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RESEARCH ARTICLE

THE EFFECT OF PREDATION OF AFRICAN SHARPTOOTH CATFISH (CLARIAS GARIEPINUS) ON THE GROWTH PERFORMANCE OF TILAPIA (OREOCHROMIS NILOTICUS).

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Abstract

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Excessive proliferation of Tilapia has been a major problem of the fattening process in semi intensive culture. The control of the overpopulation of Tilapia by Catfish (African Sharptooth Catfish) is practiced over the world. This study was conducted to determine the best size and the best stocking ratio of Catfish and Tilapia. Catfish was stocked with different sizes of Tilapia in three ratios 1:10, 2:10 and 3:10 (Catfish: Tilapia) in outdoor concrete tanks (T/C_1, T/C_2, and T/C_3) with replication. The two species were also raised in monoculture (T_1 and C_1). The fish were fed in all the tanks during 180 days of experiment. The parameters of water quality were monitored every 10, 20, and 30 days. The average daily gain (ADG) did not vary significantly in monoculture and polyculture system during the two years of experiment. The growth parameters of Tilapia and Catfish increased significantly ($p < 0.001$) in polyculture system from 90 to 180 days. The best growth rate was observed in T/C_2 with ratio 2:10 where the highest values of average daily gain were also found for Tilapia (1.416 ± 0.014) and Catfish (3.69 ± 0.07). Water quality parameters have shown a significant variation ($p < 0.001$) of pH, dissolved oxygen, salinity, turbidity and critical survival values were observed over a period of 30 days. The study showed that polyculture of Tilapia and Catfish can be used to reduce the overpopulation of Tilapia and allow farmers to obtain the best growth performance for both Tilapia and Catfish in semi-intensive farming.

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Introduction:-

Oreochromis niloticus (Linnaeus, 1758) commonly named Tilapia is a worldwide important species in aquaculture because of its fast growth in fresh water, its adaptation to captivity in semi-intensive pond and its resistance in situations of handling in severe environmental conditions. Tilapia can consume phytoplankton, detritus and a variety of natural and artificial feed and has the ability to convert feeds into high quality protein. This species is appreciated for its flesh solid texture, excellent flavor and good taste (Shoko et al., 2015; Limbu et al., 2015; Meyer and Meyer, 2007; de Graaf et al., 1999). Recognized as an ideal species for warm-water aquaculture in tropical and subtropical countries, Tilapia sexually matures early (three or four months) and at small size and weight (about 8-15 cm total

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body length and 35-45 g), often below market weight (Tahoun et al., 2008; Peña-Mendoza et al., 2005). It can reproduce all year long in fresh water and at temperatures above 23°C (Suresh and Bhujel, 2012; Meyer and Meyer, 2007). The free reproduction of the Tilapia enormously reduce their fattening or grow-out phase of production because of the presence of fry and fingerling which compete for the available space, food and oxygen needed to fatten the original fish stocked in the pond. This situation of competition often causes the stunting of all fish and ends in dwarfism. Reduction in the somatic growth of Tilapia, is often seen as a major problem in Tilapia farming. As consequence, the growth rate of adult Tilapia decreases and lower marketable-sized fish is harvested (de Graaf et al., 1999).

Many techniques and strategies exist to control the overpopulation of Tilapia. Some of these methods are culture through manual sexing, hormonal sex reversal by treating the fry with an androgenic hormone to convert fry to the male sex, culture in cages, intermittent harvesting, use of reproductive inhibitors (sterilization) such as irradiation or chemosterilants (Shoko et al., 2005; Limbu et al., 2015; Meyer and Meyer, 2007). All these methods have their limitation, are expensive and requires sometimes hatchery facilities, skilled manpower and expensive equipment. The use of predator fish to control overpopulation of Tilapia culture is perceived as one of the most appropriate, rational, safe and biological method in developing countries (Abdel-Tawwab, 2005; Offem et al., 2009). *Clarias gariepinus* (Burchell, 1822) named African sharptooth catfish is one of the commonly used predators in controlling recruits in mixed-sex Tilapia culture (de Graaf et al., 1996). The Use of *Clarias gariepinus* as the predator-control method of Tilapia in polyculture is considered safe biological method for controlling proliferation in ponds without affecting the size and the weight of tilapia (Shoko et al., 2015; Abdel-Tawwab, 2005). The present study has been conducted to determine the optimal size and the best stocking ratio of both Tilapia and African sharptooth catfish, allowing to have the best efficiency and growth performance of Tilapia in a polyculture system.

Materials and Methods:-

Study site:-

The study was conducted in the research station of Institut Togolais de Recherche Agronomique at Agbodrafo which is situated in south of Togo in Maritime area. The site is located 30 km away in the spit of Lomé in Togo (Fig1), at latitude 6°60” North and longitude 1°60” East. The altitude of study site varies between 75 and 78 (GPS) according to the position of the landscape. The zone has subequatorial climate characterized by two rainy seasons (from April to July and from October to November) and two dry season (from December to March and from August to September). The annual average of precipitation is 1321 mm. The annual mean of temperature is 25-30 °C. The area is characterized by the proximity of Togo Lake where fishing activities are developed.

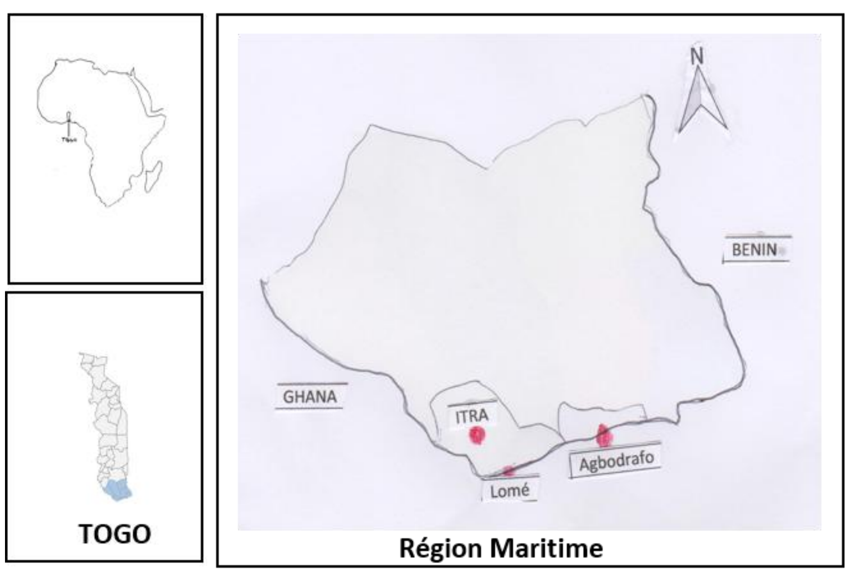

Fig 1: Map of Agbodrafo station

Experimental design:-

The experiment was conducted in two years (from June to December), in eight outdoor rectangular concrete tanks, each having 8 m of length, 4 m of width and 1.3 m of depth. Agbodrafo station has a drilling that supply the rearing with fresh water. The experiment consisted to raise Tilapia and African sharptooth catfish in monoculture and polyculture, in the same biological conditions of fresh water and feeding.

African sharptooth catfish was bought in Porto-Novo (Benin) at Royal Fish and acclimatized during two weeks in tank prior to the beginning of the experiment. Tilapia was collected directly from Agbodrafo research station. In polyculture system, 100 Tilapia and 10, 20 and 30 African sharptooth catfish weighting 13.54 ± 0.70 g were raised in 3 tanks T/C_1, T/C_2, and T/C_3 with the respective ratio of 1:10, 2:10 and 3:10 (Catfish: Tilapia). 8.96 ± 0.99 g of Tilapia were used in $T/C_{1,}$ 15.03 ± 1.16 g in $T/C_{2,}$ and 23.51 ± 2.55 g in T/C_3. In the monoculture system, a batch of 100 African sharptooth catfish (13.54 ± 0.70 g) was raised in tank C_1 and 100 of Tilapia weighing 15.03 ± 1.16 g in $T_{1.}$

In the second year Tilapia and African sharptooth catfish were raised in polyculture and monoculture. In polyculture system, two tanks T/C_2 and T/C_3 were stocked respectively with the ratio of 2:10 and 3:10 Tilapia/Catfish. The weight of Tilapia was 14.88 ± 0.77 g in T/C_2 and 22.15 ± 0.75 g in $T/C_{3.}$ The polyculture system was replicated in two others tanks. The weight of African sharptooth catfish (15.66 ± 0.32 g) was the same in all the tanks. In the monoculture system, two tanks T_1 and C_1 respectively received 100 Tilapia (22.15 ± 0.75 g) and 100 African sharptooth catfish (15.66 ± 0.32 g).

A supplementary feed of 30 % crude protein was formulated and compounded with locally available ingredients to meet the protein requirement of both fish species (Table 1). A feeding rate of 7 % of the total biomass was applied for Tilapia and African sharptooth catfish with an average body weight less than 100 g and a feeding rate of 5 % of the total biomass was applied for Tilapia and African sharptooth catfish with an average body weight over 100 g. The feed was divided into two portions and introduced twice daily in the morning between 9:00 and 10:00 am., and in the afternoon between 3:00 and 4:00 pm.

Table 1:- Composition of experimental diet.

Feed ingredients	**Weight (kg)**
Yellow corn	4
Wheat offal	5
Rice bran	5
Beer brewer	7
Roast soya	28
Fish flour	35
Leucaena sp	10
Palm kernel meal	3
Vitamin Premix	3

The weight of the fish in each tank were monitored on a monthly basis (every 30 days) during 6 months (180 days) with a scale (ACCULAB ATILON). The feed ration was also adjust according to the weight evolution of fish. Water sampling was carried out for the parameters (pH, dissolved oxygen, salinity, and turbidity) to have an optimum environmental conditions in the fish tank. Physicochemical parameters were monitored every 10, 20 and 30 days. After 30 days, the water in the tanks was renewed. The dissolved oxygen were determined directly by a portable digital oxygen meter HANNA Instrument HI 914; pH was measured with a digital pH meter HANNA Instrument HI 83141, salinity with conductivity meter WAGTECH EC 215 and turbidity with HANNA HI 93703.

The growth performance parameters were calculated according to the following equations:

- Average Weight Gain (AWG) = Average final weight (g) – Average initial weight (g)
- Average Daily Gain (ADG) = [Average final weight (g) – Average initial weight (g)] / time (days)

Statistical analysis:-

GraphPad Prism 5.0 was used to analyze results. Data were expressed as mean ± standard error of mean (n=4). The difference between groups was determined with ANOVA followed by Bonferroni test and the significance was reported at $p<0.05$.

Results:-

Water Quality:-

The results of water quality parameters collected showed a significant variation of pH, dissolved oxygen, salinity and turbidity. The pH increased significantly ($p < 0.001$) in 10 days in Tilapia monoculture tanks. In all the tanks containing African sharptooth catfish in monoculture and polyculture system, pH values increased significantly ($p<0.001$) from day 10 to day 30 (Fig 2). Dissolved oxygen decreased significantly ($p < 0.001$) from day 20 in monoculture and from day 10 to 30 in polyculture system. The lowest values (2.41-2.75 ppm) were observed on the 30th day (Fig 3). The salinity increased significantly ($p < 0.001$) from the 10th to the 30th day in both systems of culture. The highest values (470.40 mg/L) were observed in T/C_3 on the 20th day and in other tanks at the end of the experiment (371.3-436.8 mg/L) (Fig 4). The turbidity increased ($p < 0.001$) significantly in all the tanks. The highest values were observed in the monoculture of Tilapia (52.92 NTU) and the lowest values (5.68 NTU) in tank T/C_2 at 30th day. In general, turbidity values in T_1 almost reached twice the values of C_1, T/C_2 and T/C_3 (Fig 5).

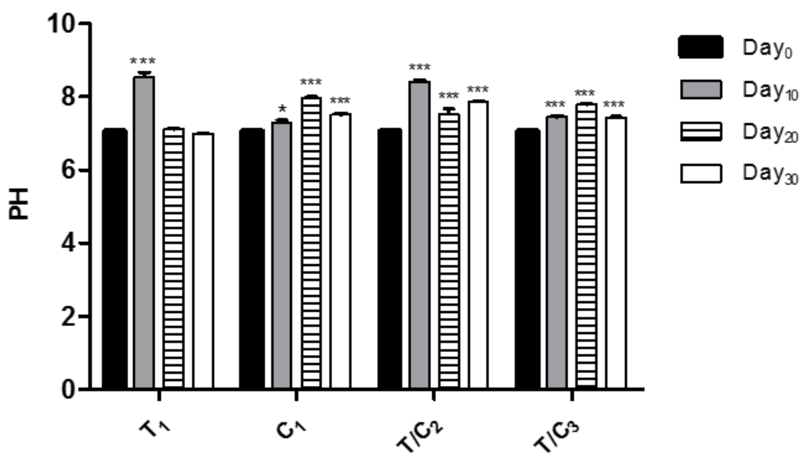

Fig. 2: Evolution of pH over time. The data was expressed as Mean ± SEM (n=4) and evaluated by ANOVA followed by Bonferroni at 5%. *$p<0.05$; ***$p<0.001$ *vs.* Day_0

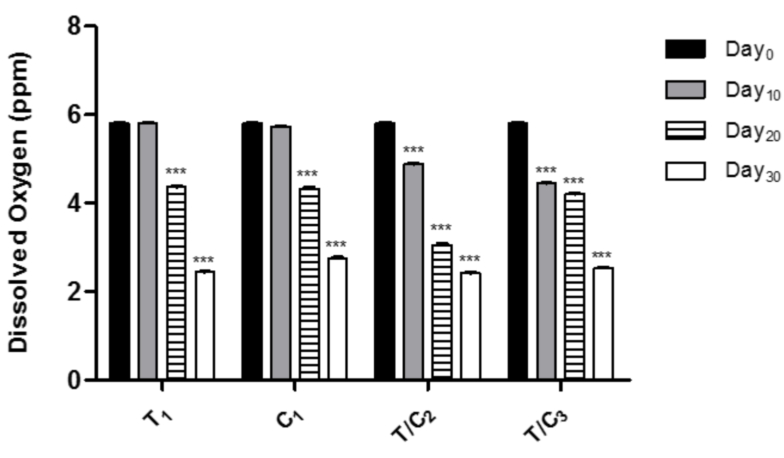

Fig.3: Evolution of dissolved oxygen over time. The data was expressed as Mean ± SEM (n=4) and evaluated by ANOVA followed by Bonferroni at 5%. ***$p<0.001$ *vs.* Day_0

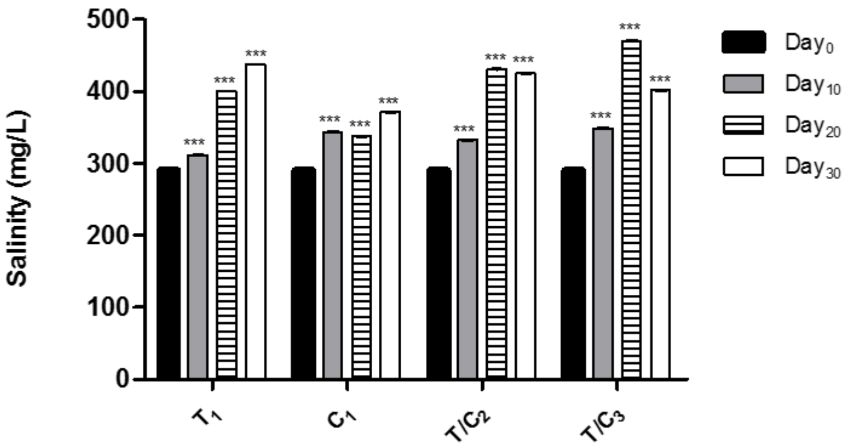

Fig.4: Salinity variation according to the time. The data was expressed as Mean ± SEM (n=4) and evaluated by ANOVA followed by Bonferroni at 5%. ***p<0.001 *vs.* Day_0

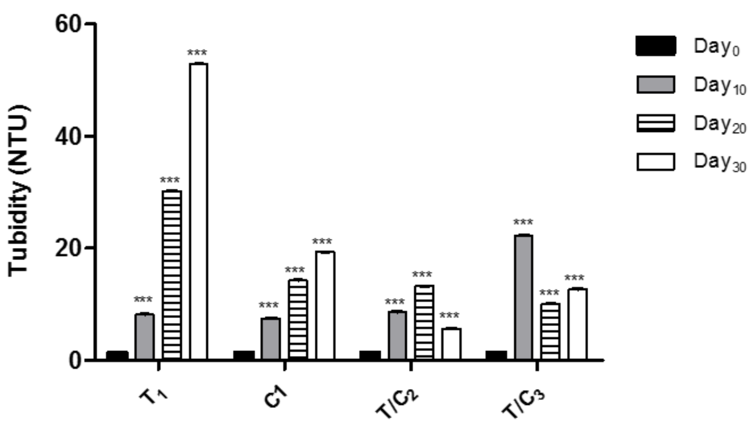

Fig.5: Evolution of turbidity over time. The data was expressed as Mean ± SEM (n=4) and evaluated by ANOVA followed by Bonferroni at 5%. ***p<0.001 *vs.* Day_0

Growth parameters:-

The average daily gain (ADG) did not vary significantly in monoculture and polyculture systems during the two years of experiment (Table 2, 3, 4, and 5). In the monoculture system the average daily gain ranged between (0.41 ± 0.02 and 0.596 ± 0.005) for Tilapia and (0.72 ± 0.02 and 2.45 ± 0.02) for African sharptooth catfish. In the polyculture system the highest values of the average daily gain were observed with the ratio 2:10 in tank T/C_2 (1.416 ± 0.014) for Tilapia and (3.69 ± 0.07) for African sharptooth catfish in the second year (Table 4, 5). The lowest values were observed in tank T/C_1 (0.19 ± 0.02) for Tilapia in the first year (Table 2, 3).

There was no significant difference in the average weight gain (AWG) values during the 6 months of experiment in the monoculture and polyculture systems. In the monoculture system, the average weight gain of Tilapia after day 180 was 90.08 ± 3.74 g in the first year (Table 2, 3) and 108.35 ± 1.06 g in the second year (Table 4, 5). African sharptooth catfish gained 159.52 ± 2.11 g in the first year and 432.94 ± 3.63 g in the second year at the end of the experiment. In the polyculture system in the second year (Table 4, 5), after 180^{th} day, Tilapia (250.3 ± 2.9 g) and African sharptooth catfish (666.6 ± 13.6 g) reached the higher average weight gain with the ratio of 2:10.

Table 2:- Monthly Average Weight Gain (AWG) and Average Daily Gain (ADG) of Tilapia during the first year

TILAPIA		Time (days)					
		Day_{30}	Day_{60}	Day_{90}	Day_{120}	Day_{150}	Day_{180}
T_1	AWG (g)	17.27 ± 2.2	31.82 ± 2.29	40.07 ± 1.41	49.7 ± 2.2	68.90 ± 2,04	90.08±3.74
	ADG	0.57 ± 0.07	0.52 ± 0.04	0.44 ± 0.01	0.41 ± 0.02	0.45 ± 0,01	0.50 ± 0.02
T/C_1	AWG (g)	5.77 ± 0.70	35.57 ± 2.31	80.31 ± 0.76	87.75 ± 1.61	94.60 ± 0.00	1073 ± 26
	ADG	0,19 ± 0,02	0,60 ± 0,04	0,886 ±0,008	0,72 ± 0,01	0.630 ± 0.000	0.59 ± 0.01
T/C_2	AWG (g)	34.52 ±1.08	56.56 ± 1.65	93.84 ± 2.97	147.01 ± 5.76	181.36 ± 3.88	226.8±10.5
	ADG	1.14 ± 0.03	0.936±0.027	1.04 ± 0.03	1.22 ± 0.05	1.203 ± 0.026	1.25 ± 0.06
T/C_3	AWG (g)	32.07± 1.85	36.18 ± 4.83	75.67 ± 1.62	98.37 ± 5.06	124.92 ± 6.23	150.35±5.97
	ADG	1.064± 0.06	0.60 ± 0.08	0.834±0.018	0.81 ± 0.04	0.83 ± 0.04	0.83 ± 0.03

Average Weight Gain (AWG) = Average final weight (g) – Average initial weight (g)
Average Daily Gain (ADG) = [Average final weight (g) – Average initial weight (g)] / time (days)

Table 3:- Monthly Average Weight Gain (AWG) and Average Daily Gain (ADG) of Clarias during the first year.

CLARIAS		Time (days)					
		Day_{30}	Day_{60}	Day_{90}	Day_{120}	Day_{150}	Day_{180}
C_1	AWG (g)	34.63±0.58	76.77 ± 2.84	91.55 ± 1.55	116.96±3.61	131.55±2.11	159.52±2.11
	ADG	1.15 ± 0.02	1.36 ± 0.06	1.01 ± 0.01	0.97 ± 0.03	0.87 ± 0.01	0.88 ± 0.01
T/C_1	AWG (g)	22.28±4.82	80.66±5.60	161.8 ± 14.7	309.5±121.7	237.64±18.71	268.17±14.26
	ADG	0,74 ± 0,16	1,34 ± 0,09	1,79 ± 0,16	2,57 ± 1,01	1,57 ± 0,12	1,48 ± 0,08
T/C_2	AWG (g)	37.91±2.58	89.85 ± 2.71	187.18±8.12	247.11±11.08	393.01±23.51	473.19±22.55
	ADG	1.26 ± 0.08	1.49 ± 0.04	2.07 ± 0.09	2.04 ± 0.08	2.61 ± 0.15	2.62 ± 0.12
T/C_3	AWG (g)	21.71±2.13	65.78 ± 1.93	124.9 ± 7.9	192.8 ± 1.6	282.2 ± 3.9	259.3 ± 15.1
	ADG	0.72 ± 0.07	1.09 ± 0.03	1.38 ± 0.08	1.60 ± 0.01	1.88 ± 0.02	1.43 ± 0.08

Average Weight Gain (AWG) = Average final weight (g) – Average initial weight (g)
Average Daily Gain (ADG) = [Average final weight (g) – Average initial weight (g)] / time (days)

Table 4:- Monthly Average Weight Gain (AWG) and Average Daily Gain (ADG) of Tilapia during the second year

TILAPIA		Time (days)					
		Day_{30}	Day_{60}	Day_{90}	Day_{120}	Day_{150}	Day_{180}
T_1	AWG (g)	15.43±0.61	29.30 ± 0.45	47.05 ± 0.78	63.6 ± 0.4	82.87 ± 0.55	108.35 ± 1.06
	ADG	0.51 ± 0.02	0.480±0.008	0.52 ± 0.01	0.524±0.005	0.548 ± 0.005	0.596 ± 0.005
T/C_2	AWG (g)	22.68±0.65	55.90 ± 0.43	108.84±0.74	165.46±0.95	213.38 ± 2.15	250.3 ± 2.9
	ADG	0.75 ± 0.02	0.928±0.006	1.20 ± 0.01	1.37 ± 0.01	1.416 ± 0.014	1.38 ± 0.01
T/C_3	AWG (g)	24.7 ± 1.2	38.86 ± 1.00	78.77 ± 1.06	108.29±1.53	143.83 ± 4.34	181.17 ± 1.10
	ADG	0.82 ± 0.04	0.64 ± 0.01	0.87 ± 0.01	0.89 ± 0.01	0.95 ± 0.03	1.000 ± 0.006

Average Weight Gain (AWG) = Average final weight (g) – Average initial weight (g)
Average Daily Gain (ADG) = [Average final weight (g) – Average initial weight (g)] / time (days)

Table 5:- Monthly Average Weight Gain (AWG) and Average Daily Gain (ADG) of Tilapia during the second year

CLARIAS		Time (days)					
		Day_{30}	Day_{60}	Day_{90}	Day_{120}	Day_{150}	Day_{180}
C_1	AWG (g)	21.94±0.80	83.80 ±0.25	180.06 ±1.03	275.28 ±4.86	368.92± 2.93	432.94± 3.63
	ADG	0.72 ± 0.02	1.395 ±0.005	1.99 ± 0.01	2.29 ± 0.04	2.45 ± 0.02	2.40 ± 0.02
T/C_2	AWG (g)	42.34±0.94	156.32 ±3.65	267.78 ±3.60	420.80 ±5.65	532.15 ±4.38	666.6 ± 13.6
	ADG	1.40 ± 0.03	2.60 ± 0.06	2.97 ± 0.04	3.50 ± 0.04	3.54 ± 0.03	3.69 ± 0.07
T/C_3	AWG (g)	54.96±0.89	120.7 ± 2.8	226.00 ±2.85	330.24 ±3.62	415.2 ± 5.4	503.6 ± 7.4
	ADG	1.82 ± 0.03	2.006 ±0.047	2.50 ± 0.03	2.74 ± 0.03	2.76 ± 0.03	2.79 ± 0.04

Average Weight Gain (AWG) = Average final weight (g) – Average initial weight (g)
Average Daily Gain (ADG) = [Average final weight (g) – Average initial weight (g)] / time (days)

During the first year of experiment, the growth parameters of Tilapia and African sharptooth catfish increased significantly ($p < 0.001$) in the polyculture system on day 90 for both species in all tanks except T/C_2 where there was a significant increase ($p < 0.05$) for Tilapia after 30 days (Fig 6). At the end of the experiment (180 days) the weight of Tilapia in T/C_2 increased and reached 35 % of the mean weight of tilapia in T/C_3 and 100 % of the mean weight in T/C_1. The best growth rates were observed in the first year in T/C_2 followed by T/C_3. The order of growth performance for Tilapia and African sharptooth catfish was T/C_2>T/C_3> T/C_1. There is no significant increase in the monoculture system for both species. The lower growth weights were observed in monoculture for Tilapia (99.34 ± 3.23 g) and African sharptooth catfish (176.06 ± 4.71 g).

The replication of T/C_2 and T/C_3 in the second year showed that Tilapia and African sharptooth catfish have the best growth rate in T/C_2 with ratio 2:10 (Fig 7). In the polyculture system, growth parameters increase significantly ($p < 0.001$) from day 90 to day 180 for tilapia and African sharptooth catfish with ratio 2:10. In tank T/C_3 with ratio 3:10, there was an early significant increase ($p < 0.001$) of growth parameters for tilapia and African sharptooth catfish from day 60 until the end of the experiment.

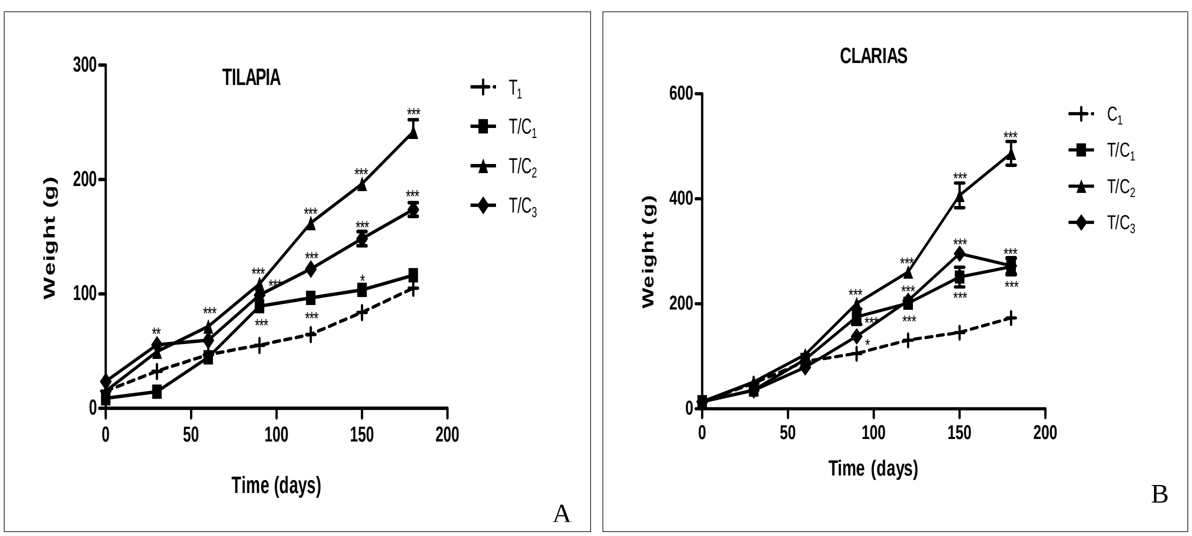

Fig. 6:- Mean weight increase of Tilapia (A) and African sharptooth catfish (B) in monoculture and polyculture over time in the first year. The data was expressed as Mean ± SEM (n=4) and evaluated by ANOVA followed by Bonferroni at 5%. *p<0.05; ***p<0.001 *vs.* Day_0

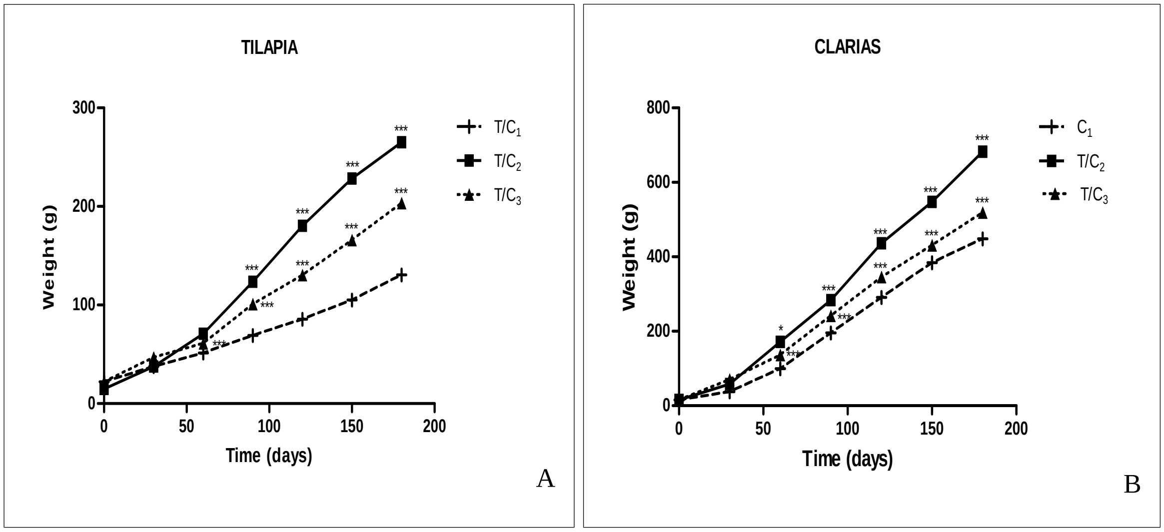

Fig. 7:- Mean weight increase of Tilapia (A) and African sharptooth catfish (B) in monoculture and polyculture over time in the second year. The data was expressed as Mean ± SEM (n=4) and evaluated by ANOVA followed by Bonferroni at 5%. *p<0.05; ***p<0.001 *vs.* Day_0

Discussion:-

The measurements of pH in the different tanks have shown a significant increase after 10th day in all the tanks. The pH values (6.99 - 8.55) were ranged within the optimum limit (6.5 - 9) recommended for the growth of most species including Tilapia and African sharptooth catfish (Summerfelt, 2011; Zweig et al., 1999; Meyer and Meyer, 2007). The same values were observed by Oyelese (2007) and recommended for intensive fish culture by Boyd (1979).

Dissolved oxygen (DO) is usually the first limit factor in pond culture and a very basic requirement for aquaculture species. The DO decrease within 30 days may be due to the waste of artificial feed which increased organic matter in the tanks. The DO concentrations recorded at the end of the experiment (2.39-2.56 ppm) were below the least tolerable limit (DO ≥ 3 ppm) recommended by Meyer and Meyer (2005). As it was shown by Aquaculture (2003) declining DO levels can be caused by oxygen consumed by aquatic organisms, putrefying organic matter and excessive turbidity. Tilapia is resistant to poor water quality and can live under 3.0 ppm. In low DO conditions, Tilapia is able to breathe oxygen at the water surface early in the morning. African sharptooth catfish endure tougher DO conditions (0 ppm) due to its accessory breathing organ allowing direct inhalation of oxygen in the air (Ducarme and Micha, 2003).

Salinity refers to the total concentration of all dissolved ions in the water. The value observed during the 30 days of the experiment (291.07-470.40 mg/L) ranged in the optimum recommended for typical freshwater salinity which is less than 500 mg/L (Zweig et al., 1999). The concentration of salinity increased significantly from 10th to 30th day in all the tanks. These values are in accord with the results of Zweig et al. (1999) who recommended 0–10000 ppm as optimum salinity for Tilapia, and 500-3000 ppm for African sharptooth catfish. As stated by Boyd (1990), salinity is very important to fishes to maintain the concentration of dissolved salts in their body at fairly constant level. In case of high concentration of salinity fish starts losing water in their environment by the process of osmoregulation (Zweig et al., 1999).

Turbidity is a measure of light penetration in water. Turbidity increased significantly in all the tanks. Tilapia in the monoculture system recorded the highest values of turbidity (52.92 NTU) and reached over the double of the values recorded in the tanks containing African sharptooth catfish. These high value may be due to the waste of leftover feed which decreased water transparency during the experiment. As it was shown by Aquaculture (2003) and Zweig et al. (1999), the turbidity results from dissolved and suspended solids such as organic compounds, the addition of feed, microorganisms or clay. According to Noba et al. (2008), Tilapia requires an optimal turbidity ranging between 25 and 45 NTU. Fish communicate visually but Tilapia will readily reproduce in turbid water. The mean values of turbidity (5.68-22.33 NTU) observed in the tanks containing African sharptooth catfish showed an optimum consumption of the food used to feed the fish. African sharptooth catfish is recognized as fish of turbid water (Ducarme and Micha, 2003).

The impact of African sharptooth catfish as a predator on Tilapia was identified in this study. The polyculture system rearing showed the best growth performance of Tilapia than monoculture system. The growth parameters of Tilapia were significantly higher in all tanks where Tilapia was stocked with African sharptooth catfish. The best growth performance was reached with Tilapia weighing 14.88 ± 0.77 g stocked with African sharptooth catfish weighing 15.66 ± 0.32 g in tank T/C_2. Prey-predator control systems are based on principles such as size of predators and size of prey (Boughey, 1978). These results confirmed those obtained by Oyelese (2007).The significant increase of growth parameters of Tilapia and African sharptooth catfish in 90^{th} day in tank T/C_2, was a result of reproduction activities of Tilapia (45–50 g) allowing African sharptooth catfish to predate Tilapia fry and have less pressure on supplemental food. The availability of food permitted Tilapia to feed at satiation, and increase its growth and survival rate. These findings are in line with the report of Oyelese (2007). According to this author predation by African sharptooth catfish reduced competition for space and food caused by Tilapia fry and fingerlings derived from the initially stocked adults through reproduction. Offem et al. (2009) have shown that the availability of food and space influence and increase positively the growth performance of Tilapia. The high percentage survival of Tilapia was caused by enough food and adequate space for its co-existence with African sharptooth catfish (Limbu et al., 2015). Similar observation was reported by Oyesele (2007), who found the best growth of Tilapia with ratio of 15/90 (African sharptooth catfish/Tilapia) and 100 % survival rate of the two species in polyculture when fed to satiation.

The ratio of 2:10 (African sharptooth catfish/tilapia) applied in this study with the close weight of Tilapia (14.88 ± 0.77 g) and African sharptooth catfish (15.66 ± 0.32 g) has shown the best rate of growth parameters of two species. Limbu et al. (2015) recommended fish farmers to reduce prolific breeding and obtain higher growth performance of marketable Tilapia by predominantly stocking ponds with large African sharptooth catfish predator of at least 60 g. In fact higher level of predation was obtained between day 60 and 90 when the weight of African sharptooth catfish reached 171.98 ± 8.16 g to 283.44 ±8.04 g. At the same time, Tilapia has also reached an optimal weight for sexual maturity (70.78 ± 0.96 g). The improvement of growth performance of Tilapia in polyculture is in agreement with the findings reported by Shoko et al., 2015; Limbu et al., 2015; Offem et al., 2009 and Oyelese, 2007.

In tank T/C_3 where the same weight of African sharptooth catfish (15.66 ± 0.32 g), was stocked with Tilapia weighing 22.15 ± 0.75 g, a mitigation of the growth of the two species occurred. The reproduction of Tilapia started early when African sharptooth catfish was not able to consume Tilapia fry and fingerling. These results are similar to the findings of Abdel-Tawwab (2005) who observed a positive correlation between the increase of mouth gape and the weight of African sharptooth catfish. The early presence of Tilapia fry and fingerling in monoculture and T/C_3 with smaller African sharptooth catfish, slowed the growth performance through feed competition and space between the stocked Tilapia and their fry and fingerling. Consequently, the growth of adult Tilapia was restricted in polyculture with small African sharptooth catfish (Limbu et al., 2015). Abdel-Tawwab (2005), noticed that the predation pressure increased significantly at the ratio of 1:15 (African sharptooth catfish/Tilapia) with big African sharptooth catfish (275, 400 and 650 g) at all rearing periods.

The early breeding of Tilapia weighing 22.15 ± 0.75 g in monoculture C_1 such as in polyculture with African sharptooth catfish (15.66 ± 0.32 g) in the tank T/C_3 has reduced their growth parameters. As indicated by Shoko et al. (2015), the system of culture did not affect the early breeding of Tilapia. The significantly higher growth of Tilapia reared in the polyculture system compared to the monoculture system can be attributed to the reduced number of Tilapia fry and fingerlings as a result of predation by African sharptooth catfish and to less competition for food and space.

Conclusion:-

Tilapia and African sharptooth catfish can be reared together to improve the growth of Tilapia. Our results showed that the size and the stocking ratio of Tilapia and African sharptooth catfish are very important for the growth performance. The polyculture system may allow farmers to diversify products at the end of the growth period and increase economic benefits. This technology can be recommended to fish farmers.

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