ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 17, Issue, 08, pp.34304-34309, August, 2025
DOI: https://doi.org/10.24941/ijcr.49322.08.2025

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

REARING JUVENILE TILAPIA SAROTHERODON MELANOTHERON (RÜPPELL, 1852) IN HAPPAS AT LAYO (CÔTE D'IVOIRE)

Kouamé Marcel N'DRI[1*], Zeré Marius GOGBE[3], Yao Nicolas AMON[3], Yao Laurent ALLA[2],Miengoh KONE[1] and Kouakou YAO[4]

[1]Institut ofAgropastoral Management, Peleforo GON COULIBALY University (PGCU), Korhogo, Côte d'Ivoire; [2]Oceanological Research Center (ORC), Abidjan, Côte d'Ivoire; [3]Faculty of Biological Sciences, Peleforo GON COULIBALY University (PGCU), Korhogo, Côte d'Ivoire; [4]Faculty of Nature Sciences, Nangui Abrogoua University (NAU), Abidjan, Côte d'Ivoire

ARTICLE INFO

Article History:
Received 11th May, 2025
Received in revised form
24st June, 2025
Accepted 19th July, 2025
Published online 20th August, 2025

Keywords:
Sarotherodon melanotheron,
Breeding, Happas.

***Corresponding author:**
Kouamé Marcel N'DRI

ABSTRACT

This study was carried out to analyze the growth and survival performance of *Sarotherodon melanotheron* reared in happas. To achieve this, 100 individuals with an initial average weight of 7.63± 1.86 g and an initial average length of 7.71± 1.96 cm were monitored for 4 weeks in two 50-L happas, at a density of 1 ind./l of water. The fish were fed at 10% of their biomass with koudijs feed containing 45% crude protein. Weekly sampling was carried out, during which 15 individuals per happas were randomly sampled, weighed and individually measured. The physico-chemical parameters of the water were also measured weekly. The results were 28.35± 1.20°C, 7.46± 0.93 mg/l and 6.94± 0.77, respectively for temperature, dissolved oxygen and pH. In terms of zootechnical performance, averages of 12.85± 1.83 g, 9.2± 1.03 cm, 0.20 ± 0.04 g/d and 95.00 ± 1.41% were recorded over the entire study period, respectively for Average Weight, Average Length, ADG and Survival Rate. Weight growth was rapid during the first two weeks, before progressing moderately until the end of the experiment. In short, this study should be repeated over a longer period to gain a better understanding of the factors influencing growth and survival in this species.

Citation: Kouamé Marcel N'DRI, Zeré Marius GOGBE, Yao Nicolas AMON, Yao Laurent ALLA, Miengoh KONE et al. 2025. "Rearing juvenile tilapia Sarotherodon melanotheron (Rüppell, 1852) in happas at Layo (Côte d'Ivoire)". *International Journal of Current Research, 17, (08), 34304-34309.*

INTRODUCTION

Aquaculture is the cultivation of plant and animal organisms in an aquatic environment. According to FAO (2024), world aquaculture production reached 123,2 million tonnes in 2022, an increase of 4.4% tonnes on 2020. In many West African countries, such as Côte d'Ivoire, fish represents the main source of protein for most populations (Fall, 2019). In Côte d'Ivoire, the population's annual need for fish is around 650,000 tonnes for an estimated production of 108,000 tonnes (FISH4ACP, 2023). According to Yao *et al*. (2017), national aquaculture production is low, despite immense human, geographical and natural potential and the many efforts made in Ivorian fish farming. As a result, the country imports fish in frozen form to make up the shortfall. According to MIRAH (Ministry of Animal and Fisheries Resources) (2022), fish imports cost the state budget 300 billion FCFA in 2020. With a view to raising the level of national aquaculture production, the Ivorian government adopted the National Policy of the development of Livestock, Fisheries and Aquaculture (PONADEPA 2022-2026), launched in 2022. It aims to promote fish self-sufficiency.

To achieve this objective, the State has entrusted research structures such as the Oceanological Research Center with the mission of identifying and studying local species with high aquaculture potential, in order to make them available to fish farmers. Catfish (*Heterobranchus longifilis; Heterobranchus bidorsalis; Clarias gariepinus*), jawfish (*Chrysichthys nigrodigitatus*) and tilapia (*Oreochromis niloticus*; *Tilapias guineensis; Sarotherodon melanotheron*) have been identified and are already being farmed in Côte d'Ivoire (INFOPECHE, 2024). Like the Nile tilapia *Oreochromis niloticus*, *Sarotherodon melanotheron*, a species characteristic of West African estuaries and lagoons, is also a good candidate for the promotion of tilapiaculture (Amoussou *et al.*, 2016). In addition, the quality of its flesh and its rapid reproduction in captivity make it a fish of great interest (Awa, 2012). With a very high market price (Adou *et al.*, 2017), it is particularly a taxon of great economic interest through its high contribution to fisheries catches (Adepo-Gourène *et al.*, 1998). In terms of rearing structures, diversion and dam ponds and floating cages are the most widely used for rearing tilapia. However, what is the effect of happas rearing *on S. melanotheron* growth and survival ?

The aim of this work is to contribute to the improvement of rearing techniques for this species. The specific objectives are to assess the quality of the farm water and to determine the zootechnical parameters of the fish.

MATERIALS AND MATHODS

Study area: The study was conducted atthe Layo Aquaculture Station (Figure 1), from February 20 to April 20, 2025. This experimental site is located on the north bank of the Ebrié Lagoon, about 40 km west of Abidjan on the Abidjan-Dabou axis.

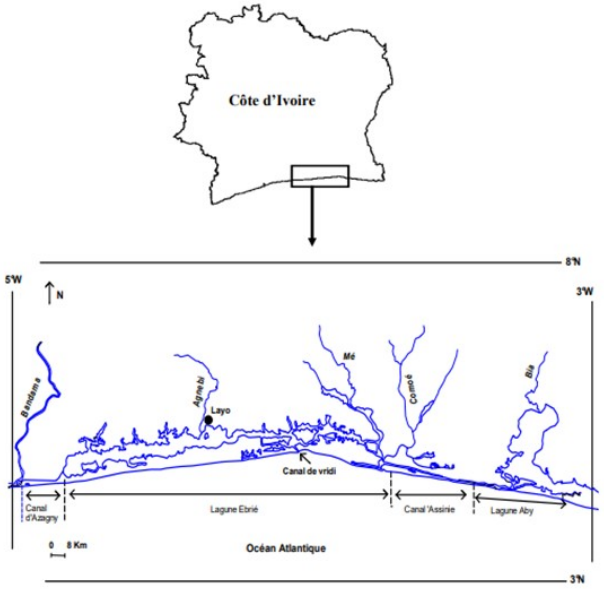
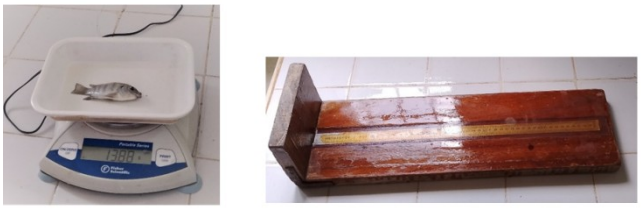


Figure 1. Geographical location of the Study Area (N'dri *et al.*, 2025b)

Biological material: To conduct this trial, 100 juvenile *S. melanotheron* ofan initial average weightof 7.71±1.96 g and an initial average length of 7.63±1.9 cm were used. These fish (Figure 2a) were caught in pond no. 7 at Layo Station. They were fed with a commercial "Koudijs" feed with a diameter of 2 mm and 45% crude proteins (Figure 2b).

(a) *S. melanotheron juveniles*(b) Feed used during rearing

Figure 2. Biological equipment used in the experiment



(a) Digital scales (b) Ichtyometer

(c) Multi-parameter (d) Spinneret with handle

Figure 3. Some of the technical equipments used during the rearing experiment

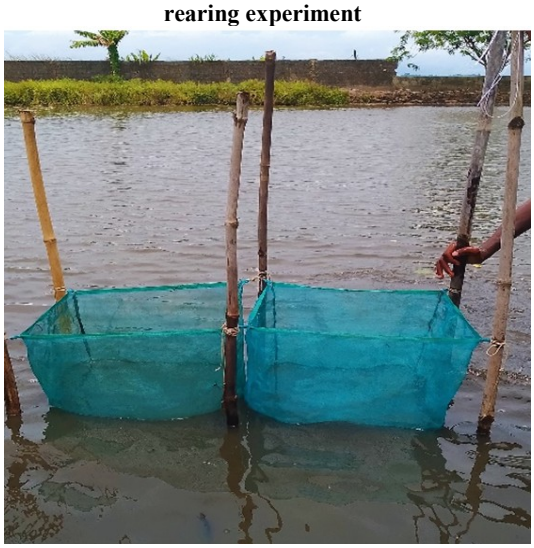
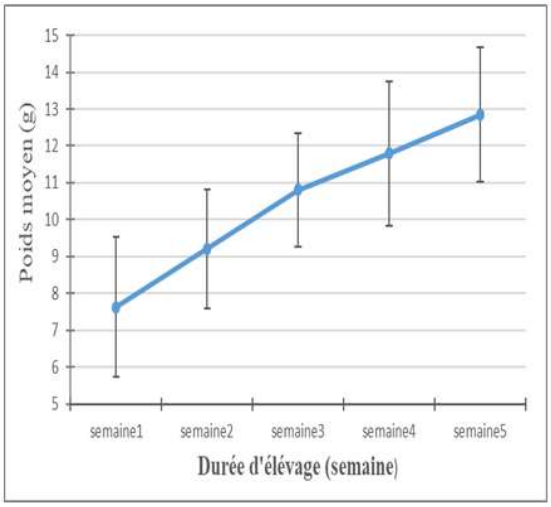
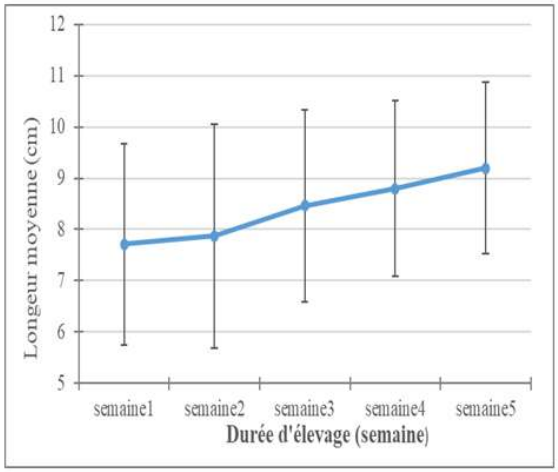


Figure 4. View of experimental happas



a



b

Figure 5. Growth in weight (a) and length (b) of *S. melanotheron juveniles* as a functionof age

Table 1. Water physico-chemical parameters recorded during rearing

Period	Temperature (°C)	Dissolved oxygen (mg/l)	pH
Week 1	28.6	8.3	7.65
Week 2	31.1	6.74	6.86
Week 3	28.7	6.72	6.89
Week 4	28.5	5.73	5.73
Week 5	28.1	6.62	7.63
Average	28.35 ± 1.20	7.46 ± 0.93	7.64 ± 0.78

Technical equipment

Technical equipment included

- two 0.01g precision digital scales (Fisher Scientific brand) used to weigh fish and feed Figure 3a;
- a 50 cm ichthyometer to measure fish size during sampling Figure 3b ;
- an HQ Series multi-parameter was used to determine the Temperature, Dissolved Oxygen and pH of the rearing water Figure 3c ;
- a fishing seine (12 mm mesh, 35 m long and 9 m drop) for catching fish during sampling;
- a landing net with 6 mm mesh handles for harvesting juveniles during sampling Figure 3d ;
- buckets, dustbins and other plastic containers for transporting fish during sampling;
- rubber bowls for serving the daily ration;
- trays for transporting the daily ration.
- Figure 3 shows some of the technical equipment used.

Rearing structure: Two identical happas made of 1.5 mm mesh were used (Figure 4). Each happas measured 50 cm in length, 40 cm in width and 40 cm in drop. The happas were installed in a single row. They were suspended in the water on bamboos of varying lengths, firmly embedded in the sediment of the chosen pond. The water depth of the happas was 25 cm. This gave each happa a useful water capacity of around 50 liters.

Methods

Fishing and conditioning: Juvenile *S. melanotheron* were caught in pond no. 7, using a 12 mm mesh seine net. After fishing, they were sorted to retain only those of uniform weight and size, and stored in a cage previously installed in the experimental pond. For two weeks, they were kept in the cage to acclimatize to their new environment. During this period, the fish were fed ad libitum three times a day (7:30 a.m., 11:30 a.m. and 3:30 p.m.) with a commercial "Koudijs" feed.

Stocking: At the end of the conditioning phase, 30 fish were taken at random, weighed and measured individually to determine average weight and average length. After this operation, 100 fish were used to stock two happas, with a density of 1 subject / liter of water: happa, i.e. 50 fish / happas.

Breeding: To feedthe fish, the commercial feed "Koudijs" titrated to 45% crude protein was used. The fish were fed at 10% of their biomass, with a daily ration distributed manually at 08:00, 12:00 and 16:00. Samples were taken every week to monitor fish growth. To do this, 15 individuals per happas were randomly sampled, weighed and measured individually using the precision balance and ichthyometer.

The ration was readjusted after each sampling, once the total biomass had been determined. At the end of the trial, all live animals were weighed, individually measured and counted. In addition, the temperature, dissolved oxygen and pH of the rearing water were measured in the happas every 7 a.m. prior to feeding. To do this, the probe of the HQ Series multi-parameter was directly immersed in the water. Once the device had stabilized, the measured parameters were displayed on the screen and recorded.

Zootechnical parameters calculated

Growth in weight and length

Average weight was estimated using the following formula:
Aw ( ) = Sum of weights of individuals weighed / Total number of individuals weighed
Average length was calculated as follows:
Al (cm) = Sum of the lengths of the subjects weighed / Total number of subjects weighed.

Average daily gain (ADG)

Calculated from the following equation:

ADG (g/d) = (final Average weight - initial Average weight) / Rearing period

Coefficient of variation (CV)

This is determined by the following formula
CV (%) = (Standard deviation / Average) X 100

- for a CV of less than 2%, the population is said to be very homogeneous;
- if CV is between 2% and 30%, the population is said to be homogeneous;
- if CV is greater than 30%, the population is said to be heterogeneous.
- Survival rate (SR)
- SR (%) = (Number of fish remaining / Initial number of fish) X 100

Data processing: The data collected was first analyzed using descriptive statistics. Certain data were represented graphically or tabulated to highlight certain trends. Statistical indicators such as average and standard deviation were also calculated. Excel version 2019 was used to organize the data and produce the graphs.

RESULTS

Farm water physico-chemical parameters: The physico-chemical parameters assessed are listed in Table 1. Average temperatures ranged from 28.10 to 31.10°C. With an average of 28.35 ± 1.20°C, the temperature peak was observed in week 2, followed by a slight drop in subsequent weeks. The temperature remained relatively stable from week 3 to week 5. Average dissolved oxygen values ranged from 5.73 to 8.3 mg/l, with an average of 7.46 ± 0.93 mg/l. The highest value of 8.3 mg/l was observed in week 1, and the lowest value (5.73 mg/l) was recorded in week 4. Dissolved oxygen fell progressively from week 2 onwards, reaching its minimum at week 4. Average pH values ranged from 5.73 to 7.65. The average was 6.94 ± 0.77. The maximum of 7.65 was obtained in week 1. Relatively constant between week 2 and week 3, pH reached its lowest value in week 4.

Zootechnical performance

Weight growth: The variation in average fish weight is illustrated in Figure 5a. From 7.63 ± 1.86 g at the start of the experiment, the average weight of the subjects reached 12.85 ± 1.83 g. However, there were two main phases in this weight growth. During the first two weeks, weight increased rapidly. From 7.63 ± 1.86 g (beginning of week 1), it reached 10.81 ± 0.47 g at the end of week 2. From week 3 to the end of the study, average weight growth increased moderately, reaching a value of 12.85 ± 1.83 g.

Growth in length: The curve representing the length of reared individuals is shown in Figure 5b. The pattern of change in average total length was less rapid than that of weight growth. However, it also has two parts. During the first week, slow growth was observed. Indeed, the average length went from 7.71± 1.96 cm (beginning of week 1) to 7.87 ± 1.19 cm (beginning of week 2). From week 2 to the end of the experiment, relatively rapid growth was observed, leading to a final average size of 9.2 ± 1.03 cm.

Average daily gain (ADG): Weekly weight measurements were used to determine Daily Weight Gain. Tested fish showed an ADG of 0.20 ± 0.04 g/d over the entire test period. The highest value was observed in the third week and corresponded to 0.28 ± 0.07 g/d. This was followed by the first week (0.22 ± 0.66 g/d). The lowest ADG was recorded during the fourth week, with a value of 0.14 ± 0.02 g/d.

Coefficient of variation (CV): Coefficients of variation (CV) for average weight and average total length were 18.26 ± 2.34% and 14.24 ± 3.15% respectively. However, these values ranged from 2% to 30%.

Survival rates: At the end of rearing, the survival rate of *S. melanotheron* juveniles was calculated in happa 1 and happa 2. The results obtained were 94% and 96% respectively, with an average value of 95.00 ± 1.41%.

DISCUSSION

The physico-chemical parameters recorded varied moderately. The averages for Temperature, Dissolved Oxygen Rate and pH were 28.35 ± 1.20°C ; 7.46 ± 0.93 mg/l and 6.94 ± 0.77 respectively. These results are comparable with the observations of N'dri *et al.* (2025a), during their work on lagoon rearing of the same species. These authors obtained 29.26 ± 0.19 for temperature; 6.20 ± 0.18 mg/L for dissolved oxygen and 6.97 ± 0.40 for pH. Our values are in line with those recommended by Ouattara *et al.* (2005), who stated that in *S. melanotheron*, the thermal preference is between 22 and 32°C, and by Ouattara *et al.* (2003), who consider that the normal pH should be between 3.5 and 7.6). For Apenuvor (2014), temperature is recognized as one of the most important abiotic factors affecting fish growth, food intake and feed conversion. With regard to dissolved oxygen levels, the average value obtained is higher than the critical value reported by Ross (2000), which is 2.3 mg/L for the species *Sarotherodon melanotheron*. Similarly, (Ouattara *et al.* (2003) showed that it tolerates low levels of dissolved oxygen and does not encounter any particular metabolic difficulties if the level of dissolved oxygen in the water is not lower than 3 mg/l. The values obtained for the various parameters are similar to those de Alla *et al.* (2024). Our results show that the fish were reared in a suitable environment. This could be justified by the fact that the water in the enclosure is permanently renewed.
Regarding fish growth, the curve shows a rapid change in weight during the first two weeks of rearing, followed by moderate growth until the end of the experiment. This accelerated growth at the beginning of rearing corroborates that of N'dri *et al.* (2025a). This could be attributed to the good quality of the feed and rearing water. The subjects were thus able to take advantage of the nutrients present in the natural environment in addition to the artificial feed served. For N'dri *et al.* (2025a), another explanation could be that the individuals benefited from an adequate stocking density. These results contradict those of Alla *et al.* (2024) in their study of the effect of density on the same species. These authors showed that growth rates (weight and length) were low for all batches during the first two weeks of rearing. For them, this situation could be considered as a period of adaptation of the fish to their new living environment. The same observation was made by N'dri *et al.* (2024) during their experiment on the effect of rationing rate in *Sarotherodon melanotheron* fry.

From the third week to the end of the experiment, fish growth was moderate. This could be explained by the fact that the

rainy season had begun at this time. Indeed, during heavy rains, fish feed consumption is disrupted. For Amoussou *et al.* (2016), tilapia *Sarotherodon melanotheron* growth is discontinuous, characterized by a succession of periods of slow and rapid growth. With regard to Average Daily Gain, the final average value (0.20 ± 0.04 g/d) obtained was similar to that of Yao *et al.* (2013), who recorded an average of 0.21 ± 0.02 g/d in their study of hybrid juveniles in lagoon environments. In contrast, our results were lower than those of Koumi *et al.* (2011), who recorded a value of 0.67 ± 0.03 g/d in the same species. Our results were also lower than those of Ouattara *et al.* (2005), who obtained 0.42 ± 0.00 g/d in their freshwater floating cage study, and Gbaï *et al.* (2014), who found a value of 0.35 g/d in a lagoon environment. This low ADG could be justified by moderate growth after the second week of rearing.

As for the Survival Rate, the best result obtained would be linked to the favorable rearing conditions and stress resistance of this species. Our results are very similar to those of Alla *et al* (2024), who obtained a value of 95.00 ± 1.33% for the same species reared in happas. They are also comparable to those of N'dri *et al.* (2025a), who obtained a rate of 94.2 ± 1.12%. However, our survival rate was higher than that of N'Zué and Kouadio (2021) cited by Touré (2024). These authors obtained a value of 85% in their work on the evaluation of growth performance and survival of tilapia *Sarotherodon melanotheron* in lagoon enclosures. Our results were also superior to those of Ouattara *et al.* (2005), who reported a survival rate of 72.8 ± 3.9% in earthen ponds for the same species.

CONCLUSION

This study assessed the growth performance and survival of juveniles of *Sarotherodon melanotheron*. The results show that this species adapts well to happas rearing. Final juvenile growth in weight and length were 12.85 ± 1.83 g and 9.18 ± 1.67 cm respectively. The average daily gain recorded over the duration of the experiment was 0.28 ± 0.07 g/d. The survival rate value (95 ±1.41%) is satisfactory. However, it would be desirable to continue this experiment up to grow-out to really evaluate zootechnical performance, which will provide a necessary database for fish farmers.

Competing interests: The authors declare that they have no competing interests.

REFERENCES

Adepo-Gourène, B., Pouyaud, L., Teugels, G. G., Hansens, M. M., Agnèse, J-F. 1998. Morpho logical and genetic differentiation of West African populations of *Sarotherodon melanotheron* Rüppell, 1852 (Teleostei, Cichlidae). In: Agnèse, J.-F. Ed, Genetics and Aquaculture in Africa. 1-4 April 1998 ORSTOM "Colloques et Séminaires", Paris, pp. 189-198.

Adou, Y. E., Blahoua, K. G., Bamba, M, Yao S. S., Kouamelan, E. P., N'Douba, V. 2017. First inventory of data on the ichtyological population of a West African lake located between two hydroelectricb dams: Lake d'Ayamé 2 (Côte d'Ivoire). *Journal of Applied Biosciences*, 110, 10808-10818.

Alla, Y. L., N'dri, K. M., Amon, Y. N., N'guessan, K. M., Tano, K., Yao, K. 2024. Effect of stocking density on the growth and survival of Tilapia juveniles (*Sarotherodon melanotheron*) reared in happas at Layo station (Dabou, Ivory Coast). International Journal of Biosciences, 24(1), 10-18. http://dx.doi.org/10.12692/ijb/24.1.10-18

Amoussou, T. O., Toguyeni, A., Imorou, T. I., Chikou, A., Youssao, A. K. I. 2016. Biological and zootechnical characteristics of African tilapias *Oreochromis niloticus* (Linnaeus, 1758) and *Sarotherodon melanotheron* Ruppell, International Journal of Biological and Chemical Sciences,10(4), 1869-1887. DOI: 10.4314/ijbcs.v10i4.35

Apenuvor, T. 2014. Crossing, Sex reversal and reproductive capacity of two populations of *Sarotherodon melanotheron* (Cichlidae) from the Central Region of Ghana. PhD thesis, Department of Fisheries and Aquatic Sciences, University of cape coast, Ghana, p142.

Awa, N. 2012. Responses of tilapia *Sarotherondon melanotheron* to multiple stresses (chemical contaminants and salinity): a multi-parametric approach. PhD thesis, Montpelier II University, (France), p226.

Fall, M., Diop, M. B., Didier, M., Maiga, A. S. 2019. Fish fermentation in West Africa and societal challenges for products quality (Adjuevan, guedj et lanhouin). Cah. Agri., 28(7), 1-12.https://doi.org/10.1051/cagri/2019007

FAO. 2024. The state of world fisheries and aquaculture 2024-the blue transformation in action. Rome http://doi,org/10.4060/cd0683frAccessed on 18/04/2025

FISH4ACP. 2023. Value chain for farmed Nile tilapia in Côte d'Ivoire, Analysis and update report, Côte d'Ivoire, p289.

Gbaï, M., Yao, K., Atsé, Y. 2014. Comparative study of growth and survival of *Sarotherodon melanotheron* X *Oreochromis niloticus* hybrids, *O. niloticus* and native tilapia from Ivorian lagoons (*S. melanotheron* and *Tilapia guineensis*). Livestock Research for Rural Development, 26(1), 1-8. http://lrrd.cipav.org.co/lrrd26/1/gbai26018.html.

INFOPECHE. 2024. Ministerial Conference on Fisheries Cooperation between African States bordering the Atlantic Ocean. Website: INFOPÊCHE | Conférence Ministérielle sur la Coopération Halieutique entre les Etats Africains Riverains de l'Océan Atlantique (infopeche.co). Accessed on 15/09/24.

Koumi, A. R., Koffi, K. M., Atsé, B. C., Kouamé, L. P. 2011. Growth, feed efficiency and carcass mineral composition of *Heterobranchus longifilis*, *Oreochromis niloticus* and *Sarotherodon melanotheron* juveniles fed different dietary levels of soybean meal-based diets. Afr. J. Biotechnol, 10(66), 14990-14998.

MIRAH. 2022. National Policy of the Development of Livestocks, Fisheries and Aquaculture

(PONADEPA 2022-2026), Abidjan Côte d'Ivoire, p178.

N'dri, K. M., Agnissan, A. J-P., Alla, Y. L., Tano, K., Adépo, B. A. C., Yao, K. 2024. Impact of Rationing on Growth Parameters (Length-Weight) and Survival of *Sarotherodon melanotheron* Rüppell, 1852 Larvae at the Layo Aquaculture Experimental Station in Ivory Coast. Journal of Advances in Biology & Biotechnology,27(12), 499-508.https://doi.org/10.9734/jabb/2024/v27i121798

N'dri, K. M., Agnissan, A. J-P., Koné, T., Alla, Y. L., Diaby, M., Brou, G. K. G., Touré, A.,

Nafan, D. 2025a. Technical analysis of tilapia Sarotherodon melanotheron Rüppell, 1852 reared in lagoon pens during the grow-out phase (Layo, Ivory Coast). *International Journal of Biosciences*, 27(7),10-18.

N'dri, K. M., Alla, Y. L., Amon, Y. N., Setin, K. D., Tano, K., Diomandé, D. 2025b. Influence of Feeding Intensity on Growth Parameters and Survival of *Coptodon Guineensis.*Günther, 1862 Juveniles Raised at the Layo

Aquaculture Experimental Station, Ivory Coast. *Journal of Advances in Biology & Biotechnology*, 28(3),97-106.https://doi.org/10.9734/jabb/2025/v28i32073

Ouattara, N. I., Teugels, G. G., N'Douba, V., Philippart, J. C. 2003. Aquaculture potential of the black-chinned tilapia, *Sarotherodon melanotheron* (Cichlidae). Comparative study of the effect of stocking density on growth performance of landlocked and natural populations under cage culture conditions in Lake Ayamé (Côte d'Ivoire). *Aquaculture Research*, 34(13), 1223-1229.

Ouattara, N. I., N'Douba, V., Kone, T., Snoeks, J., Philippart, J. C. 2005. Growth performance of an isolated strain of the estuarine tilapia *Sarotherodon melanotheron* (Perciformes, Cichlidae) in concrete basins, earthen ponds and floating cages. *Annal of Marien Ngouabi University*, 6(1), 113-119.

Ross, L. G. 2000. Environmental physiology and energetics. In Tilapias: Biology and Exploitation, Beveridge MCM, McAndrew BJ (eds). Springer Netherlands (Fish and Fisheries Series): Netherlands, 89-128.

Touré, A. 2024. Monitoring the rearing of tilapia *Sarotherodon melanotheron* during the grow-out phase in a lagoon enclosure at the Layo Experimental Aquaculture Station. Final dissertation for the professional Bachelor Degree in Agropastoral Management, p47.

Yao, N. A., Kouakou, Y., Boua, C. A., Mamadou, O. 2013. Survival and growth of hybrid juveniles from the *Oreochromis niloticus* (linnaeus, 1758) and *Sarotherodon melanotheron* (rüppel, 1852) intergeneric cross in lagoon environment. International Journal of Biological and Chemical Sciences, 7(3), 1069-1077.

Yao, A. H., Koumi, A. R., Aste, B. C., Kouamelan, E. P. 2017. State of knowledge on fish farming in Côte d'Ivoire. Agronomie Africaine, 29(3), 227-244.

****