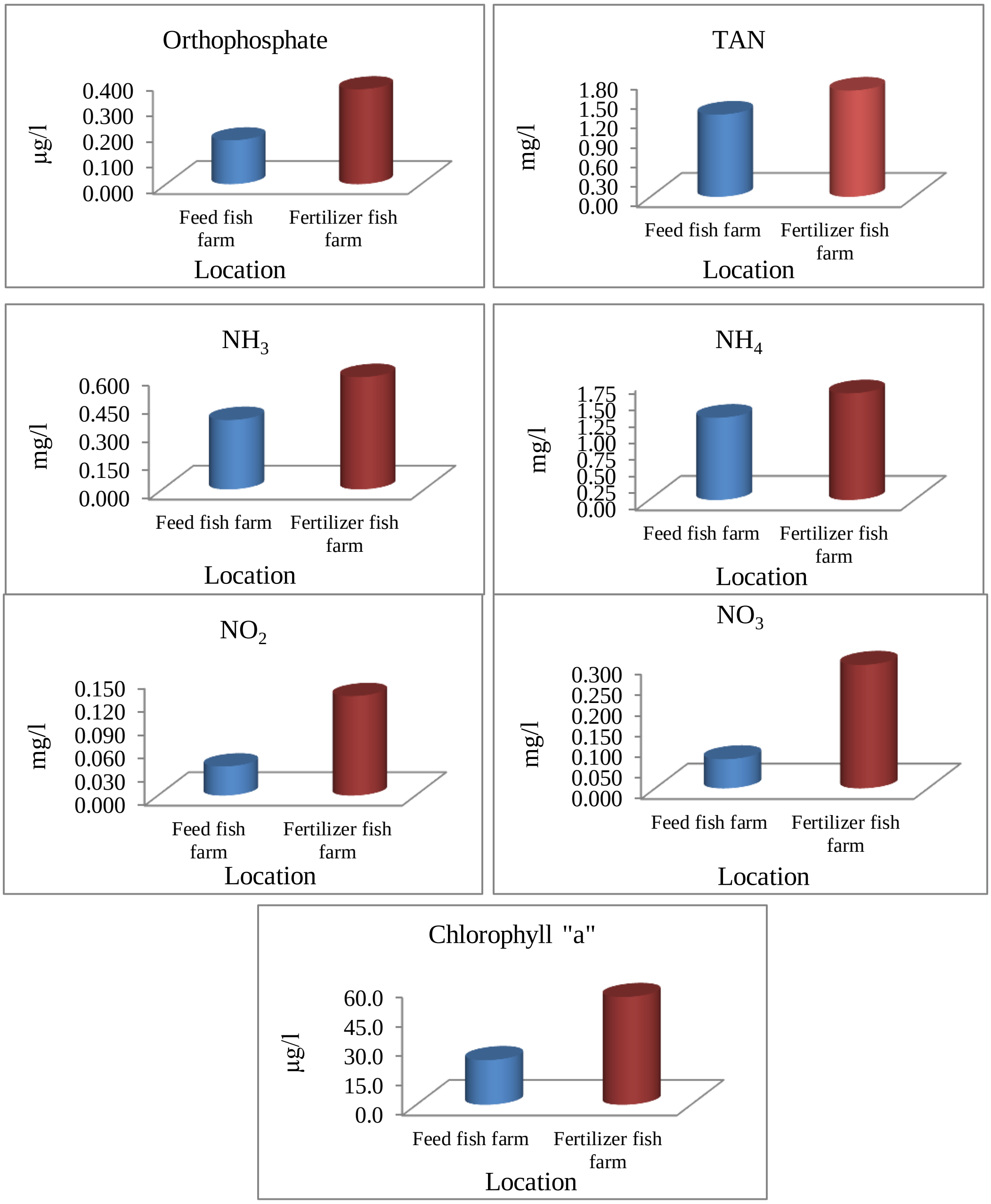


Fig.3. Annual average of orthophosphate, TAN, NH_4, NH_3, NO_2, NO_3 and Chlorophyll “a” in feed and fertilizer fish farms during the experimental period (July, 2014- June, 2015).

sediments (Singh *et al.*, 1989). The same authors indicated that pond sediments are considered as reservoir of contaminants, being ecologically important in the classification of trophic status of aquatic systems.

Data in table, (3 and 4) and fig (4) show physical properties of sediments in surface and subsurface layers at the beginning and end of the experimental period. The average of organic matter in surface layer of the fertilizer fish farm slightly increased that of feed fish farm at the beginning of the experiment. At the end of the experiment, organic matter content in surface layer of the fertilizer fish farm drastically increased from 7.14% at the start of the experiment to 10.07% at the end of experimental period. This may be due the intensive application of organic fertilizer (100 kg/feddan/day) over the pond bottom. On the other hand, the low rate of diet application (30-50 kg/feddan/day) in the feed fish farm leads to slow change in organic matter content.

Organic matter content in subsurface layers slightly increased from 3.88% to 4.11% in the feed fish farm, while drastically increased from 4.58% to 6.04% in the fertilizer fish farm from the start to the end of the experimental period, respectively. So, OM significantly increased ($P<0.05$) after experimental period in the surface and subsurface layers of the two farms, as a result of fish farming activities.

Organic matter content of soil consists of feces, uneaten feed and sedimented algae. Pond management plays a key role in determining organic matter content reaching the bottom sediments. Organic manure constituting a major part in the surface sediments (Boyd and Tucker, 1998; Boyd, 1995). Sediments organic matters play a central role with regards to physical and chemical conditions of soil, enhancing its capacity to retain water (Boyd, 1995). Boyd, *et al.* (2002) recommended a value of OM concentration in pond sediment ranged from 3- 5%.

The sediment pH values in the surface layer at the end of the experiment did not differ significantly compared to those at the start of the experiment in both the feed and fertilizer fish farm ($P>0.05$).The same trend of sediments pH values was observed in the subsurface layer in both farms. These results indicated that the pond management (feed and organic fertilizer) did not affect sediments pH in both the surface and subsurface layers during the period of the experiment. These result in agreement with those obtained by Shaker *et al*, (2015b) who reported that the change in soil pH would be very low.

Water quality in fish farms is greatly influenced by feed management and fertilizer inputs which in turn affect sediment quality in ponds. Feed and organic fertilizer inputs are considered as essential sources of nutrients, mainly due to metabolic ammonia and phosphates, with only 35% of supplied nitrogen and phosphorus retained in fish biomass (Gilani and Bahmanvar, 2008; Shaker, 2008).

Change in the ratio of sediments components (sand, silt and clay) depends on many factors including, quality of irrigation water, irrigation system, management plan of ponds and fish density and behavior. In the present study the silt and clay percentage were significantly ($P<0.05$) altered at the end of the experimental period compared with the begininng. These results are in agreement with Gilani and Bahmanvar, (2008); El-Halag et al., (2013) and Shaker and Farouk (2016) who reported that changes in the natural properties of sediments can be including through long periods exposure to intensive aquaculture activities and human intervention. Generally there is no relationship between the change in the ratios of sand, silt and clay in the soil layers and the management of earthen ponds employed during the study period.

Heavy textured soils have a high clay content with high adsorption capacity as regards to orthophosphate, consequently acting as nutrient sink, while moderately medium textured soils have moderate organic matter content (Ekubo and Abowei, 2011). Chemical properties of sediments in surface and subsurface layers in the two fish farm are presented in tables (4&5) and fig (4). The average values of sediments salinity in surface layer before and after experimental period were 9.23g/l and 8.38g/l in the feed fish farm and 10.94g/l and 9.54g/l in the fertilizer fish farm, while the average values of salinity in subsurface layer before and after the experimental period were 8.15g/l and 8.97g/l in the feed fish farm; 9.19g/l and 10.39g/l in the fertilizer fish farm.

Table.3. Physical properties and particle size distribution of the surface layer soil in different fish farms before and after the study during (July,2014- June, 2015).

Items / Farms	Time	O.M %	pH	Sand%	Silt %	Clay%	Texture
Feed Fish Farm	**Before**	6.78 $\pm0.065^{c}$	7.32 $\pm0.12^{a}$	25.15 $\pm1.22^{a}$	33.66 $\pm1.33^{b}$	41.19 $\pm1.27^{a}$	Clay
	After	7.64 $\pm0.027^{b}$	7.56 $\pm0.035^{a}$	23.26 $\pm1.06^{b}$	34.64 $\pm2.35^{b}$	42.1 $\pm2.1^{a}$	Clay
Fertilizer Fish Farm	**Before**	7.14 $\pm0.033^{b}$	7.36 $\pm0.044^{a}$	26.14 $\pm1.58^{a}$	34.17 $\pm1.73^{b}$	39.69 $\pm2.11^{b}$	Clay
	After	10.07 $\pm0.065^{a}$	7.32 $\pm0.103^{a}$	22.76 $\pm1.08^{b}$	36.28 $\pm2.17^{a}$	40.96 $\pm2.15^{a}$	Clay

Letters (a to c) show differences between feed and fertilizer fish farm in the same column during the experimental period. Data shown with different letters are statistically different at $P < 0.05$ level.

Table.4. Physical properties and particle size distribution of the subsurface layer soil in different fish farms after the study during (July, 2014- June, 2015).

Items / Farms	Time	O.M %	pH	Sand%	Silt %	Clay%	Texture
Feed Fish Farm	**Before**	3.88 ±0.036[c]	7.42 ±0.047[a]	27.36 ±1.13[a]	32.85 ±1.27[a]	39.79 ±1.37[b]	Sandy clay loam
	After	4.11 ±0.033[b]	7.48 ±0.039[a]	23.58 ±1.09[b]	33.55 ±1.13[a]	42.87 ±1.29[a]	Clay
Fertilizer Fish Farm	**Before**	4.58 ±0.037[b]	7.38 ±0.035[a]	27.88 ±1.17[a]	33.77 ±1.21a	38.35 ±1.12[b]	Sandy clay loam
	After	6.04 ±0.065[a]	7.38 ±0.066[a]	22.78 ±1.06[b]	34.48 ±1.37[a]	42.74 ±1.55[a]	Clay

Letters (a to c) show differences between feed and fertilizer fish farm in the same column during the experimental period. Data shown with different letters are statistically different at $P < 0.05$ level.

These results indicated that salinity decreases in surface layer and increased in the subsurface layer at the end of the experimental period in the two farms. Water renewal in earthen ponds leads to leaching of salt in the surface layers of soil as a result of fish farming operations, regardless of pond management practices.

Sediments salinity depends on several factors including inlet water salinity, ground water level, evaporation rate and the rate of the water exchange. These results are in good agreement with those obtained by Shaker *et al.,* (2015b) who reported that the sediments salinity depending on salinity of inlet water, ground water level and salinity and soil amendments. Important macronutrients such as nitrogen and phosphorous are continuously being interchanged between sediment and overlying water (Abowei and Sikoki, 2005).

All salt cations and anions concentration decreased in the surface layer at the end of the experiment compared with initial concentrations of these salts at the beginning of the experiment this may be resulted from seepage of salts downward. These washed salts tended to accumulate in the subsurface layer in both the feed and fertilizer fish farms. As described in table (5) fig. (4), salt contents including anions and cations tended to increase during the course of the experiment. The overall cations and anions picture can be described in reduction of salt contents in the surface layer and accumulation of salts in the subsurface layer in both farms by the end of the experiment.

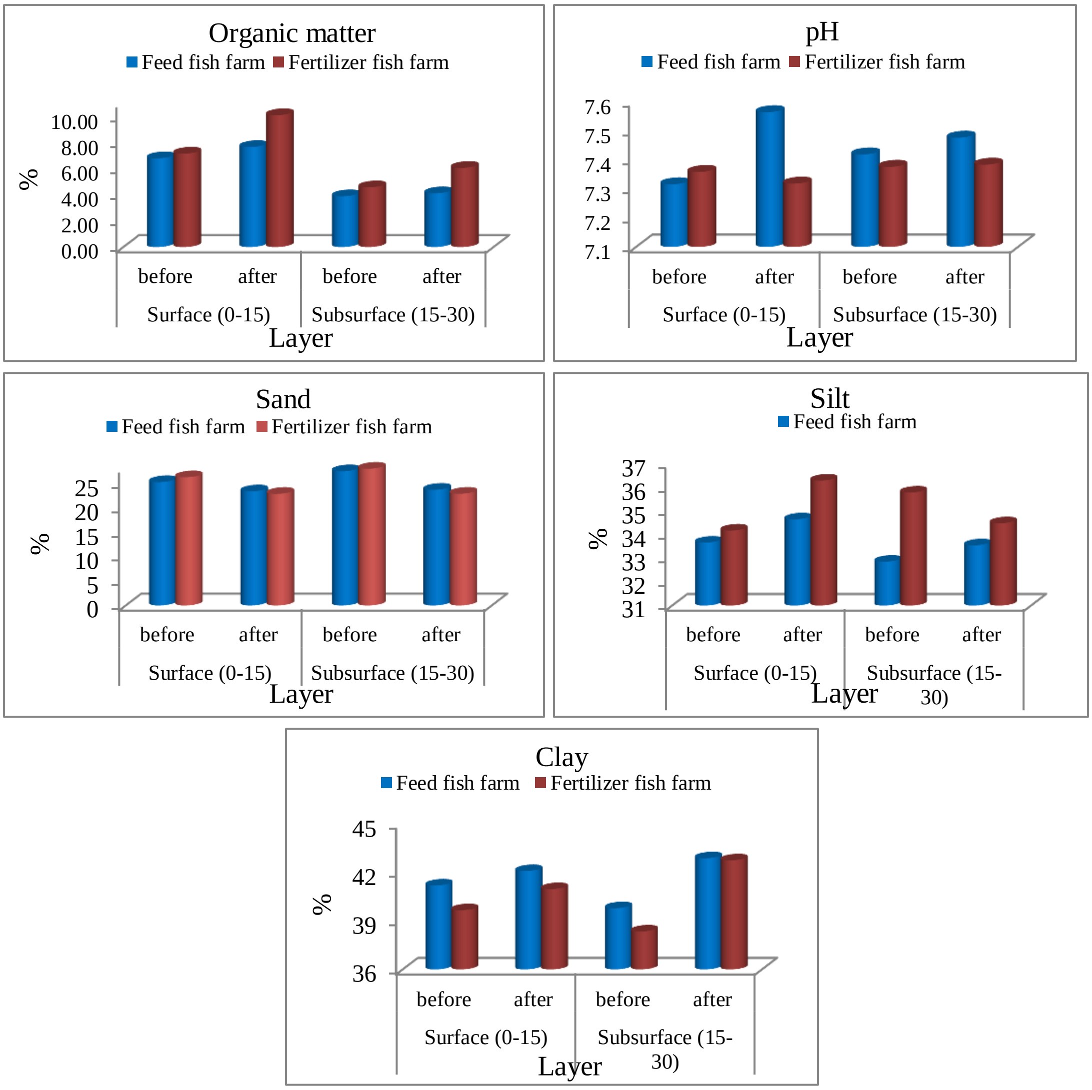


Fig.3. Physical properties and particle size distribution of the surface and subsurface layer sediments in different fish farms before the study during (July, 2014- June, 2015).

Data nitrogen content it was substantially increased overtime in the surface and subsurface layers of the fertilizer fish farm due to the high chicken manure inputs during the experiment. However, phosphorus content tended to slightly increase overtime but at lower rate compared to that of nitrogen. A slight increase in nitrogen salt content was observed in the surface layer of the feed fish farm at the end of the experiment. The percentages of change in soil chemical properties of sediments in different

Table.5. Chemical prosperities of the sediments surface layer in different fish farms before and after the study during (July, 2014 a-June, 2015).

Items / Farms	Time	Salinity g/l	Cations and anions (meq/l)								Total N ppm	Available macro nutrient (ppm)		
			Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO_3^{2-}	HCO_3^{-}	Cl^{-}	SO_4^{2-}		N	P	K
Feed fish farm	Before	9.23 $\pm0.17^{b}$	41.7 $\pm2.33^{a}$	34.5 $\pm1.24^{b}$	52.6 $\pm2.33^{c}$	5.4 $\pm0.013^{c}$	0.4 $\pm0.001^{c}$	64.7 $\pm2.73^{b}$	56.8 $\pm1.39^{b}$	12.3 $\pm0.11^{dc}$	127 $\pm9^{c}$	28.42 $\pm1.33^{d}$	7.2 $\pm0.2^{c}$	9.26 $\pm0.5^{ab}$
	After	8.38 $\pm0.14^{b}$	38.8 $\pm2.47^{b}$	33.1 $\pm1.33^{c}$	47.8 $\pm2.27^{d}$	5.2 $\pm0.017^{c}$	0.3 $\pm0.001^{c}$	58.7 $\pm2.53^{c}$	52.5 $\pm1.37^{c}$	13.4 $\pm0.51^{cb}$	168 $\pm9^{b}$	33.33 $\pm1.37^{c}$	7.6 $\pm0.3^{c}$	9.77 $\pm0.3^{a}$
Fertilizer fish farm	Before	10.94 $\pm0.22^{a}$	40.7 $\pm2.17^{a}$	40.5 $\pm1.55^{a}$	70.2 $\pm2.16^{a}$	6.9 $\pm0.024^{a}$	5.7 $\pm0.011^{a}$	77.8 $\pm2.67^{a}$	59.5 $\pm1.88^{a}$	15.3 $\pm0.12^{a}$	139 $\pm7^{c}$	41.26 $\pm2.06^{b}$	10.3 $\pm0.62^{b}$	8.78 $\pm0.3^{b}$
	After	9.54 $\pm0.19^{a}$	37.4 $\pm2.11^{b}$	34.5 $\pm1.43^{b}$	59.9 $\pm2.17^{b}$	6.4 $\pm0.023^{b}$	4.8 $\pm0.011^{b}$	65.9 $\pm2.77^{b}$	52.8 ±1.93c	14.7 $\pm0.12^{ba}$	314 $\pm14^{a}$	76.28 $\pm3.15^{a}$	12.7 $\pm0.74^{a}$	10.35 $\pm0.4^{a}$

Letters (a to d) show al differences between feed and fertilizer fish farm in the same column during the experimental period. Data shown with different letters are statistically different at $P < 0.05$ level.

Table.6. Chemical prosperities of the sediments subsurface layer in different fish farms before and after the study during (July, 2014 and June, 2015).

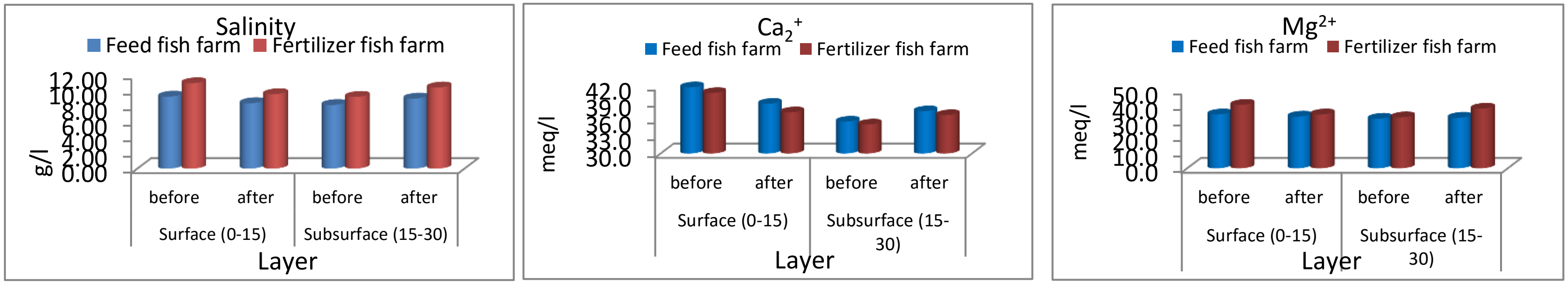
Items / Farmss	Time	Salinity g/l	Cations and anions (meq/l)								Total N ppm	Available macro nutrient (ppm)		
			Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO_3^{2-}	HCO_3^{-}	Cl^{-}	SO_4^{2-}		N	P	K
Feed fish farm	Before	8.15 $\pm0.16^{c}$	35.7 $\pm1.56^{a}$	31.7 $\pm2.14^{b}$	48.1 $\pm3.44^{d}$	3.3 $\pm0.1^{d}$	0.8 $\pm0.01^{b}$	60.9 $\pm3.8^{c}$	52.5 $\pm3.75^{c}$	4.6 $\pm0.15^{a}$	94 $\pm5.5^{c}$	22.16 $\pm1.2^{b}$	4.4 $\pm0.1^{b}$	2.3 $\pm0.1^{b}$
	After	8.97 $\pm0.19^{b}$	37.5 $\pm2.11^{a}$	32.3 $\pm2.17^{b}$	53.8 $\pm3.77^{c}$	4.1 $\pm0.1^{c}$	0.6 $\pm0.01^{b}$	66.3 $\pm4.2^{b}$	57.9 $\pm4.65^{b}$	2.9 $\pm0.12^{c}$	107 $\pm6.6^{b}$	23.94 $\pm1.4^{b}$	4.5 $\pm0.1^{b}$	2.6 $\pm0.1^{b}$
Fertilizer fish farm	Before	9.19 $\pm0.21^{b}$	35.2 $\pm1.74^{a}$	32.6 $\pm2.55^{b}$	61.3 $\pm4.86^{b}$	4.7 $\pm0.1^{b}$	6.2 $\pm0.3^{a}$	68.7 $\pm4.55^{b}$	55.8 $\pm4.42^{b}$	3.1 $\pm0.1^{b}$	103 $\pm6.2^{b}$	26.17 $\pm1.6^{b}$	4.5 $\pm0.1^{b}$	2.4 $\pm0.1^{b}$
	After	10.39 $\pm0.25^{a}$	36.8 $\pm2.55^{a}$	38.1 $\pm3.06^{a}$	71.7 $\pm5.36^{a}$	5.2 $\pm0.1^{a}$	6.2 $\pm0.2^{a}$	76.8 $\pm5.44^{a}$	65.8 $\pm5.14^{a}$	3.0 $\pm0.1^{b}$	155 $\pm8.5^{a}$	40.14 $\pm2.3^{a}$	5.8 $\pm0.1^{a}$	3.1 $\pm0.1^{a}$

Letters (a to c) show differences between feed and fertilizer fish farm in the same column during the experimental period. Data shown with different letters are statistically different at $P < 0.05$ level.

Table.6. Percentages of change in sediments chemical properties in different layers in the feed and fertilizer fish farms.

Items / Farms	Soil depth	Salinity	Cations and anions								Total N Ppm	Available macro nutrient		
			Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO_3^{2-}	HCO_3^{-}	Cl^{-}	SO_4^{2-}		N	P	K
Feed fish farm	surface	-9.21	-6.95	-20.62	-9.13	-3.70	-25	-9.27	-7.57	+8.94	+32.28	+17.28	+5.56	+5.51
	Subsurface	+10.06	+5.04	+1.89	+11.85	+24.24	-25	+8.87	+10.29	-36.96	+13.83	+8.03	+2.27	+13.04
Fertilizer fish farm	surface	-12.79	-8.11	-14.81	-14.67	-7.25	-15.79	-15.30	-11.26	-3.92	+125.9	+84.88	+23.30	+17.88
	Subsurface	+13.06	+4.55	+16.87	+16.97	+10.63	0.0	+11.79	+17.92	-3.23	+50.49	+53.38	+28.89	+29.16

(+) increase of the ions content, (-) decrease of the ions content.



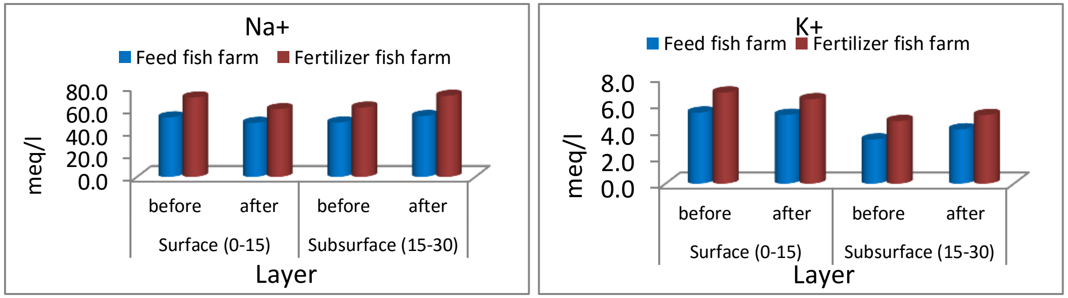
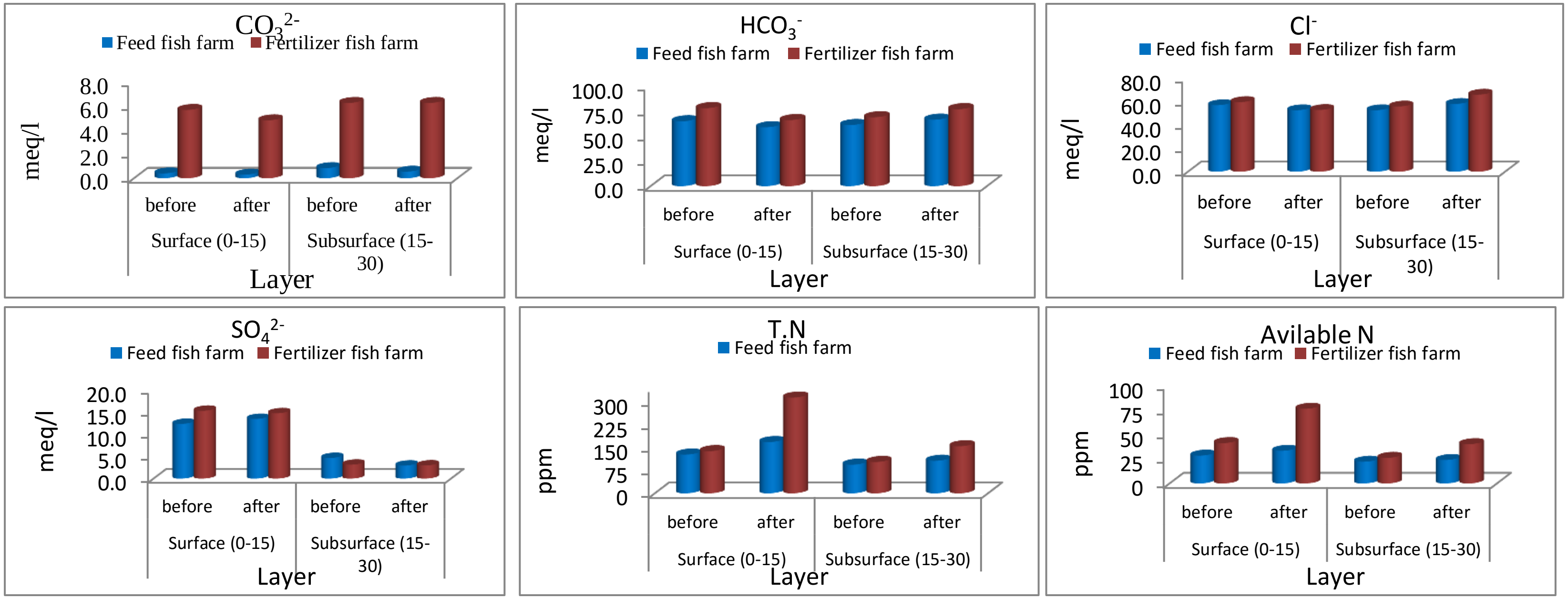


Fig.4. Soil chemical prosperities of the sediments surface and subsurface layer in different fish farms before and after the study during July, 2014 and June, 2015).



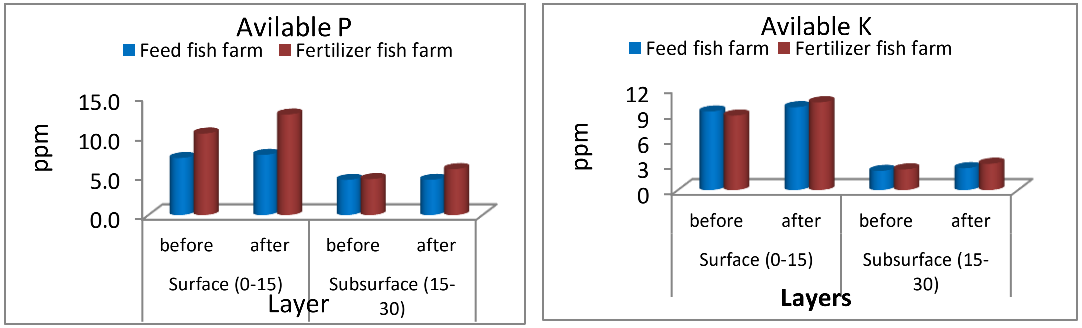


Fig.5. Continually, chemical prosperities of the sediments surface and subsurface layer in different fish farms before and after the study during (July, 2014 and June, 2015).

layers in the feed and fertilizer fish farms are presented in table (6). The highest change percentage was recorded in total nitrogen and nitrogen salts in the fertilizer fish pond. These results clear that nitrogen accumulated in the surface layer of the fertilizer fish pond. Organic matter (O.M) in bottom sediment is considered as parameters that determine soil fertility. Heavy organic content in surface soil of aquaculture ponds deteriorates both bottom soil quality and overlying water quality (Steeby *et al*., 2001; Thunjai *et al*., 2004). Boyd and Tucker, (1998) mentioned that the normal value of sediments pH lies between 6.5 and 7.5 this concept is in agreement with the results of the current study.

Conclusions

From the current study, it is concluded that the physical and chemical of water and sediments are influenced by pond management. Increased of nutrients ions and organic matter are observed in the different management especially with that of organic fertilizers. The study recommended that organic matter should be removed from the surface layer of the sediment at the end of the culture season to reduce the of organic matter content in sediment.

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تأثير نظم إدارة المزارع السمكية على الخواص الطبيعية والكيميائية للمياه والرسوبيات فى الاحواض الترابية

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أجريت الدراسة فى مزرعتين ترابية (مركز الرياض- محافظة كفر الشيخ). أحدهما تعتمد على التغذية الصناعية (العلف الصناعى) والاخرى تعتمذ على التسميد العضوى (بزرق الدواجن) بجانب كسر المكرونة كعايقة اضافية. أستخدم فى الدراسة عدد ٤ حوض ترابى مساحه كل منها ٨٤٠٠م^{٢}. بدأت الدراسة فى شهر يوليو ٢٠١٤ وحتى يونيو٢٠١٥. تم أخذ عينات مياة مرة شهريا لقياس كلا من درجات الحرارة، الاس الهيدروجينى، قرص الشفافية، الاكسجين الذائب، القلوية الكلية، العسر الكلى، الامونيا، الامونيوم، النترات، النيترات، الفوسفور الذائب وكلوروفيل "ا"، تم اخذ عينات من التربة قبل وبعد الدراسة من الطبقة السطحية (٠-١٥سم) والطبقة التحت سطحية (١٥-٣٠سم).كانت اهم النتائج المتحصل عليها،لوحظ أنه لاتوجد فروق معنويه بين المزرعتين فى درجه الحرارة - الملوحه – التوصيل الكهربى و العسر الكلى فى حين ان هناك زيادة معنوية فى الاس الهيدروجينى pH - الاكسجين الذائب – قراءة قرص الشفافية – القلوية الكلية – الفوسفور الذائب – المركبات النيتروجينية (الامونيا – النتريت- النترات) والكلوروفيل أ فى المزرعه التى تعتمد على التسميد العضوى.

وأظهرت الخواص الفيزيائية للرسوبيات، زيادة المادة العضوية فى طبقات التربة السطحية اكبر منها فى التحت سطحية خاصة فى المزرعه التى تعتمد على التسميد العضوى. كما أنه لايوجد فروق معنوية فى قيم ال pH . كما أن التغير فى نسب الرمل والسلت والطين اكبر فى الطبقة السطحية عنها فى الطبقة التحت سطحية. الخواص الكيميائية، فقدلوحظ أن هناك إنخفاض معنوى فى ملوحه الطبقة السطحية للرسوبيات فى المزرعتين بعد نهاية الدراسه فى حين لوحظ زيادة منعوية فى ملوحة الطبقة التحت سطحية. كما لوحظ وجود انخفاض معنوى فى الكاتيونات والانيونات فى الطبقة السطحية بالمزرعتين فى حين لوحظ زيادة معنوية فى الطبقة التحت سطحية. الا ان هناك زيادة فى نسبة النيتروجين والفوسفور والبوتاسيوم فى الطبقة السطحية للمزرعة التى تعتمد على التسميد العضوى عنها فى المزرعة التى تعتمد على التغذية الصناعية. أوضحت الدراسة ان نظام ادارة المزرعة السمكية هو المسئول عن زيادة تراكم المادة العضوية فى الرسوبيات مما قد يتسبب فى حدوث مشاكل نفوق الاسماك فى نفس الموسم او المواسم القادمة وعلية فإن الدراسة توصى بضرورة إزاحه جزء من الطبقة السطحية عقب نهاية الموسم لتقليل كميات المادة العضوية بالتربة.