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Effect of exploitation of fish ponds in the cultivation of wheat in the winter season on growth performance and total yield of *Oreochromis niloticus*.

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ABSTRACT

This study aimed to illustrate healthy and profitable alternative culture method for *Oreochromis niloticus* with wheat. Six earthen ponds (4200 m²) were used in this study. Fish farming has been two successive seasons separated by cultivating wheat in the winter period. Fish farming of *O. niloticus* in the first season was in the period 15/5/2012 until 21/10/2012 followed cultivating wheat in the period 5/11/2012 until 10/05/2013 followed farming *O. niloticus* in the period from 21/15/2013 until 27/10 /2013. *O. niloticus* fish were exposed to three treatments (Two replicates for each treatment). The first treatment fish were fed on artificial feed 25% crude protein only, in the second treatment fish were fed on artificial feed 25% crude protein with inorganic fertilization and in the third treatment fish were fed on artificial feed 25% crude protein with organic fertilization. The wheat was cultured without fertilization. *O. niloticus* fingerlings averaging 30.07g for first year and 30.83g for second year were assigned randomly (12000 fingerlings/ feddan). Results obtained can be summarized as follows:

Season of aquaculture: the first season recorded the highest ranges of body weight (BW), body length (BL), condition factor (K), daily weight gain (DWG) and specific growth rate (SGR).

Treatments: treatment3 recorded the highest ranges of body weight (BW), body length (BL), condition factor (K), daily weight gain (DWG) and specific growth rate (SGR).

Wheat culture: third tratment recorded the highest ranges of total weight of Wheat crop.

Based on results obtained in this study and on the economical evaluation, it could be concluded that, wheat can grow in the fish ponds during the winter season, taking into account feeding *O. niloticus* on a artificial feeding contain 25% crude protein in addition to organic fertilization using chicken manure also add organic fertilization to increase the weights of fish as well as increasing wheat crop of fish ponds, in addition to that it was the best in terms of economic efficiency compared with other treatments.

Key words: Fish ponds, cultivation of wheat, growth performance, *O. niloticus*

INTRODUCTION

Integration of aquaculture with agriculture is more developed in Asia than in any other region of the world. However such integrated farming systems are presently used by only a very small minority of farmers (<I %) in a few countries and have not progressed far in terms of productivity and efficiency from their traditional beginning. This point is often missed by donors and development agencies that, seeing that Asia produces 75% of the worlds cultured fish (Lightfoot, 1990).

Crops-fish culture can actually increase crops yields (up to 10% in some cases) while providing farmers with an important source of protein and extra income. A perfect design is relatively inexpensive and of low-risk to fish farming in crop fields, and farmers generally follow this procedure. Alternative fish culture demonstrated a perfect design for gaining maximum outputs of land, water and manpower. The culture system develops the productivity of poor lands and water to produce valuable animal protein and fielded crops (clover, wheat and Barley). Alternative methods produce high quality human food and a friendly method of disease control (not only for food but for the surrounding environment too) (Baotong, 1984, Colman and Edwards, 1987 and Stefan 2004).

The repeated aquaculture of semi-intensive earthen ponds without dry periods leads to uncontrolled wild vegetation, propagation of some intermediate hosts as snails and outbreaks of many uncontrolled diseases. Aquaculture in Egypt is variable and of many methods and either unitary, alternative or integrated either with plants and/or animal species (Tambi, 2001). Moreover the most economic use of water is in this study as we use agriculture drainage water which is considered waste water meeting the countries policy in careful use of our share of water. Therefore the study is a unique demonstration of an applied field trial for increasing both quality and quantity of fish production and making maximum use of soil to produce field crops.

MATERIALS AND METHODS

The study had been done in a private farm (in Tollumbat No. 7 in Riyad City, Kafr El-Sheikh governorate, Delta district at the Northern part of Egypt) to evaluate the Effect of exploitation of fish farms in the cultivation of wheat in the winter season on growth performance and total yield of *Oreochromis niloticus* and wheat yield. The pond preparation, alternative culture, stocking density and pond daily management are described in details. Also, water quality measurements, fish sampling and data collected during harvest are recorded too. Equations and statistical methods for analysing the specific growth rate, daily weight gain and the condition factor are given.

Experimental design:

The current experiment was conducted using randomized block design for three treatments of similar surface area (4200 m2) in each pond. The experimental ponds were equal in water volume (5250 m3) and dimensions (42x100 m) with the same average water depth of 125 cm. before beginning of this experiment. The farm water source was mainly agricultural drainage water and comes from El-Gharbia drainage canal. The water system of the experimental ponds is maintained by gravity.

Experimental fish:

Fish species:

The experimental ponds were stocked with *O. niloticus* (12000 of fingerlings/ feddan). The fingerlings were stocked at first season with an average initial total length of 15.57cm and an average initial total weight of 30.07g for all treatments. The average of initial total length at second season was 16.33cm and an average initial total weight of 30.83g.

Treatments:

O. niloticus fish were exposed to three treatments, The first treatment fish were fed on artificial feed 25% crude protein only, in the second treatment fish were fed on artificial feed 25% crude protein with organic fertilization and the fish in third treatment were fed on artificial feed 25% crude protein with inorganic fertilization (each treatment with 2 replicates for fish and wheat culture).

Pond management:

The first season of this study was carried out during the period 15/5/2012 (beginning the culture of *O. niloticus*) until 21/10/2012 (154 days harvesting time) followed by cultivating wheat during the period from 5/11/2012 until 10/05/2013 (160 days) and this followed again by culture of *O. niloticus* at 21/5/2013 and harvested on 27/10/2013(154 days). In which the following culture practices were done:

Fertilizers applications for *O. niloticus:*

Ponds were fertilized for 22 week. Fertilization was done once a week by broadcasting of:

-Organic fertilizer: poultry manure 50kg (treated by heating in commercial diet factory) /feddan/week: during the experimental period and the application was done on pond surface.

-Inorganic fertilizers: (Triple super phosphate; 20% P_2O_5 and urea containing 46% nitrogen) were added as sources of phosphorus and nitrogen to ponds weekly at a rate of 8 kg/feddan of Triple super-phosphate, by dissolving it in water and splashed all over the experimental ponds water. While 2kg urea/feddan were broadcasted at pond water surface.

Supplementary feed for *O. niloticus*:

Commercial diet was manufactured by Sherbeen-Domiatte, local animal feed factory. Sample of fish feed was collected from several sacks and sent for proximate analysis at the Central Laboratory for Aquaculture Research at Abbassa. The fingerlings for two seasons were fed commercial floating diet to keep the diets available for fish (25% crude protein-pellets 3mm in diameter), and fed six days per week at a daily feeding rate of 3% of the estimated fish-weight twice at 9.00am and 3.00pm during the experimental period. Feed was applied by broadcasting over pond water surface in the same place and fish were considered satiated when they did not show an interest on the feed.

Feed quantity was adjusted according to average body weight of the sample in each pond. In order to determine the average weight of fish, biweekly samples were taken by seining where 60 fishes from each pond (replicate) were collected and then released again in the pond after individual measuring the weight and length.

Water management:

Water temperature, dissolved oxygen and pH were measured daily at 6 a.m. and 12 p.m. (during the two seasons of study) using thermometer, dissolved oxygen meter (YSI model 57) and pH meter (model Corning 345), respectively. Determinations of the other water quality parameters (alkalinity and ammonia) were carried out every two weeks according to the methods of Boyd (1979).

Harvesting:

At the end of this experiment (21^{st} of October, 2012) and (27^{th} of October, 2013) for the first and second seasons, respectively ponds were gradually drained from the water and fish were harvested by seining and transferred to fiberglass tanks and carried to the processing centre where they washed, and the fish were sorted and collectively weighed.

Wheat culture:

At the end of fish culture and harvesting of fish in the beginning of October and began planting wheat seeds that were planted at the third week of November, after conducting different service to the wheat crop from the plow and the settlement of the pelvic floor. Wheat was cultured without fertilization.

Flooded the seeds in water for 24 hours and then evenly distributed using stores tractors because of wet ponds of fish production. And for the distribution of seeds well in the field and at depth and to provide a suitable quantity of seeds used 60KG of seed germination and after patching is 10 kg of seeds as recommended by Baotong (1984) and Salah, (2003).

Irrigation:

The irrigation ponds must be taken 4 irrigations only because of the presence of water basins and care in mind and accuracy in planting dates because increasing times of irrigation leads to swelling of the grain and decreases lead to roasted and thus lower germination percentage. Irrigation of reviving was after about 50 days of agriculture, thereafter irrigation and then every 25 days and to prevent irrigation when it is characterized by the arrival of plants to maturity Physiological and that by the last battalion yellowish.

Fish samples and measurements:

Random samples (60 fish of *O. niloticus* for each pond) were taken biweekly during the experimental period to keep records on body weight and length. During this experiment, body measurements (body weight in g and body length in cm) were recorded 10 times, at biweekly interval throughout the whole experimented period.

Condition factor was determined by using the following formula:

$$K= [\text{ weight (g) / length (cm)}^3] \times 100$$

Specific growth rate was calculated according to Jauncey and Rose (1982).

Statistical analysis:

The statistical analysis of data collected was carried out by applying the computer program (SAS, 1996) by adopting the following fixed model:

$$xij = \mu.. + \alpha i + \beta j + \alpha\beta ij.$$

Where:

Xij = observation of the ijkl-th fish μ = Overall mean. αi = the effect of I-th year.

βj = the effect of J-th tratment.

αβij = the effect of interaction between I-th year and treatment J-th.

Differences among means were tested for significancy according to Duncan's multiple range tests (Duncan, 1955).

RESULTS AND DISCUSSION

Water Quality parameters:

Results of water quality parameters of the experimental ponds during the experimental period (2012 and 2013) as averages of the monthly samples are summarized in Table (1). In general, averages of water temperature during the two seasons ranged from 27.2, 27.8 and 26.9°C for year 2012 and 26.5, 27.4 and 27.1 °C for year 2013, respectively. Dissolved oxygen ranged between 4.9, 6.8 and 5.5 mg / l and 5.2, 6.4 and 5.8mg / l. for two years 2012 and 2013, respectively. AIT (1986), and Hasssan *et al*. (1997) reported that 2.3 mg DO /l is above the normal tolerance level of tilapia.

Table 1: Some water quality parameters of earthen ponds during to experimental seasons.

Variable	NO.	2012			2013		
		T1	T2	T3	T1	T2	T3
Tem.(C°)	6	27.2±1. 2	27.8±1. 2	26.9±1. 2	26.5±1. 2	27.4±1. 2	27.1±1. 2
DO oxygen	6	4.9±0.3	6.8±0.3	5.5±0.3	5.2±0.3	6.4±0.3	5.8±0.3
PH	6	7.6±0.6	8.2±0.6	8.1±0.6	7.3±0.6	7.9±0.6	7.1±0.6
S. disk (cm)	6	26.2±1.7	21.2±1.7	23.1±1.7	22.4±1.7	20.4±1.7	21.9±1.7
NH_3 mg/l	6	0.35±0.01	0.32±0.01	0.29±0.01	0.31±0.01	0.26±0.01	0.28±0.01
NO_2 mg/l	6	0.040±0.01	0.039±0.01	0.039±0.01	0.039±0.01	0.038±0.01	0.039±0.01
NO_3 mg/l	6	0.11±0.02	0.10±0.02	0.11±0.02	0.12±0.02	0.12±0.02	0.11±0.02
T. alk. (mg/l)	6	407.7±9.4	429.2±9.4	4.16.9±9.4	384.8±9.4	398.5±9.4	402.3±9.4

pH ranged between 7.6, 8.2 and 8.1 for year 2012 and 7.3. 7.9 and 7.1 for year 2013 Boyd (1998) reported that waters with a pH range of 6.5 – 9 are the most suitable for fish production. The average values of seechi disk readings were 26.2, 21.2 and 23.1cm for year 2012 and 22.4, 20.4 and 21.9cm for years 2013, respectively. The significant decrease in seechi disk reading less than 20 cm for T1 of year 2012 indicates that pond is too turbid, which may due to either phytoplankton or suspended soil particles (Boyd 1998). The average concentration of unionized ammonia (NH_3) was 0.4, 0.037 and 0.039mg/l for year 2012 and 0.035, 0.038 and 0.037mg/l for year 2013. in this respect Diana and Lin (1998) reported ammonia concentration of 0.374 – 0.410 mg/l in ponds fertilized with both chicken manure and inorganic fertilizers in combination.

The values of the total alkalinity ranged between 407.7 and 384.8 mg/l, for two years. The above results showed that all parameters of water quality were in the suitable range required for Nile tilapia (Boyd, 1979).

Wheat yield:

Data in Table (2) showed the effect of artificial feed, inorganic and organic fertilization for fish ponds on wheat yield and its components. The data indicated that all parameters were significantly affected by organic and inorganic fertilization.

The superiority of organic fertilization for fish ponds, in the yield and its components in both seasons may be due to the increase in number of spikes and tillers/m2, number of grains, spike length, weight of 100 grains as illustrated in Table (4). Sharma *et al*., (2000) and Verma *et al*., (2000) studied the effect of fertilization on yield and yield attributes of wheat, and found that increases in grain yield/ha, 100-grain weight, number of spikes/m2 and plant height. Bassel, *et al*., (2001) studied the effect of bio- fertilization and showed that bio-fertilizer application resulted in significant increases in plant height, number of spikes/m2, number of grains/spike, 100 grain weight, grain and straw yields/feddan.

Table 2: effect of artificial feed, organic and inorganic fertilization for fish ponds on wheat yield and its parameters.

Variable	No.	T1	T2	T3
No. of tiller/m^2	3	309.55±2.31c	317.94±2.31b	322.0±2.31a
No. of spikes/m2	3	28831±4.04a	291.85±4.04a	298.93±4.04a
Spike length (cm)	3	9.69±0.58b	10.52±0.58a	10.90±0.58a
100 grain weight	3	4.22±0.29b	4.47±0.29a	4.64±0.29a
No. of grains/spike	3	49.29±0.87c	51.78±0.87b	53.16±0.87a
No. of grains/m^2	3	14211±49.07c	15112±49.07b	15891±49.07a
weight of grains (Kg)/m^2	3	59.970±20.21c	67.551±20.21b	73.735±20.21a
grains yield kg/feddan	3	2518.72±20.21c	2837.13±20.21b	3096.86±20.21a
straw yield kg/feddan	3	2720.77±29.56c	2887.58±29.56b	2911.26±29.56a

a, b, c ± records of the same row having the same letter do not differ significantly ($P<0.05$) other wise they do.

The highest values of studied charactersparameters i.e. number of tiller/m2, number of spikes/m2, number of grains/spike, 100 grain weight(g), straw yields (Kg/fed) and grain yield(kg/fed), were obtained by artificial feed, organic and inorganic fertilization for fish ponds. Compared to the controlgroup. Furthermore T3 recorded the highest ($P<0.05$) values folloed in a decreasing significant by T2 and T1, resspectively except No. Of spikes/m^{2,} spike length (cm) and 100 grain weight where T3 and T2 were significantly higher in this traits.

Body weight:

Table (3) shows means of body weights, at the start and the end of the experiment as affected by years 2012 and 2013. As described in this table, the averages of initial weights of *O. niloticus* were 30.07 and 30.83g respectively; while at the end of the experiment, the averages of body weight for *O. niloticus* were 322.94 and 311.23g, respectively regardless treatments applied. These results indicate that, the body weight for first year was higher than that obtained in second year. The differences between tow years were significant ($P<0.05$).

With regard to the effect of pond treatments on body weight, Table (3) showes that, the initial body weight was 30.49, 30.30 and 30.61g for three treatments artificial feeding (AF), artificial feeding with inorganic fertilizers (urea and Triple super phosphate) (AFI) and artificial feeding with organic fertilizer (AFO), respectively. While at the end of experiment the means of body weight for treatments were 298.19, 333.22 and 319.85g for three treatments, respectively regardless of year. These results indicate that, the average body weight for treatment (AFO) was higher (P<0.05) than other treatments. The analysis of variance of these results indicates that, the differences among treatments were significant (P<0.05). These results are in agreement with El-Ebiary (1998) who studied the use of organic manures in polyculture system for tilapia, mullet and carp, and found that, the average of final weight influenced by an increase of the period of organic fertilization. He referred that, organic fertilizer is not enough to rely upon as a suitable food for Fish.

Table 3: Least-square means and tested standard error of the factors affecting on body weight (gm).

Variable	No.	Initial weight	Final weight
Year (Y)			
Y1	**360**	30.83±0.72a	322.94±2.34a
Y2	**360**	30.07±0.72a	311.23±2.34b
Treatments (T)			
AF	**240**	30.49±0.89a	298.19±2.67c
AFI	**240**	30.30±0.89a	319.85±2.67b
AFO	**240**	30.56±0.89a	333.22±2.67a
Interaction between Y*T			
Y1*AF	**120**	30.80±1.27a	299.19±2.78d
Y1*AFI	**120**	30.70±1.27a	328.20±2.78b
Y1*AFO	**120**	31.00±1.27a	343.44±2.78a
Y2*AF	**120**	30.18±1.27a	298.32±2.78d
Y2*AFI	**120**	29.90±1.27a	311.50±2.78c
Y2*AFO	**120**	30.±1.27a	323.01±2.78b

a, b, c ± Means with the same letter in each column are not significantly different (P≥0.05).
Y1 = year 2012 Y2 = year 2013 AF = Artificial feed only AFI = Artificial feed with inorganic fertilizer AFO = Artificial feed with organic fertilizer

Islam *et al.* (2008) studied the effects of fertilization and supplementary feed on growth performance of the three major carps. He reported that, the artificial diets with caw manure influenced the growth and survival rate and harvested fish biomass.

Jasmine et al., (2011) found that, average gain in body weight of all the fish species together was less in the pond without fertilizer than that in the pond with fertilizer. The fertilizer increased the primary productivity and finally caused a significant increase in fish yield in ponds.

Results presented in Table (3) show that variations were significant (P<0.05) due to the interaction between years 2012 and 2013 and treatments (artificial feeding, artificial feeding with inorganic fertilization and artificial feeding with organic fertilization) which indicated that these two factors act dependently on each other and also each of them had its own significant effect. The averages of initial weights of *O. niloticus* were 30.19, 29.90, 30.11, 30.79, 30.70 and 31.01g; while at the end of the experiment, the averages of body weight were 299.19, 328.20, 343.44, 298.32, 311.50 and 323.01g, respectively for the treatments Y1*AF, Y1*AFI, Y1*AFO, Y2*AF, Y2*AFI and Y1*AFO. As showed in this Table, the best final weight was obtained for 3nd treatment (AFO, being 343.44g) at first year. This result may be due to the wheat crop was stressful for the soil, leading to a lack of nitrogen from the soil which is essential for phytoplankton bloom. This result are agreement with , Chakraborty (2007) he found that, the alternation of fish culture with both planting Clover followed by culturing fish was the best, but *O. niloticus* farmed after wheat culture given the low growth. This may be attributed to the fact that Clover roots grow deeply into the soil aerating it, fixing atmospheric nitrogen and adding beneficial bacteria.

Body length:

Table (4) shows means of body length, at the start and the end of the experiment as affected by years 2012 and 2013. As described in this table, the averages of initial body length of *O. niloticus* were 11.57 and 16.33cm respectively regardless of treatments; while at the end of the experiment, the means of body length for *O. niloticus* were 34.30 and 32.81cm, respectively. These results indicate that, the body length for first year was higher than that obtained in second year. The differences between two years were significant (P<0.05).

With regard to the effect of pond treatments on body length, Table (4) showes that, the initial body length was 15.99, 15.80 and 16.06cm for three treatments artificial feeding (AF), artificial feeding with inorganic fertilizer urea and Triple super phosphate) (AFI) and artificial feeding with organic fertilizers (AFO), respectively. While at the end of experiment the means of body length for treatments were 32.69, 34.14 and 33.93cm for the three treatments (AF, AFI and AFO), respectively. These results indicate that, the average body length for treatment (AFI) was higher (P<0.05) followed in a decresing significant order by AFO and AF, respectively. The analysis of variance of these results indicates that, the differences among treatments were significant (P<0.05). Prabahar and Murugan (2012) found increasing body length when major carp, fed on artificial feed plus organic fertilizer and inorganic fertilizers.

Table 4: Least-square means and standard errors of the tested factors affecting total body length (cm).

Variable	No.	Initial length	Final length
Year (Y)			
Y1	**360**	15.57±0.73b	34.30±1.27a
Y2	**360**	16.33±0.73a	32.81±1.27b
Treatments (T)			
AF	**240**	15.99±0.90a	32.69±1.09c
AFI	**240**	15.80±0.90a	34.14±1.09a
AFO	**240**	16.06±0.90a	33.93±1.09b
Interaction between Y*T			
Y1*AF	**120**	15.67±0.93b	34.67±1.07b
Y1*AFI	**120**	15.40±0.93b	32.90±1.07d
Y1*AFO	**120**	15.41±0.93b	35.30±1.07a
Y2*AF	**120**	16.29±0.93a	30.69±1.07e
Y2*AFI	**120**	16.20±0.93a	33.17±1.07c
Y2*AFO	**120**	16.51±0.93a	34.57±1.07b

a, b, c ± Means with the same letter in each column are not significantly different (P≥ 0.05).

Results presented in Table (4) show that variations were significant (P<0.05) due to the interaction between years 2012 and 2013 and treatments (artificial feeding, artificial feeding with inorganic fertilization and artificial feeding with organic fertilization) which indicated that these two factors act dependently on each other and also each of them had its own significant effect. The averages of initial body length of *O. niloticus* were 15.67, 15.40, 15.41, 16.29, 16.20 and 16.51cm; while at the end of the experiment, the averages of body length were 34.67, 32.90, 35.30, 30.69, 33.17 and 34.57cm, respectively for treatments Y1*AF, Y1*AFI, Y1*AFO, Y2*AF, Y2*AFI and Y1*AFO. As showed in this Table, the best final body length was obtained for 3rd treatment (AFO, being 35.30cm) at first year. Hafez (1991), found a strong correlation between body weight and body length for tilapia, mullet and carp fish. Chakraborty (2007) found that, the alternation of fish culture with wheat followed by culturing fish showed the lowest of body length.

Condition factor (K):

Table (5) shows means of Condition factor (K), at the start and the end of the experiment as affected by years 2012 and 2013. As described in this table, the averages of initial (K) of *O. niloticus* were 1.80 and 1.49 respectively; while at the end of the experiment, the means of (K) for *O. niloticus* were 0.93 and 0.87, respectively. These results indicate that, the Condition factor (K) for first year was higher than obtained in second year. The differences between tow years were significant ($P<0.05$).

With regard to the effect of pond treatments on Condition factor (K) regardless of treatments, Table (5) showeds that, the initial (K) was 1.63, 1.71 and 1.60 for three treatments artificial feeding (AF), artificial feeding with inorganic fertilizers (urea and Triple super phosphate) (AFI) and artificial feeding with organic fertilizer (AFO), respectively. While at the end of experiment the effect of pond treatments on Condition factor for treatments were 0.88, 0.84 and 0.84 for the three treatments, respectively. These results indicate that, the average Condition factor (K) for treatment (AF) was higher ($P<0.05$) than other treatments. The analysis of variance of these results indicates that, the differences among treatments were significant ($P<0.05$). Feeding treatment in adequate quantities with chicken manure fertilization led to higher condition factor since the fish grow well when the supply of food is adequate. Similar results in which condition factor increased with the feeding rate have been reported by Chua and Teng (1982). Dioundick and Stom (1990) demonstrated that, for *O. massambicus*, the values of condition factors decreased with increasing the ∝-cellulose percent from 0 to 10% of the diet.

Table 5: Least-square means and standard error of the tested factors affecting on condition factor (K).

Variable	No.	Initial K	Final K
Year (Y)			
Y1	**360**	1.80±0.31a	0.93±0.15a
Y2	**360**	1.49±0.31b	0.78±0.15b
Treatments (T)			
AF	**240**	1.63±0.39b	0.88±0.11a
AFI	**240**	1.71±0.39a	0.84±0.11b
AFO	**240**	1.60±0.39b	0.84±0.11b
Interaction between Y*T			
Y1*AF	**120**	1.74±0.55ab	0.72±0.09d
Y1*AFI	**120**	1.88±0.55a	0.88±0.09bc
Y1*AFO	**120**	1.78±0.55ab	0.74±0.09c
Y2*AF	**120**	1.51±0.55b	1.03±0.09a
Y2*AFI	**120**	1.54±0.55b	0.80±0.09c
Y2*AFO	**120**	1.43±0.55c	0.95±0.09b

a, b, c ± Means with the same letter in each column are not significantly different ($P\geq 0.05$).

Results presented in Table (5) show that variations in K values were significant ($P<0.05$) due to the interaction between years (2012 and 2013) and treatments (artificial feeding, artificial feeding with inorganic fertilization and artificial feeding with organic fertilization), the averages of initial (K) were 1.74, 1.88, 1.78, 1.51, 1.54 and 1.43, while , the averages of final (K) were 0.72, 0.88, 0.74, 1.03, 0.80 and 0.95, respectively for treatments Y1*AF, Y1*AFI, Y1*AFO, Y2*AF, Y2*AFI and Y1*AFO. As showed in this Table, the best final K value was obtained for first treatment (AF, being 1.03) at second year. Baotong, (1984) reported that, Condition factor (K) increased when alternation of fish culture with both planting Clover followed by culturing fish, but *O. niloticus* farmed after wheat culture decreased Condition factor.

Daily weight gain (DWG):

Table (6) shows means of Daily weight gain (DWG), during the experimental period as affected by years 2012 and 2013. As described in this table, the averages of

(DWG) of *O. niloticus* were 1.74 and 1.67g/fish for year 2012 and 2013, respectively. These results indicate that, the (DWG) for first year was higher than that obtained in second year. The differences between the two years were significant (P<0.05).

With regard to the effect of pond treatments on DWG, table (6) showes that, the DWG was 1.59, 1.72 and 1.80g/fish for the three treatments artificial feeding (AF), artificial feeding with inorganic fertilizers (urea and Triple super phosphate) (AFI) and artificial feeding and organic fertilizer (AFO), respectively. These results indicated that, the average DWG for treatment (AFO) was higher than the other treatments. Analysis of variance of these results indicates that, the differences among treatments were significant (P<0.05). Hassan *et al.* (2008) revealed that artificial feed application to blue tilapia reared in earthen ponds improved specific growth rate values as compared with other treatments in fertilized ponds. Increases were recorded in the growth performance by using artificial feeding and poultry litter compared with other treatments (artificial feeding only and organic fertilized ponds only).

Results presented in Table (6) show that differences in daily weight gain were significant (P<0.05) due to the interaction between years 2012 and 2013 and treatments (artificial feeding, artificial feeding with inorganic fertilization and artificial feeding with organic fertilization) which indicated that these two factors act dependently and due to changes in water quality and water conditions on each other and also each of them had its own significant effect. The averages of (DWG) of *O. niloticus* during the whole period were 1.60, 1.68, 1.74, 1.59, 1.62 and 1.68 g/fish for treatments Y1*AF, Y1*AFI, Y1*AFO, Y2*AF, Y2*AFI and Y1*AFO, respectively. As showed in this Table, the best (DWG) was obtained for third treatment (AFO, being 1.94) at first year.

Table 6: Least-square means and standard error of the tested factors affecting on DWG and SGR.

Variable	No.	Daily weight gain(DWG), G/fish	Specific growth rate (SGR), %/day
Year (Y)			
Y1	**360**	1.74±0.27a	1.39±0.33a
Y2	**360**	1.67±0.27b	1.40±0.33a
Treatments (T)			
AF	**240**	1.59±0.29c	1.36±0.32b
AFI	**240**	1.72±0.29b	1.40±0.32ab
AFO	**240**	1.80±0.29a	1.42±0.32a
Interaction between Y*T			
Y1*AF	**120**	1.60±0.24d	1.37±0.29b
Y1*AFI	**120**	1.68±0.24b	1.40±0.29ab
Y1*AFO	**120**	1.74±0.24a	1.44±0.29a
Y2*AF	**120**	1.59±0.24d	1.35±0.29c
Y2*AFI	**120**	1.62±0.24c	1.41±0.29ab
Y2*AFO	**120**	1.68±0.24b	1.43±0.29a

a, b, c ± Means with the same letter in each column are not significantly different (P≥ 0.05).

Specific growth rate (SGR):

Table (6) shows means of Specific growth rate (SGR), during the experimental period as affected by years 2012 and 2013. As described in this table, the averages of (SGR) of *O. niloticus* were 1.40 and 1.39%/day, respectively. These results indicate that, the (SGR) for first year was higher than obtained in second year.

With regard to the effect of pond treatments on Specific growth rate (SGR) during the exprimental period, Table 6 showed that, the (SGR) was 1.36, 1.40 and 1.42%/day for three treatments artificial feeding (AF), artificial feeding with inorganic fertilizers (urea and Triple super phosphate) (AFI) and artificial feeding and organic fertilizer (AFO), respectively. These results indicate that, the average Specific growth rate for treatment (AFO) was higher than other treatments. The analysis of variance of these results indicates that, the differences among treatments were significant (P<0.05). Essa *et al.* (1989) and Hussein (1995) reported that, the highest growth of *O. niloticus* and mullet (*M. cephalus*) was recorded in polyculture conditions with organic fertilizers and supplementary feeding.

Results presented in Table (6) show that variations were significant (P<0.05) due to the interaction between years 2012 and 2013 and treatments (artificial feeding, artificial feeding with organic and artificial feeding with inorganic fertilization) which indicated that these two factors act dependently on each other and also each of them had its own significant effect. The averages of (SGR) of *O. niloticus* during the whole period were 1.37, 1.40, 1.43, 1.35, 1.41 and 1.42%/day for treatments Y1*AF, Y1*AFI, Y1*AFO, Y2*AF, Y2*AFI and Y1*AFO, respectively. As showed in Table (6), the best Specific growth rate (SGR) was obtained for third treatment (AFO, being 1.83) at first year. El-Gendy and Shehab El-din (2011) when studied the effect of alternative fish culture with both monosex males of tilapia and some winter field crops and found that SGR for ponds fish only and fish cultured with Clover was best of compared toponds of wheat and barley.

Total yield:

Averages of total yield at the end of the experiment are listed in table (7). As described in Table (7) *O. niloticus* gained the highest yield (22073.74kg-100%) from all ponds for year 2012 compared with 21507.42kg – 97.43% gained by year 2013 from all ponds. These results may be attributed to the effect of wheat culture on aquaculture.

As presented in this Table (7), third treatment (AFO) gained the highest yield (15510.06 kg -100.00%), compared with (AF) (13336.42kg – 85.99%) and (14734.68kg – 95.00%).

Table 7: Total yield of two years as affected by feeding treatments.

Variable	Yield (Kg)	% of the biggest value
Year (Y)		
Y1	22073.74	100%
Y2	21507.42	97.43%
Treatments (T)		
AF	13336.42	85.99%
AFI	14734.68	95.00%
AFO	15510.06	100%
Interaction between Y*T		
Y1*AF	6677.92	84.39%
Y1*AFI	7482.96	94.57%
Y1*AFO	7912.86	100%
Y2*AF	6658.50	84.15%
Y2*AFI	7251.72	91.64%
Y2*AFO	7597.20	96.01%

The interaction between two years and type of feeding was found to be significant. This may indicate that, for tilapia fish under the artificial feed with inorganic and organic fertilizer system, the total yield of tilapia increased compared with other feed treatments. Third treatment (AFO) gained the highest yield (7912.86kg -100.00%) for first year, compared with third treatment (7597.20Kg – 96.01%) for second year, (AF) (6677.92Kg – 84.39%) for first year , (6658.50Kg 84.15%) for second year, (AFI) (7482.96Kg – 94.57%) and (7251.72Kg – 91.64%).

Economic evaluation:

Results of costs including variable, fixed coasts and interest on working capital for the treatments applied are shown in Table (8). Results of this table revealed that costs of fingerlings of Nile tilapia are similar in all treatments applied, however the feed costs differed according to wheat culture, poultry litter, Triple supper phosphate and urea additive with some diets and were the lowest for treatment1, artificial feeding only (AF) 1880.87 LE/feddan for first year and increased to 2060.16, 2181.77, 4704.33, 4925.42 and 5163.69LE/feddan for other treatments treatment2 and treatment3, for first year and treatment1, treatment2 and treatment3 for second year, respectively.

Table 8: The effect of the experimental factors on economic efficiency (LE/Feddan).

Items	2012			2013		
	T1	T2	T3	T1	T2	T3
A-Variable costs (LE/Feddan)						
1-fish production						
a. *O. niloticus* fingerlings	2280	2280	2280	2460	2460	2460
b. Feeds	26539.35	29112.65	30464.5	26462.18	27631.3	28652.28
c. Poultry manure	0	0	829.4	0	0	872.3
d. Triple supper phosphate	0	193.6	0	0	232.20	0
e. Urea	0	66	0	0	72.6	0
2- Wheat production						
a. Wheat Seed	0	0	0	280	280	280
b. Plowing & Irrigation	0	0	0	420	420	420
c. harvesting	0	0	0	240	240	240
d. baler	0	0		840	840	840
Total variable costs (LE/Feddan)	28819.35	31652.25	33573.9	30462.18	31936.1	33524.58
B- Fixed costs (LE/Feddan)						
a. Depreciation (materials&others) 10%	500	500	500	500	500	500
b. Taxes	400	400	400	400	400	400
Total fixed costs (LE/Feddan)	900	900	900	900	900	900
Total operating costs (variable&fixed)	29719.35	32552.25	34473.9	31362.18	32836.1	34424.58
Interest on working capital *	1880.87	2060.16	2181.77	4704.33	4925.42	5163.69
Total costs	31600.22	34612.41	36655.67	36066.51	37761.52	39588.27
% of the smallest value	100	110%	116%	114%	119%	125%
Returns						
Total return (LE) ** — *O. niloticus*	36728.6	41156.3	43520.7	36621.7	39884.5	41784.6
Wheat	0	0	0	6068.4	7469.5	8182.2
Straw	0	0	0	771.4	784.8	792.1
Total	36728.6	41156.3	43520.7	43461.5	48138.8	50759.0
Net return (LE/Feddan)	5128.34	6543.87	6865.06	7395.00	10377.26	11170.70
% of the smallest value of net return	100%	127.60%	133.86%	144.20%	202.35%	217.82%
% Net returns to total costs	16.23%	18.91%	18.73%	20.50%	27.48%	28.22%

* 15% × total operating costs × 140/365 days.

** The economical evaluation of results was carried out according to market prices in 2012 and 2013 in LE.

O. niloticus = LE 190 /1000 fry (2012), LE 205 /1000 fry (2013). Wheat seed= 4000/1000Kg
Urea =LE 1500/1000 Kg (2012), LE 1650/1000 Kg (2013). Triple supper phosphate = LE 1100/1000 Kg (2012), LE 1200/1000 Kg (2013). Manure = LE 580 /1000 Kg (2012), LE 610 /1000 Kg (2013). Fish feed (25% protein) = LE 2850 /1000 Kg (2012), LE 3200 /1000 Kg (2013).

Total costs per feddan increased for treatment 1, artificial feeding only (AF) (31.600.22 LE- 100%) for first year and increased to, (34612.41 – 110%), (36655.63 – 116%), (36066.51 – 114%), (37761.52 – 119%) and (39588.27LE – 125%) for other treatments treatment2 and treatment3, for first year and treatment1, treatment2 and treatment3 for second year, respectively. Differences in total costs were attributed to the differences in feed costs, organic and inorganic fertilizer additives and wheat culture coasts.

Total returns in LE/feddan for treatment 1, treatment 2 and treatment 3 for two years 2012 and 2013 were 36728.56, 41156.28, 43520.73, 43461.50 (Nile tilapia, wheat and straw), 48138.77 (from Nile tilapia, wheat and straw) and 50758.96 LE (from Nile tilapia, wheat and straw), respectively (Table 8). Net returns/pond in LE were found to be. 5128.34, 6543.87, 6843.06, 7395.00, 10377.26 and 11170.70 LE for treatments Y1*AF, Y1*AFI, Y1*AFO, Y2*AF, Y2*AFI and Y1*AFO, respectively. The percentage of net return to total costs were 16.23, 18.91, 18.75, 20.50, 27.48 and 28.22% for treatments Y1*AF, Y1*AFI, Y1*AFO, Y2*AF, Y2*AFI and Y1*AFO, respectively.

These results indicated that feeding of Alternative culture method for *O. niloticus* fish ponds with wheat in earthen ponds after fish harvesting *O. niloticus* fed on diets containing 25% crude protein with poultry litter resulted in best economic efficiency compared to the other treatments.

CONCLUSION

Based on results obtained in this study and on the economical evaluation, it could be concluded that, Wheat cultivation in ponds during the winter period, taking into account feeding *O. niloticus* on artificial feed containing 25% crude protein with organic fertilization lead to increase the weights of fish, as well as increase the yield of wheat product from fish ponds in addition to that he was best in terms of economic efficiency compared to other treatments.

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ARABIC SUMMARY

تأثير استغلال الأحواض السمكية في زراعة القمح في موسم الشتاء على أداء النمو والمحصول الكلي لأسماك البلطي النيلي.

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تهدف هذه الدراسة إلى دراسة تأثيرإستخدام أحواض ألإستزراع السمكى فى زراعة القمح بطريقة صحية ومربحة فى فترة الشتاء. واستخدمت ستة أحواض ترابية في هذه الدراسة، كانت مساحة كل حوض ١ فدان (٤٢٠٠ م٢). وكانت تربية الأسماك موسمين متتاليين مفصولة بزراعة القمح في فترة الشتاء. تم إستزراع أسماك البلطي النيلي في الموسم الأول في الفترة ٢٠١٢/٥/١٥ حتى ٢٠١٢/١٠/٢١ تلاها زراعة القمح في الفترة ٢٠١٢/١١/٥ حتى ٢٠١٣/١٠/٥م وإستزراع أسماك البلطي النيلي في الفترة الثانية من ٢٠١٣/١٥/٢١ حتى ٢٠١٣/١٠/٢٧م. عوملت أسماك البلطي النيلي بثلاثة معاملات (مكررتين لكل معاملة). تم تغذية الأسماك فى المعاملة الأولى على الأعلاف الصناعية ٢٥٪ بروتين خام فقط، تم تغذية الأسماك المعاملة الثانية على العلف الصناعي ٢٥٪ من البروتين الخام بالإضافة للتسميد غير العضوي من السوبرفوسفات الثلاثى مع اليوريا والمعاملة الثالثة للأسماك تم تغذيتها على الأعلاف الصناعية ٢٥٪ بروتين خام مع التسميد العضوي بإستخدام زرق الدواجن. وكانت زراعة القمح بدون إستخدام أى تسميد، وذلك لدراسة تأثير زراعة القمح على نمو وإنتاجية أسماك البلطى النيلى. تم تسكين إصبعيات البلطي بمتوسط وزن٣٠.٠٧ جرام فى الموسم الاول ٣٠.٨٣ فى الموسم الثانى بشكل عشوائي (١٢٠٠٠ إصبعية /الفدان). النتائج التي تم الحصول عليها يمكن تلخيصها على النحو التالي:

تأثير موسم الإستزراع: سجل الموسم الأول أعلى معدل من وزن الجسم، طول الجسم، معامل الحالة، الزيادة اليومية فى الوزن ومعدل النمو النوعى.

تأثير المعاملات: سجلت المعاملة الثالثة: أعلى معدل من وزن الجسم، طول الجسم، معامل الحالة، الزيادة اليومية فى الوزن ومعدل النمو النوعى.

زراعة القمح: سجلت المعاملة الثالثة أعلى معدل من إجمالى محصول القمح.

استنادا إلى النتائج التي تم الحصول عليها في هذه الدراسة يمكن أن نوصى:

بزراعة القمح فى الاحواض السمكية أثناء فترة الشتاء مع مراعاة تغذية أسماك البلطى على عليقة صناعية تحتوى على ٢٥% بروتين خام بالإضافة الى التسميد العضوى بإستخدام زرق الدواجن حيث أدت إضافة التسميد العضوى الى زيادة أوزان الاسماك وكذلك زيادة محصول القمح المنتج من الاحواض السمكية بالإضافة الى أنه كان الأفضل من ناحية الكفاءة الإقتصادية مقارنة بالمعاملات الأخرى.