Decision support system for Management Fish farms

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Abstract: In Egypt, fish farm has great economic importance as a major source of fish. The present study was conducted on fish farm (14 Feddan) located at Mergam region West of Alexandria. The results revealed that mean season at temperature, pH and salinity are in the convenient level for the culture species (*O. niloticus, M. Capito* and *D. Labrax*), while the DO are at minimum level. Mergam's fish farm suffer from high level of BOD, high blooming of phytoplankton represented by low transparency, high value of measured chlorophyll-a and total phosphorus. The proposed Trophic State Index System (TSIS) is an effectiveness Decision Support System (DSS) intended to support decision makers to manage fish farm. The main component of TSIS is the inclusion of TSI model that was implemented in this study to identify different Trophic State Index (TSI). The resulting seasonal showed that the lowest level of eutrophication 67.15 and 69.74 recorded in spring and winter respectively, this mean that extensive macrophyte problem due to dominance of blue-green algae and algal scum probable. While, the highest level of eutrophication 74.36 and 72.07 recorded in summer and autumn respectively, this mean that often hypereutrophic due to heavy algal blooms possible throughout the summer.

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1. Introduction

Aqua culture is the most important source of fish production in Egypt and is recognized by the government as the important sector within fisheries which can provide for the increasing fish demand. In Egypt aqua culture is developing rapidly from a traditional family-run business into a modern industry. As a result, the number of traditional family fish farms is declining and replaced by semi-intensive with an annual production of between 2.8 to 8.0 tons/hectare, and intensive farming operation with an average production of between 14-25 tons/ hectares [1, 2].

There for aquaculture is considered to be the only possible solution to increase fish production, which lead to reduce the gap between production and consumption of protein. Most fish farms receive water directly from river, lake or canals with special impact on water quality management and the subsequent discharged into rivers, lakes, or canal without any previous treatments. Activities of fish farms cause impacts on the environments as a result for discharge of waste water into water streams, lakes and river. Fish farm's water affected by complex interactions between physical and chemical parameter and biological factor directly depends on water quality [3].

The environmental impact was evaluated by diagnoses of physical and chemical analysis during the fish farm operation stage depend on input and output, with special emphasis on the frequency and nature of nutrient added to the fish farm system, consequently production has to be planned to minimizing environment impact and optimizing the resource utilization. The objective of fish farm management is to manage the water quality [4].

Decision Support System (DSS) is an interactive, flexible and adaptable computer based information system, especially developed for supporting the solution of a non-structured management problem for improved decision making, by select one of the many alternative solutions to a problem. In other words, it utilizes data, provides an easy-to-use interface, and allows for the decision maker's own insights. It intended to enhance decision-making effectiveness, improve communication among decision makers and increase their satisfaction [5, 6]. DSS helps organization to increase production, reduce costs, increase profitability and enhance quality [7].

There for the present research aimed to identify water quality of fish farm by using physicochemical, biological factors and Trofic State Index System (TSIS) to manage water quality for fish farm. It is a propose system use DSS which contain TSI model that aims to build based simple model to identify differences trofic state related to seasons of fish farm.

2. Material and methods

2.1. Study area

Fish farm is located at Mergam west of Alexandria, its lies in west south of Lake Mariout. Mergam Fish farm total area is 14 feddans, divided into 3 equal ponds; from the first pond one feddan is separate as nursing pond for fries. The water depth in the farm's ponds varies from 1 to 2 m with average depth 1.5 m., the morphmetrical parameters of farm are shown in Table 1. This farm is receives its feeding water from drainage El-kilo 21 and discharge its water in El-Malahate through three drains, the diameter of each one is 8inch. The main water source is agriculture drainage water collected from the cultivated land around south and west of Alexandria.

Table 1: Morphmetrical Parameters of Fish Farm

Maximum depth (m)	2.00 m.
Mean depth (m)	1.50 m.
Area (m^2)	58800 m^2
Water volume (m^3)	88200 m^3

2.2. Sampling:

Water sampling was conducted monthly (2016-2017), one day in the each month was select to represent the whole month. Surface water samples were collected in plastic bottles of one and half-liter capacity each at 10 cm below the surface water, at 2 stations water In-put and Out-put representing the different ecological areas of fish farm.

We freeze 250 ml water samples immediately without filtration in plastic containers until further analysis for Chlorophyll-a, and Total Phosphorus (TP) put in ice-box and takes to the central lab of National Institute of Oceanography & Fisheries (NIOF), Alexandria.

2.3. Physiochemical and Biological Parameters

2.3.1. Temperature

Surface and depth water temperature was measure by dipping the bucket thermometer, with 0.2°C division, into the upper and depth water layer for a few minutes.

2.3. 2. Turbidity

The transparency of fish farm water was measure using a circular black-white Secchi disc, 25 cm in diameter. Readings of secchi depth were represented by taking the average distance of disappearance and reappearance of secchi disc expressed in (cm).

2.3.3. Hydrogen Ion Concentration

Samples for determination of Hydrogen Ion Concentration (pH) were drowning from the water sampler immediately after sampling by filling a 50 ml wide-mouth polyethylene bottle. pH values were measure immediately using a Lovibond Water Testing, Senso Direct 150.

2.3.4. Salinity

Samples for determination of Salinity were drowning from the water sampler immediately after sampling by filling a 50 ml wide-mouth polyethylene bottle. Salinity values were measure immediately using a Digital Refractometers for Sea Water Measurements.

2.3.5. Dissolved Oxygen

Sampling for dissolved oxygen (DO) was carrying out as rapidly as possible from sampler in 300 ml BOD bottles. The water sample was allowed to flush 2-3 times the bottle's volume until finally was filled. Without intermediate stopping, fixation of oxygen was carry out by addition of Winkler reagents; 2 ml $MnCl_2$ + 2 ml alkaline iodide solution [8]. We shake the bottles were vigorously for about 1 minute and then precipitate was allowed to settle in a dark place.

2.3.6. Biological Oxygen Demand

Water sample for Biological Oxygen Demand (BOD) was taking in full dark bottle put in ice-box and take to the central lab of NIOF, incubating the BOD bottle for 5 days.

2.4. Fish Farm Management:

The source of stocking fry (*D. labrax* and *M. capito*) was collected from estuary of the Nile River Delta. During nursing period (30 days) the fries of *D. labrax*, *M. capito* and mono sex *O. niloticus* with mean weight from 40 to 93gm by average length from 10 to 22 cm were nursed in earthen pond (one feddan).

The rearing period began in March, *D. labrax*, *M. capito* and mono sex *O. niloticus* fingerlings were stocked in the three rearing earthen ponds (13 feddan) at rate 140, 10 and 250 thousand respectively, the feeding rate randomly, twice a day at 10 am and 4 pm for six days/week. The commercial supplementary feed meal was from ALER AQUA Company (30% protein).

2.4.1. Trophic State Index (TSI)

Carlson's trophic state index (CTSI) was calculated using variables Secchi disk (TSISD), chlorophyll-a (TSIChl) and total phosphorus (TSIP) [9, 10].

2.4.2. Proposed System

This case will propose TSIS for identify differences trofic state of fish farm. TSIS is an effectiveness DSS intended to support decision makers to management and identify differences trofic state related to seasons of fish farm.

2.4.2.1. Components of TSIS

TSIS consists of three interacting components: Environmental Database, TSI model and easy-to user interface, as shown in Fig. 1.

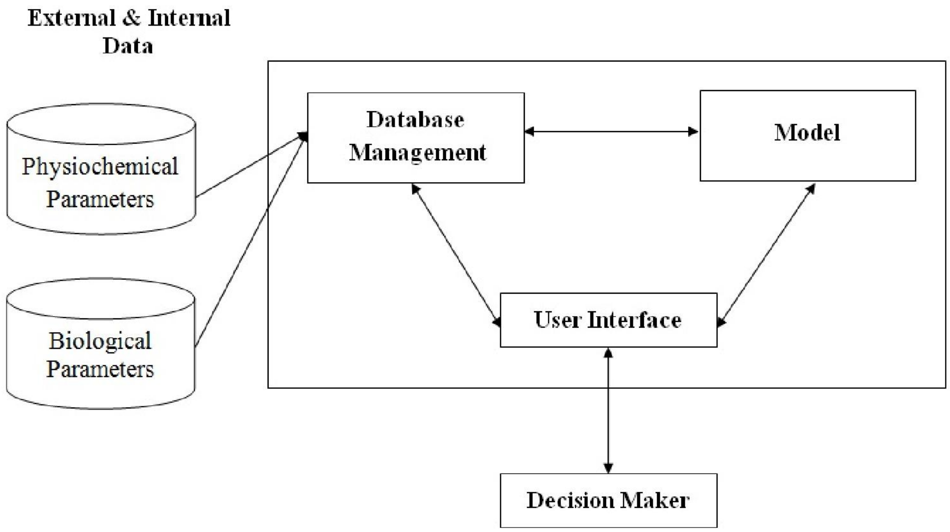

Fig. 1: Components of TSIS for of fish farm.

2.4.2.2. TSI Model

Due to the growing complexity and uncertainty in many decision situations, managers seek models to plan for their research topics and decision-making such as the quantitative models. Quantitative models are the dominant components that provide the primary function of a decision support system. It is designed so a user can manipulate parameters of the model with ease so as one could analyze data to have a positive outputs. TSI Model is quantitative model. In this model will address the Assumptions of TSI Model, the trofic state index equations for identify water quality of fish farm by using CTSI equation modified by[11].

TSIChl = 9.81In Chlorophyll-a (μg/L) +30.6............................$eq^n 1$

TSISD = 60-14.41In Secchi depth (Meters)..............................$eq^n 2$

TSITP = 14.42 In Total phosphorous (μg/l) + 4.15................... $eq^n 3$

From $eq^n 1$, 2, and 3 CTSI and In is Natural logarithm is

CTSI = [TSIChl + TSISD + TSITP] / 3

3. Results:

3.1. Physiochemical and Biological Parameters

3.1.1. Water Temperature:

Fish is considered a cold blood animal, its body temperature changes according to that of ecosystem which affecting its metabolism and physiology and ultimately affecting the fish production in fish farm.

The results of water temperature are presented in Table 2. Owing to the shallowness of the water depth the air temperature greatly affects the water temperature. The mean water temperature decreased to reach its lowest value in winter 15.67 ± 3.50˚c then it rose during the spring 21 ± 3.95˚c attaining its peak value 27 ± 1.86˚c in summer, then it decrease again in autumn to 20.83 ± 4.31˚c.

3.1.2. Turbidity:

Turbidity is ability of water to transmit the light that restricts light penetration and limit photosynthesis is termed as turbidity and is the resultant effect of several factors such as suspended clay particles, dispersion of plankton organisms, particulate organic matters and also the pigments caused by the decomposition of organic matter. Sechi-Disc reading is presented in Table 2. The mean seasonally water turbidity in the two stations (Input and Output) showed that Secchi-Disc reading reached its lowest reading (i.e. high turbidity) during summer season 0.18 ± 0.041 m. The mean Secchi-Disc reading began to increase gradually until its highest value 0.33 ± 0.140 m (i.e. low turbidity during winter season.

3.1.3. pH:

Measurement of pH in aquatic habitat is essential as it reflects the biological activity and changes in the water as well as pollution. The mean seasonal pH value in fish farm ranges between 7.72 ± 0.31as a minimum in winter and 8.04 ± 0.40 in spring as maximum Table 2.

3.1.4. Salinity:

Salinity is one of the most important factors which affects the survival and distribution of aquatic biota. The effect of salinity may be directly affecting the survival of fish or indirect by affecting the amount and type of plankton which constitutes the main food of the early larval stages. The average seasonally water salinity reached its lowest in winter season 4.34 ± 1.51. Salinity raised during spring 6.80 ± 1.31 attaining its peak value in summer 7.58 ± 1.43, while it slightly decrease again in autumn to 5.37 ± 1.42 Table 2.

3.1.5. DO:

DO is considered as one of the most important and useful parameter for the identification of different water masses and assessing the degree of water quality. It affects the growth, survival, distribution, behavior and physiology of aquatic organism [12]. Oxygen is the most important gas dissolved in the water. The dissolved oxygen is very important factor in natural water, not only as a regulator of metabolic process of organisms, but as indicator of water condition.

The average seasonally dissolved oxygen in fish farm, fluctuated considerably throughout the year. The lowest values appeared in summer average 4.10 ± 2.24 mg/l and the highest values were recorded in winter season average (7.69 ± 2.96) mg/l Table 2.

3.1.6. TP:

Almost all of the Total Phosphorus (TP) present in water is in the form of phosphate (PO_4) and in surface water mainly present as bound to living or dead particulate matter and in the soil is found as insoluble $Ca_3(Po_4)_2$ and adsorbed phosphates on colloids except under highly acid conditions. It is an essential plant nutrient as it is often in limited supply and stimulates plant (algae) growth and its role for increasing the aquatic productivity is well recognized.

The average Total phosphorus content in water recorded in fish farm fluctuated considerably through the year Table 2. The lowest value appeared in autumn average 17.02 ± 8.95 µg/l and the highest values were recorded in winter 24.27 ± 10.36 and in summer 25.58 ± 4.47 µg/l.

3.1.7. BOD:

BOD is measurement of total dissolved oxygen consumed by micro organism for biodegradation of organic matter such as food particles or sewage.....etc.

The average seasonally BOD reached its lowest 13.1 ± 20.66 mg/l in spring, at the beginning of culture season and then it gradually increase in summer and autumn with values 41.61 ± 21.62 and 94.97 ± 41.35 mg/l respectively to reach it highest value in winter 168 ± 213.71 mg/l, it's the end of culture season or drying season Table 2.

3.1.8. Chlorophyll-a:

Phytoplankton biomass has been estimated using chlorophyll-a as biomass indicator. The present investigation revealed that the average seasonally chlorophyll-a value, reached its lowest value 72.18 ± 11.84 µg/l in spring season began rearing period.

chlorophyll-a is raised during summer 338.33 ± 215.11 µg/l, attaining it highest value 373.18± 41.67 µg/l in autumn. Whilst it lowest in winter to 203.93 ± 164.15 µg/l Table 2.

Table 2: Physicochemical and Biological parameters of Mergam Fish Farm during the Period 2016-2017.

	Water Temp. °C	Secc-disk meter	pH	Salinity 0%	DO mg/L	TP µg/L	BOD mg/L	Chlorophyll-a µg/L
Spring	21 ± 3.95	0.23 ± 0.042	8.04 ± 0.40	6.80 ± 1.31	6.16 ± 1.58	22.57 ± 9.23	13.1 ± 20.66	72.18 ± 11.84
Summer	27 ± 1.86	0.18 ± 0.041	7.87 ± 0.26	7.58 ± 1.43	4.10 ± 2.24	25.58 ± 4.47	41.61 ± 21.62	338.33 ± 215.11
Autumn	21 ± 4.31	0.22 ± 0.041	7.92 ± 0.48	5.37 ± 1.42	4.47 ± 1.42	17.02 ± 8.95	94.97 ± 41.35	373.18 ± 41.67
Winter	16 ± 3.50	0.33 ± 0.140	7.72 ± 0.31	4.34 ± 1.51	7.69 ± 2.96	24.27 ± 10.36	168 ± 213.71	203.93 ± 164.15

3.2. TSI Model

This model is important because of its simplicity and modest requirements. Parameter estimation methods, using theoretical equations and the required input data are Physicochemical and Biological data for fish farm, ideally of this model; the decision makers can identify water quality of fish farm and make quick decisions.

TSI defined as the total weight of living biological (Biomass) in a body water at a specific location and time [13]. Chlorophyll-a pigment, Secchi depth and Total Phosphorus are variable independently used to estimate algal biomass. Trophic State is an absolute scale that describes the biological condition of the water body.

The results revealed that the mean seasonally of TSISD reached its highest value 84.44 during summer then it began to decrease gradually during autumn to 82.04 until attained its lowest value 75.83 in winter and TSICh recorded the highest values 88.7 and 87.73 in autumn and summer respectively, while it decrease to 82.76 and 72.58 in winter and spring respectively Fig. 2.

Whereas the TSITP fluctuate between 50.9 and 50.63 as a highest values in summer and winter respectively, while it recorded lowest value 45.5 and 47.4 in autumn and spring respectively as shown in Fig. 2. There for transparency and chlorophyll-a are a better predictor than TP which may related to algal biomass.

TSI Model revealed that Mergam fish farm suffers from eutrophication. The lowest level 67.15 and 69.74 recorded in spring and winter respectively, this mean that extensive macrophyte problem due to dominance of blue-green algae and algal scum probable. While, the highest level 74.36 and 72.07 recorded in summer and autumn respectively, this mean that often hypereutrophic due to Heavy algal blooms possible throughout the summer as shown in Fig. 2.

Seasons	Aveg. Secc-disk (Meter)	Aveg. Chlorophyll-a (μg/L)	Aveg. TP (mg/L)	Ln Secc-disk	Ln Chlorophyll-a	Ln TP	TSI Secc-disk	TSI Chlorophyll-a	TSI TP
Spring	0.225	72.1817	20.0415	-1.49165	4.279186089	2.9978	81.49475	72.57881554	47.38
Summer	0.183	338.3333	25.575	-1.69645	5.824031603	3.2416	84.44583	87.73375002	50.89
Autumn	0.217	373.1800	17.577	-1.5294	5.922060877	2.8666	82.03858	88.6954172	45.49
Winter	0.333	203.9288	25.11	-1.09861	5.317771077	3.2233	75.831	82.76733426	50.63

Seasons	TSI Secc-disk	TSI Chlorophyll-a	TSI TP	CTSI	Trophic Status Attributes
Spring	81.495	72.579	47.3783	67.151	Eutrophic: Dominance of blue-green algae, algal scum probable, extensive macrophyte problems
Summer	84.446	87.734	50.8941	74.358	Eutrophic: Heavy algal blooms possible throughout the summer, often hypereutrophic
Autumn	82.039	88.695	45.4862	72.073	Eutrophic: Heavy algal blooms possible throughout the summer, often hypereutrophic
Winter	75.831	82.767	50.6295	69.743	Eutrophic: Dominance of blue-green algae, algal scum probable, extensive macrophyte problems

Fig. 2: The Interface of TSI Model.

4. Discussion:

The aim of Fish farm management is to optimal fish production, which is totally dependent on the physical, chemical and biological qualities of water to most of the extent. Consequently, successful management requires an understanding of water quality such as temperature, transparency, pH, salinity, DO, Phosphate, BOD and plankton.

Fish classify as a cold blooded animal and environment affect on body temperature changes according its metabolism and physiology, in the end affecting the production.

The suitable water temperature for fish culture is between 24 and 30°C, also the levels of temperature as 28-32°C good for fish culture. whilst, water temperature level greater than 35°C lethal to maximum number of fish species and less than 12°C lethal but good for growth and survival for fishes. The suitable water temperature range for grows *O. niloticus*, *M. Capito* and *D. Labrax* ranged between 15-35 °C [14 and 15]. These result in agreement with the present results reveal that temperature influences the total standing crop of phytoplankton represent by chlorophyll-a where it decreases during winter 16°C and regains its maximum value during summer 27°C.

Turbidity affected by temperature and light intensity, the clay turbidity in water to 30 cm or less may prevent development of plankton blooms, 30 to 60 cm and as below 30 cm. Generally, adequate for good fish production and there is an increase in the frequency of dissolved oxygen problems when values above 60 cm, as light penetrates to greater depths encourage underwater macrophyte growth, and so there is less plankton to serve as food for fish [16].

The good range of turbidity for fish health and optimum productivity is 30-40 cm, also 15-40 cm is good for intensive culture system but less than 12 cm causes stress [14 and 15]. These results in agreement with the present results were transparency between 0.18 ± 0.04m and 0.33 ± 0.14 m in summer and winter respectively as minimum and maximum values.

pH measures negative logarithm of hydrogen ions concentration. Carbon dioxide concentration is affects on nature of water pH, which carbon dioxide is an acidic gas. The suitable pH range for fish culture is between 6.7 and 9.5 and ideal pH level is between 7.5 and 8.5 and above and below this is stressful to the fishes [15 and 17]. This result is agreement with the present result pH mean range between 7.72 ± 0.31 to 8.04 ± 0.40 in winter and spring respectively as minimum and maximum.

Salinity is a measure the salt content of water and is equivalent to the total amount of dissolved solids in sea water by weight. Salinity of the surface waters of the world is highly variable, depending mainly upon ionic influences of drainage, exchange from the surrounding land, atmospheric sources, as well as the equilibrium and exchange with sediments inside the water body. Salinity of the natural waters is influenced further by depth, latitude and the mode of water percolation [18]. Salinity is a main factor that affects the growth and density fish. Also, They are sensitive to the salt concentration of their waters. Fish evolve a system that maintains a constant salt ionic balance in its bloodstream through the movement of salts and water across their gill membranes [19]. The marked variation of salinity in Lake Manzala range between 0.86 and 9.39 gm/l with average range 2 gm/L in areas impacted by drain water to 15 gm/l in the coastal areas. As well, *O. niloticus, M. Capito and D. Labrax* are the species inhabiting in Lake Manzala [20]. This result is agreement with the present result Salinity mean range between 4.34 ± 1.51 to 7.58 ± 1.43 in winter and summer respectively as minimum and maximum.

Oxygen values are the important factors that control the distribution of fish. Various investigators have showed that fish are always present where the oxygen concentration is high, and the fish tend to choose water of high oxygen concentration [20]. There is Inverse relationship between temperature and DO; this is because temperature is affect on DO concentration [21]. Oxygen deficiency in water leads to Malnutrition, mortality and low growth of fish. The average level of DO between 3.0-5.0 mg/l in ponds is unproductive. The suitable level of DO is greater than 5 mg/l which is necessary to support good fish production [14].

The present results revealed that the DO mean value ranged between 4.10 ± 2.24 mg/l in summer as a minimum to 7.69 ± 2.96 mg/l in winter as a maximum, this value under control by introduction of fresh water from El-Kilo 21 canal the main water source of fish farm all night every day. These result considered in adequate value in aquaculture and agreement with [22] which recommended that fish can die if exposed to less than 0.3 mg/l of DO for a long period of time. The minimum concentration of 1.0 mg/l DO is essential to sustain fish for long period and 5.0 mg/l are adequate in fishponds. The environmental management of pond fish culture explains that for good water quality; maintain the DO level at above 4 mg/l.

BOD is the measurement of DO consumed by microorganisms for biodegradation of organic matter such as food particles or sewage. The BOD level between 3.0-6.0 mg/l is optimum for normal activities of fishes; 6.0-12.0 mg/l is sub-lethal to fishes and greater than 12.0 mg/l can usually because death of fish due to suffocation [14]. BOD level is the optimal for aquaculture should be less than 10 mg/l but the water with BOD less than 10-15 mg/l can be considered suitable for fish culture [16].

There for the present result revealed that Mergam fish farm considered definitely poor due to the high value of BOD which ranged between 13.1 ± 20.66 mg/l in spring season as a minimum value, then it gradually increased to 41.61 ± 21.62 and 94.97 ± 41.35 mg/l in Summer and Autumn respectively, to reach 168 ± 213.71 mg/l in winter season as a maximum. This problem of high BOD due to biodegradation of organic matter such food particle and sewage. Thus, the water pump is operated 12 hours daily in night to increase the amount of dissolved oxygen in the water

TP concentration present in water is in the form of phosphate (PO_4) and it in surface water mainly present as bound to living or dead particulate matter. Also, it is an essential algae nutrient as it is often in limited supply and stimulates growth of algae and its role for increasing the aquatic productivity. The desired level of TP for fish culture is 0.06 mg/l while, the optimal and productive value 0.05-0.07 mg/l and 1.0 mg/l is good for plankton production [14 and 24].

The present result revealed that the mean value of TP is ranged between 17.02 ± 8.95µg/l in autumn as a minimum to 25.58 ± 4.47 µg/l in summer as a maximum, this mean that the value of TP in agreement with [14 and 23].

Planktons are aquatic pelagic organisms, which are carried about by the movement of the water rather than their own ability to swim. There is a close relationship between plankton and fish production, this is because the main food for major fish is planktons [24]. Chlorophyll-a concentration helps to calculate of phytoplankton group for the purpose of calculating the biomass of individual phytoplankton group successfully [25].

Primary productivity of plankton can be estimated by measuring the Chlorophyll-a by measure the biomass of algal. If the productivity value ranged between 0.5 to 1.5 mg/m^3, it was considered as oligotrophic; while, the range between 1.5 to 10 mg/m^3 it was considered as mesotrophic. Also, the range between 5 to10 mg/m^3 it was considered as eutrophic and greater than 10 mg/ m^3 it was considered as highly eutrophic [26].

Ecosystem classification based on various methods and indices have been made by various authors. The classical and most commonly used method is based on the water body productivity. It is the biomass related to trophic state index developed by [9]. CTSI is a common method for characterizing any ecosystem's trophic state. This method uses Secchi's disc transparency, chlorophyll-a, and TP measurements. Trophic state is defined as the total weight of the biomass in a water body at a specific location and time. CTSI mainly uses algal biomass involving three variables namely chlorophyll.a, Secchi disc and TP.

Trophic state monitoring is an important part in assessing and managing ecosystems. As TP is a limiting nutrient in algal growth [27], TP is commonly measured in the assessment of trophic state. Algal concentration can be estimated indirectly by determining the chlorophyll-a. The more chlorophyll-a corresponds to more phytoplanktons and more eutrophic state of the ecosystems. The measurement of chlorophyll-a can be used as a primary index for trophic state classification and to infer the functioning of ecosystems [28]. Secchi's disc is used to measure the transparency of water. The transparency depends upon the density of algal populations and other suspended solids in water [29].

TSIS is a proposed system which uses DSS tools to identify eutrofication level, high concentration level of chlorophyll-a in water column of Mergam fish farm is inversely proportion to Secchi-disc. It is designed so user can manipulate parameters of the model with ease so as one could analyses data to have a positive output.

There for, present result revealed that transparency and chlorophyll-a are a better predict than TP which may related to algal biomass.

5. Conclusion and Decision Maker Recommendation:

Mergam fish farm is located in Lack Mariout West of Alexandria. its area is 14 feddans, divided into 3 equal ponds; from the first pond one feddan is separate as nursing pond for fries. The water depth in the farm's ponds varies from 1 to 2 m with average depth 1.5 m. The rearing period began in March, D. labrax, M. capito and mono sex O. niloticus fingerlings were stocked in the three rearing earthen ponds (13 feddan) at rate 140, 10 and 250 thousand respectively, the feeding rate randomly, twice a day at 10 am and 4 pm for six days/week. The commercial supplementary feed meal was from ALER AQUA Company (30% protein).

The results revealed that mean season at temperature, pH and salinity are in the convenient level for the culture species (O. niloticus, M. Capito and D. Labrax), while the DO are at minimum level. Mergam's fish farm suffer from high level of BOD, high blooming of phytoplankton represented by low transparency, high value of measured chlorophyll-a and total phosphorus. The proposed Trophic State Index System (TSIS) is an effectiveness Decision Support System (DSS) intended to support decision makers to manage fish farm. The main component of TSIS is the inclusion of TSI model that was implemented in this study to identify different Trophic State Index (TSI). The resulting seasonal showed that the lowest level of eutrophication 67.15 and 69.74 recorded in spring and winter respectively, this mean that extensive macrophyte problem due to dominance of blue-green algae and algal scum probable. While, the highest level of eutrophication 74.36 and 72.07 recorded in summer and autumn respectively, this mean that often hypereutrophic due to heavy algal blooms possible throughout the summer. From the result of TSIS decision maker recommended that:

1. Fish farm manager must be careful preparation of the pond bottom by removing the accumulated organic matter and scraping the bottom pond prior to stocking fries.
2. Manager must be avoid over feeding by diet rate must be 5% of its biomass twice a day for 6 days/week.
3. Improved nutrient efficiency and reduced the need for dietary fish meal and fish oil.

References:

1. FAO. World Review of Fisheries and Aquaculture, 2014. The State of World Fisheries and Aquaculture, Part 1, 2014.
2. FAO. World Review of Fisheries and Aquaculture, 2016.
3. Konsowa, A. H. Ecological studies on fish farms of El- Fayon depression (Egypt). Egyptian Journal of Aquatic Research, v. 33, n. 1, p. 290-300, 2007.
4. Tavares, L. H. S. and Santeiro, R. M.. Fish farm and water quality management. Acta Scientiarum. Biological Sciences, ISSN: 1679-9283, vol. 35, núm. 1, enero-marzo, pp. 21-27, 2013.
5. Turban, E. S. R., Aronson, J. E. and King, D. 'Business Intelligence: A Managerial Approach,' Second Edition, Pearson Prentice Hall, 2011.
6. Arnott1, D. and Pervan, G.. A critical analysis of decision support systems research revisited: the rise of design science. Journal of Information Technology. 29, pp. 269–293, 2014.
7. Tripathi, K.P. Decision Support System Is A Tool For Making Better Decisions In The Organization. Indian Journal of Computer Science and Engineering (IJCSE). www.ijcse.com/docs/IJCSE11-02-01-054.pdf. ISSN: 0976-5166. Vol. 2 No. 1. pp. 112-117, 2011.
8. Strickland, J. D. and Parsons, T. R. A pracktical Hand Book of Sea Water Analysis. Fish. Res. Board Cand., Ottawa, pp.331, 1972.
9. Carlson, R. E. A. Trophic State Index for Lakes. Limnology and Oceanography, v. 22, n. 2, p. 361-369, 1977.
10. Carlson, R.E. More complication in the chlorophyll.a-Secchi's disc relationship. Limnology and Oceanography. 25: 378-382, 1980.
11. Devi Prasad, A. G. and Siddaraju. Carlson's Trophic State Index for the assessment of trophic status of two Lakes in Mandya district. Advances in Applied Science Research, 3 (5):2992-2996, 2012. www.pelagiaresearchlibrary.com
12. Solis, N.B. The Biology and Culture of Penaeus Monodon, Department Papers. SEAFDEC Aquaculture Department, Tigbouan, Boilo Philippines, pp 3-36, 1988.
13. Carlson, R.E. and Simpson, J. A Coordinator's Guide to Volunteer Lake Monitoring Methods.

North American Lake Management Society, Madison, WI, 1996.
14. Bhatnagar, A., Jana, S.N., Garg, S.K. Patra, B.C., Singh, G. and Barman, U.K. Water Quality Management in Aquaculture, In: Course Manual of Summerschool on Development of Sustainable Aquaculture Technology in Fresh and Saline Waters, CCS Haryana Agricultural, Hisar (India), pp 203- 210, 2004.
15. Santhosh, B. and Singh, N.P. Guidelines for Water Quality Management for Fish Culture in Tripura, ICAR Research Complex for NEH Region, Tripura Center, Publication no.29, 2007.
16. Boyd, C.E and Lichtkoppler, F. Water Quality Management in Fish Ponds. Research and Development Series No. 22, International Centre for Aquaculture (J.C.A.A) Experimental Station Auburn University, Alabama, pp 45-47, 1979.
17. Boyd, C. E. Water Quality in Warm water Fish Ponds, Agriculture Experiment Station, Auburn, Alabama, pp 359, 1979.
18. Badr, B.N. Chemical Studies on Copper in The Coastal Mediterranean Water in front of Alexandria. Msc Thesis. Alex. University, 1993.
19. Jamabo, N.A. Ecology of Tympanotonus fuscatus (Linnaeus, 1758) in the Mangrove Swamps of the Upper Bonny River, Niger Delta, Nigeria. Ph.D. Thesis, Rivers State University of Science and Technology, Port Harcourt, Nigeria, pp 231, 2008.
20. Mustafa, M. M. Constructing a Proposed DSS Simulation Based Model to Optimize the Ecosystem of El Manzala Lake. M.D. Thesis, Sadat Academy for Management Sciences. Faculty of Management Sciences. 2014.
21. Saad, M.A.H. Limnological studies on the Nozha Hydrodrome, Egypt with Special References to The Problems of Pollution. Sci. Total Environ., 67(2-3): pp.195-214, 1987.
22. Ekubo, A. A. and Abowei, J. F. N. Review of Some Water Quality Management Principles in Culture Fisheries, Research Journal of Applied Sciences, Engineering and Technology, 3(2), pp 1342-1357, 2011.
23. Stone, N. M. and Thomforde H. K. Understanding Your Fish Pond Water Analysis Report. Cooperative Extension Program, University of Arkansas at Pine Bluff Aquaculture / Fisheries, 2004.
24. Smith, E. V. and Swingle. H. S. The Relationship Between Plankton Production and Fish Production in Ponds. Transactions of the American Fisheries Society, 68, pp 309-315, 1938.
25. Schiüter L., MØhlenberg, F., Havskum H., Larsen, S. The use of phytoplankton pigments for identifying and quantifying phytoplankton groups in coastal areas: testing the influence of light and nutrients on pigment/chlorophyll a ratios. Marine Ecology Progress Series Mar Ecol Prog. Ser. Volume 192: 49-63, 2000.
26. Trifonova, I. S. Change in community structure and productivity of phytoplankton as indicator of lake reservoir eutrophication, Archiv für Hydrobiologie–Beiheft Ergebnisse der Limnologie, 33, pp 363- 371, 1989.
27. Horne A.J and Goldman C.R. Limnology. 2nd Ed. McGraw Hill, New York. 1994.
28. Hosmani S.P. Trophic State Index in Conservation of lake Ecosystems. *Advances in Plant Sciences*, 23 (II) 593-596, 2010.
29. Heiskary S.A. Trophic state of Minnesota lakes. MQCA Roseville. 1985.

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