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Evaluation of performance of Nile tilapia (*Oreochromis niloticus)* crop in rice-fish ponds

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Abstract
Rice-fish farming is a system that contributes to food security, income generation and better nutrition for the farmer. To evaluate the performance of Oreochromis niloticus in rice-fish pond, the environmental parameters that may influence Oreochromis niloticus pre-growth and growth stage in association rice varieties "Wita 12 and Djoukèmin" and fish zootechnical performances were determined to improve this crop in Ivory Coast. O. niloticus (1,28 g and 37,1 g) were stocked into ponds with the density of 20 fish/m^2 for pre-growth stage and 0.7 fish/m^2 for growth stage. Six 400 m^2 ponds were used to test fish farming, rice cropping and rice-fish culture in two replicates. The present study results showed that water quality was similar in different environments and suited to the ecological requirements of O. niloticus, except dissolved oxygen content below the optimal threshold. The densities of zooplankton, phytoplankton and benthic macroinvertebrates biomass are lower in rice-fish cropping. In rice-fish cropping, fish zootechnical performances were slightly better than those of the fish environment. Moreover, rice-fish culture shows the advantage to increase rice yield. Intensive rice-fish culture system has been successfully tested in pond and could achieve food security in rural areas.

Keywords: Performance, *Oreochromis niloticus*, variety Wita 12 and Djoukèmin, rice-fish.

1. Introduction

Fish and rice are among the most consumed foods in West Africa [1] In Ivory Coast, the fish is the main source of animal protein for the population (15 kg/hat/year) [2]. However, domestic production, estimated at 70,000 t/year with a share of 1.57% for aquaculture [2], is still insufficient. It covers only 23% of the needs and the deficit is offset by massive imports of frozen fish. This low contribution of aquaculture would be due to the high production costs for fish farmers, poor control of the different development stages of species raised and a deficit at the popularization of farming techniques. Rice became the staple diet in the Ivory Coast (58 kg/hat/year), but national production covers only 50% of needs [3]. Like tests carried out in Guinea, rice-fish combination auspiced a good symbiotic relationship in which each culture draws necessary resources for growth [4]. According to this author, rice-fish culture promotes a high production of fingerlings which are used to re-stocking the rice locker in the next crop cycle. However, Ivory Coast, farmers who practice rice-fish culture using fingerlings for stocking the ponds. Therefore, they do not realize fish pre-growth in this culture system. To date, data on the pre-growth and the growth of the tilapia *Oreochromis niloticus* rice-fish environment are almost non-existent. To contribute to improving the practice of rice-fish farming in Ivory Coast, the performance of *O. niloticus* of the pre-growth and growth in rice-fish pond environment were evaluated. The present study was performed to elevate educational level of the farmers, who need skills in rice cultivation as well as fish management.

2. Materials and Methods

Test procedure

The test production of *O. niloticus* in rice-fish system was carried in two phases (pre-growth and growth) alternately in the same seven fish ponds of fish farming research station (National Agricultural Research Center, Bouaké). Initially, there was fish pre-growth stage which lasted 97 days for the production of "fingerlings". Secondly, the "fingerlings" male after manual sexing, were used for the growth stage which lasted 150 days.
The two phases of the experiment were conducted in seven fish ponds. One pond was used for the different rice nursery (Wita 12 and Djoukèmin). In each stage, rice-fish system were tested with only rice crop and fish farming in two replication in six ponds (Fig 1).

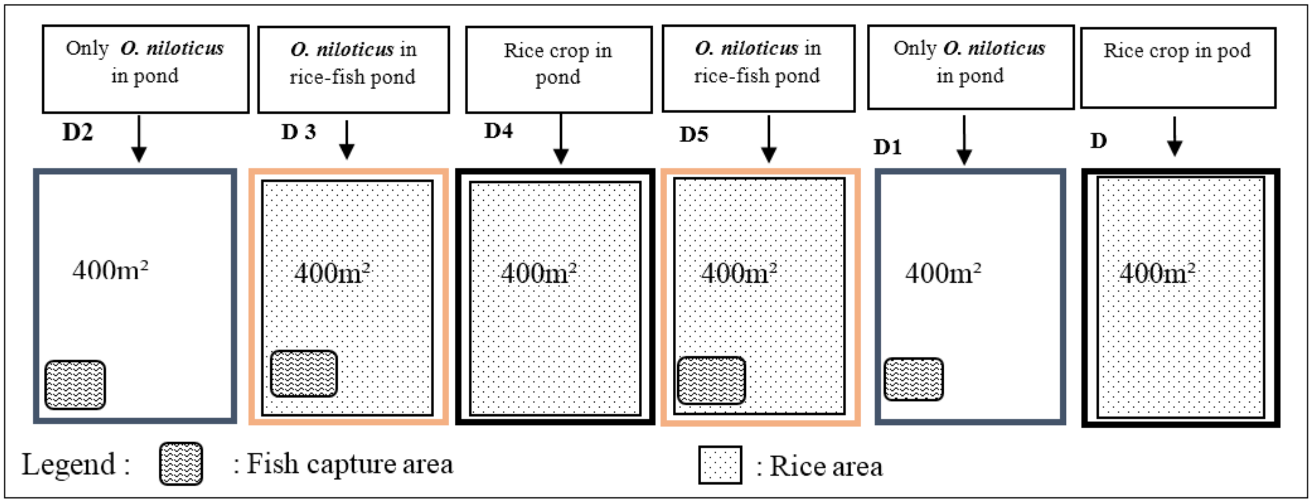

Fig 1: Experimental plan

Similar for both phases of the experiment, we started with the rice seedlings in a 400 m^2 pond. Then, 15 day old rice seedlings were transplanted into experimental ponds at 20 x 20 cm spacing and submerged progressively with water depending on the size of the plants. The water level was maintained constant at a 50 cm level using cistern valves (Fig.2). One month later rice variety Wita 12 transplanting, the ponds have been charged with 8000 fingerlings of *O. niloticus* with a density of 20 fish / m² for pre-growth without providing food or fertilizer (Fig 2). Furthermore, for the growth stage, the ponds have been charged with 280 male fingerlings of *O. niloticus* with a density of 0.7 fish / m² 45 days after rice transplanting (variety Djoukèmin).

a) Rice Nursery; **b) Transplanting Rice;** **c) Pond gradually; flooding;** **d) Rice seedling**

Fig 2: Some images of technical stage of rice-fish farming

Monitoring of the water ecology

For each phase of experiment, water ecological parameters were regularly monitored throughout the rice growth period. Thus, water temperature (°C), pH, conductivity (µS.cm-1), dissolved oxygen (mg.l-1) and turbidity level (NTU) were measured fortnightly from 6:30 to 8:00 am in each pond using a multiparameter apparatus *WTW 840i* and an electronic turbidimeter *AQUALYTIC*. In addition, water samples were collected in polyethylene bottles and stored at a temperature below 4 °C. These were analyzed for dissolved inorganic nitrogen [nitrite (NO_2^-), nitrate (NO_3^-), ammonium (NH4+)] and orthophosphate ($PO4_3^-$) according to the standard spectrophotometric method (AFNOR 93).

Biotic parameters

Biotic parameters were also sampled at fortnightly intervals and involved the collection of specimens of phytoplankton, zooplankton and benthic macroinvertebrates. Plankton was collected by filtration of 30 liters of water in plankton net and identified under stereomicroscope using specialized literature [for phytoplankton [6-9] and [10, 11] for zooplankton]. Benthic macroinvertebrates were sampled using a long-handled scoop (20 cm diameter, 0.5 mm mesh size) for 10 minutes. The different samples were labeled and transported to the laboratory. The books were used to identify snails and insects [12-15].

Zootechnical and agronomic data collection

For the each phase (pre-growth and growth stage), the initial and final average weight of fish were determined. At the end of the experiment so 97 days old (for pre-growth) and 150 days old (growth stage) fish pond charging, a sampling 30 fish per pond was made in line the day of each harvest. The standard length and individual fish weights were determined respectively centimeter and the gram.

Rice harvest was made 90 days old for Witta 12 and 150 days old for the Djoukèmin after sowing. The total amount of harvested rice (paddy) was weighed and yields were evaluated for each phase of the experiment.

Data analysis and parameters calculation methods

To evaluate the efficacy of the combination rice-fish, different production parameters and indices were calculated:

- **Body Mass Gain**: Commonly called average weight gain (GPM), is used to evaluate weight gain of fish during a given time [16]. *GPM (g) = final average weight - initial average weight.*
- **Specific growth rate (TCS)** is used to evaluate the weight gained by the fish every day as a percentage of live weight [16] *TCS (% /day) = 100 * [ln (final biomass) - ln (initial biomass)] / duration*
- **Relative growth (length-weight relationship):** $W = aL^b$, **W** is the weight of fish (g) **L** is the standard length of the fish (cm), **a** is a constant and **b** is the allometric coefficient (between the weight and length)
- **Condition Factor**: $K = W / L^3$, **W** is the weight in grams and **L** is the standard length (cm)
- **Survival rate**: *Survival rate (%) = final number of fish * 100 / initial number of fish*
- **Rice yield** was calculated by: *Rice yield (kg / ha)* **=** *Weight of dry grains (kg) / Surface*

Data according plankton and benthic macrofauna

- **Taxonomic richness and diversity**: It is the total number of species found in an ecosystem [19]
- **Percentage of occurrence (F)** which provides information on the preference of a given species in a given habitat type [20, 21]. *F = Fi * 100 / Ft*

Where **Fi** = number of records containing species **i** and **Ft** = total number of such records. Depending on the value of F, three species groups are distinguished: constants species (F> 50%), accessories species (25% <E <50%) and accidental species (F <25%).

- **Diversity Index Shannon-Weaver (H)**

$H = - \Sigma (ni / N) \log2 (ni / N) = \log 2 - \Sigma Ai (Ai)$. Where ***Ai*** = abundance of species, ***ni*** = number of individuals of species ***i*** and ***N*** = total number of individual [22].

- **Equitability**: $E = H'/\log_2 S$

Where **H** was the Shannon-weavers index, **S** was the number of species in samples [23].

- **The total zooplankton density**: *D (Ind / L.) = (N / V1) x (V2 / V3)*

With **n** = number of individuals counted, **V1** = volume (ml) of filtrate collected, **V2** = volume (ml) of the filtrate concentrated, **V3** = volume (mL) of filtered water.

Data statistics

The analyses were carried out using the statistical software *XLSTAT 7.5.2* in Excel (Microsoft Office 2007) and *STATISTICA 7.1*. The Shapiro-Wilk test was used to test the normality of the parameters measured. For large samples (> 30), the comparison of means was made with the Student *t* test at significance level $p = 0.05$. Non-parametric Kruskal-Wallis test (multiple comparisons) and Mann-Whitney *U* test (comparison of two samples) were performed to check differences between samples.

3. Results

Water parameters

For the water physical parameters of both phases of the test, there is no significant difference between variations in the temperature, pH, conductivity and turbidity of the water measured in the different environments of experiments (table 1) (Kruskal-Wallis, α = 0.05). However, there is a significant difference between the dissolved oxygen content. The dissolved oxygen levels are significantly higher in the fish culture compared to rice-fish and rice for both phases of the test (U test of Mann-Whitney, p <0.05).

Table 1: Summary of physical parameters by crop system. The average values of columns with the same exponents (a, b) are not significantly different at α = 0.05 threshold (Kruskal-Wallis test, Mann-Whitney

Test phase	Crop system	pH	Dissolved oxygen (mg/l)	Conductivity (µS/cm)	Temperature (°C)	Turbidity (UNT)
Pre-growth	Fish only	$6,7 \pm 0,2^a$	$4,7 \pm 1^a$	$238,5 \pm 11,2^a$	$26,6 \pm 0,4^a$	$22,3 \pm 2,9^a$
	Rice-fish	$6,7 \pm 0,1^a$	$3,1 \pm 0,7^b$	$241,4 \pm 12,9^a$	$26,2 \pm 0,5^a$	$20,0 \pm 5,2^a$
	Rice only	$6,6 \pm 0,1^a$	$3,0 \pm 0,3^b$	$247,3 \pm 15,2^a$	$25,9 \pm 0,7^a$	$18,4 \pm 4,5^a$
Growth	Fish only	$7,0 \pm 0,1^a$	$4,8 \pm 1,1^a$	$228,1 \pm 5,6^a$	$25 \pm 2,4^a$	$17,2 \pm 3,6^a$
	Rice-fish	$6,9 \pm 0,2^a$	$2,2 \pm 0,6^b$	$231 \pm 6,8^a$	$24,1 \pm 2,3^a$	$15,2 \pm 4,1^a$
	Rice only	$6,9 \pm 0,2^a$	$3,2 \pm 1,5^b$	$232,8 \pm 5,6^a$	$24,8 \pm 2,8^a$	$13,3 \pm 3,3^a$

The average concentrations of nutrient compounds from water in the different treatments are given in table 2. The contents of NO_3^- and PO_4^{3-} are higher in fish farming in the other two treatments. Fish and rice farming have higher levels of NO_2^- (5.33 ± 1.92 mg/l) than the rice-fish farming (1.33 ± 0.51 mg/l). For NH_4^+ ion, the rice crop has the highest concentration (129.05 ± 72.06 mg/l).

Table 2: Levels of nutrient compounds crop system. Rows with the same values exhibitors are not significantly different (Mann-Whitney test, α = 0.05).

Crop system	Average concentrations of nutrient compounds (µg/l)			
	NO_3^-	NO_2^-	NH_4^+	PO_4^{3-}
Fish only	$26,83 \pm 1,28^b$	$5,33 \pm 2,99^a$	$103,6 \pm 28,14^a$	$0,75 \pm 0,74^b$
Rice-fish	$20,91 \pm 8,12^a$	$1,33 \pm 0,51^b$	$95,70 \pm 4,78^a$	$0,29 \pm 0,07^a$
Rice only	$20,96 \pm 9,88^a$	$5,33 \pm 1,92^a$	$129,05 \pm 72,96^b$	$0,17 \pm 0,08^a$

Characterization of biotic environments

Aquatic macroinvertebrates

A total of 22 taxa of macroinvertebrates were collected in different crop system. These consist essentially of aquatic snails (belonging to 2 orders) and insects (belonging to 5 orders). The occurrences of macroinvertebrate after sampling in different ponds are given in table 3. There is a constant appearance of *Melanoides tuberculata*, *Biomphalaria pfeifferi, Lymnaea natalensis*, and *Zygomyx* sp insects. (Belonging to the Odonata order) in all environments. The species *Bulinus globosus* is absent from the rice fields but it appears accessory in the two other crop system. *Bulinus truncatus* and *Microvela* sp. are absent from fish farming and rice growing environments. However, they are found incidentally in rice-fish farming. In rice-fish farming, *Lanites varicus* is not found while it is present as accessory for fish or rice farming.

Table 3: Occurrences of macroinvertebrates in different environments. (-) = No; (±) = Accidental; (+) = Accessory and (++) =. Constant.

Class	Oder	Family	Taxa	Fish only	Rice only	Rice-fish
Insects	Coleoptera	Elmidae	*Potamodytes* sp.	±	±	±
		Hydrophilidae	*Amphios* sp.	+	++	+
		Dytiscidae	*Hydrocanthus micans*	±	+	+
	Diptera	Chironomidae	*Polypedilum fuscipenne*	±	+	±
		Orthocladiinae	*Cricoptus quadrifasciatus*	±	±	++
	Odonata	Coenagriidae	*Pseudagrion* sp.	+	±	+
		Libellulidae	*Zygomyx* sp.	++	++	++
	Heteroptera	Baetidae	*Baetis* sp	+	+	+
		Belostomidae	*Diplonychus* sp.	++	++	++
		Naucoridae	*Naucoris obscuratus*	±	+	+
		Notonectidae	*Anisops* sp.	±	±	+
		Veliidae	*Microvela* sp.	-	±	±
		Ranatridae	*Renata* sp.	++	+	++
	Trichoptera	Philopotamidae	*Chimarra petri*	±	+	+
Snails	Mesogastropoda	Ampullariidae	*Pila africana*	++	++	±
			Lanistes varicus	±	±	-
		Thiaridae	*Melanoides tuberculata*	++	++	++
	Basommatophora	Lymnaeidae	*Lymnaea natalensis*	++	++	++
		Planorbidae	*biomphalaria pfeifferi*	++	++	++
			Bulinus truncatus	±-	±	±
			Bulinus forskalii	±	+	±
			Bulinus globosus	±	-	±

Taxonomic richness is the same for both environments (fish and rice-fish) which contain fish (18 taxa) against 20 taxa for the rice fields. The Shannon index is higher in rice (3,03 ± 0,2) and lower in rice-fish farming (2,81 ± 0,31). The rice fields is the most diversified and balanced for all crop system, also he have highest equitability (0,63 ± 0,02). A equitability in fish was 0,60 ± 0,05 0,57 ± 0,02 against in rice-fish farming (table4). The Kruskal-Wallis test does not show significant difference (p> 0.05) between different diversity indices calculated for each crop system.

Table 4: Macroinvertebrate diversity indexes of different crop system

Diversity indices	Crop system		
	Fish only	Rice only	Rice-fish
Taxonomic richness	18	20	18
Shannon index	2,94 ± 0,37	3,03 ± 0,2	2,81 ± 0,31
Equitability	0,60 ± 0,05	0,63 ± 0,02	0,57 ± 0,02

Plankton monitoring

The analysis of occurrences of phytoplankton taxa shows that Chlorophytes appear accidentally in all environments in general except *Scenedesmus* sp. that constantly appear in fish and rice-fish environments. The Euglenophytes constitute an accessory group except *Phacus* that are almost constant in all environments. Cyanobacteria such as *Coelosphaerium* sp., *Cyanosarcina* sp. and *Oxillatoria* sp. accidentally included in all environments while *Chroococcus* sp., *Pseudanabaena* sp. and *Microcystis* sp. are accidental taxa that only fish environments and rice-fish. There is a total absence of *Micrasterias* sp., *Pleurotaenium* sp., *Pediastrum* sp. and *Euglena* sp. in the rice-fish system. Diatoms are present consistently in all environments. Rotifers and copepods have emerged as the consistent groups in fish farming and rice crop environments while they are accessories in rice-fish environment. The Cladocera are incidental in all system (table 5).

Table 5: Occurrences of different taxa of plankton. (-) = No; (±) = Accidental; (+) = Accessory and (++) = Constant.

Groups	Taxa	Crop system		
		Fish only	Rice only	Rice-fish
	Micrasterias sp.	-	+	-
	Pleurotaenium sp.	±	-	-
	Cosmarium sp.	±	-	±
Chlorophytes	*Pediastrum* sp.	++	±	-
	Scenedesmus sp.	++	+	++
	Spirogyra sp.	-	±	±
	Tetraedron sp.	±	±	±
	Phacus sp.	++	++	++
Euglenophytes	*Euglena* sp.	++	±	-
	Strombomonas sp.	+	-	+
	Trachelomonas sp.	+	±	+
	Chroococcus sp.	+	±	+
	Coelospharium sp.	±	±	±

	Cyanosarcina sp.	±	+	±
Cyanobacteria	*Merismopodia* sp.	++	±	±
	Microcystis sp.	+	+	+
	Oxillatoria sp.	-	-	±
	Pseudanabaena sp.	+	-	+
Bacillariophyceae	Diatoms	++	++	++
	cladocerans	+	+	+
Zooplanktons	copepods	++	++	+
	Rotifer	++	++	+

Fish Growth parameters

For both phases, the values of various parameters obtained by rice-fish culture were slightly higher compared to those of fish farming. Thus, a specific growth rate of 2.18 ± 0.13%.d^{-1} is observed for phase pre-growth and 1.56 ± 0.4%.d^{-1} for growth in rice-fish against respectively 2.01 ± 0.06%.d^{-1} and 1.2 ± 0.14%.$d^{-1}$for fish farming.

The fish allometry at all ponds is correlated (0.91 to 0.98) and varies 2.66 ± 0.23 to 2.84 ± 0.14. All these allometric values were less than 3 (Student t test, $p>0.05$). For each phase of the farming (pre-growth and growth), no significant difference ($\alpha = 0.05$, Student's t test) was observed from one area to another between the growth parameters (table 6).

Table 6: Average values of *Oreochromis niloticus* growth parameters.

Paramètres	**Pre-growth**		**Growth**	
	Fish only	**Rice-fish**	**Fish only**	**Rice-fish**
Survival (%)	65,02 ± 4,71	65,99 ± 15,57	80,89 ± 14,39	74,11 ± 9,85
GPM (g)	7,88 ± 0,12	8,85 ± 0,12	74,61 ± 9,74	106,53 ± 16,25
TCS (% /d^{-1})	2,01 ± 0,06	2,18 ± 0,13	1,2 ± 0,14	1,56 ± 0,12
Standard length L Ls	6,13 ± 0,05	6,10 ± 0,12	15,2 ± 0,1	15,5 ± 0,4
Average weight (g)	9,20 ± 0,26	10,06 ± 0,21	131,4 ± 5,4	134,4 ± 12,5
Condition factor K	0,04 ± 0,002	0,05 ± 0,002	0,03± 0,03	0,03 ± 0,11
Allometric coefficien	2,84 ± 0,14	2,79 ± 0,23	2,66 ± 0,13	2,83 ± 0,09

Rice grain yield

Yields at the end of each phase of the test, after harvesting and drying of rice grains are shown in table 7. The Wita 12 rice yield in rice-fish system was 1.67 ± 0.51 t / ha and was higher than the 12 Wita yield in rice only system which is 1.40 ± 0.68 t / ha. Moreover, the Djoukèmin rice yield obtained at the rice-fish culture was 2.33 ± 1.80 t / ha against 2.03 ± 0.38 t / ha for rice only. For different varieties there is no significant difference between the rice yields from one system to another (Mann-Whitney test, $p> 0.05$). Compared to rice, the rice-fish association has helped increase 14.79% rice yield per unit area (hectare).

Table 7: Rice grain yield (t/ha)

	Rice grain yield (t/ha)	
Varieties	**Rice only**	**Rice-fish**
Wita 12	1,40 ± 0,68	1,67 ± 0,51
Djoukèmin	2,03 ± 0,38	2,33 ± 1,80

4. Discussion

Analysis of physical and chemical parameters allows rate of overall and the temperature of the water ranges from 25.15 to 27.10 °C in different culture system. These values are included in the favorable thermal interval to better growth of O. *niloticus* which ranges from 24 to 28 °C as indicated by [25]. Extreme values of pH are between 6.37 and 6.9 and remain within the limits recommended for the survival of *O. niloticus* and rice that evolve between 5 and 11 respectively according [25] and between 5.5 and 7.5 according [26]. The Extreme values of conductivity (223 S/cm and 257.50 S/cm) are included in the suitable range for the conductivity fish ranging from 150 to 450 S/cm according [27]. The values of the turbidity of the water, from 13.82 to 28.67 NTU, is included in the range of 5-30 NTU characterizes a slightly turbid water and suitable to the best development of *O. niloticus*. As for dissolved oxygen, the minimum content (1.90 mg / l) observed in rice-fish farming is below 3 mg/l value below which respiratory stress occurs in *O. niloticus* [28]. The average lowest recorded for dissolved oxygen in the pond containing the rice would be caused by use of the oxygen in the ponds by the rice for its biological activities overnight. With the respiration of animals and plants, anoxic conditions occur overnight and the period before dawn according to [29]. The values of dissolved nutrient compounds (NO_3^-, NO_2^-, NH_4^+ and PO_4^{3-}) remain below the thresholds described by [30] which are 2,1 mg/l for nitrate, 2,1 mg/l for nitrites, 2,3 mg/l for ammonia and 0,5 mg/l for phosphate (value not to be exceeded to avoid a proliferation of algae [31]). Analysis of physical and chemical parameters has shown to vary only slightly from one medium to another. This observation could mean that the treatment nature has not significantly changed the water physical and chemical qualities. Therefore, the rice-fish combination would not have significantly affected the physical and chemical parameters of the water may influence negatively the growth of *O. niloticus*.

Regarding the biotic environment, the macroinvertebrates taxonomic richness varied little for the two environments (fish and rice-fish) which contain fish (18 taxa) against 20 taxa for the rice fields. The equitability index values shows that different system appears to have the same abundances of taxa. However, the low taxonomic richness fish farming environments result from fish predation on some taxa as noted by the work of [32] with regard to the occurrences that have been recorded. Furthermore, the occurrences of the organisms show an absence or presence of taxa in rice-fish crop. Taxa absent in the rice-fish crop while they are present in at least one control system are: *Micrasterias Pleurotaenium, Pediastrum* in chlorophytes*, Euglena* lchez the euglenophytes and *Lanites varicus* among macroinvertebrates. Also accidental presence of *Spirogyra* and *Oxillatoria* sp., *Microvela* sp and *Bulinus truncatus* was noted.

As fish growth parameters, fish in rice-fish had exhibited specific growth rate (2.18 ± 0.13%. j-1 and 1.56 ± 0.4%. d-1) higher than those of the fish environment. This weight gain is linked to a higher power provided by commensal organisms (algae or organisms that attach to substrates, submerged rice stalks or various twigs) and macroinvertebrates (Snails and insects). This is confirmed by examinations of water samples taken in this environment that indicate a significant wealth of micro-organisms (phytoplankton and zooplankton) including occurrence of zooplankton which consume phytoplankton before being eaten by fry. However, these growth rates are near to those obtained with the [33] test who obtained a specific growth rate of 1.5%.d^{-1} with fry of *O. niloticus* he fed with meal of smoked fish in a fish farming. The fish condition factor K does not differ significantly between the two farming system. However, the fish K value (0.05 ± 0.02) in the rice-fish system exhibited higher would be linked to new ecological environment created by the presence of rice with the appearance of plankton and macroinvertebrates (Snails and insects) beneficial to the diet of juvenile *O. niloticus* [34]. This is related by [32] who confirmed that in different East African lakes, this species feeding is based on plankton, including cyanobacteria, benthic algae (Chlorococcales, Volvocales, Euglénophycées and diatoms) cladocerans, rotifers, copepods, oligochaetes, chironomid larvae (Diptera), insects and debris.

The survival rates observed for pre-growth stage are 65.02 ± 4.71% for fish farming environments and 65.99 ± 15.57% in rice-fish farming. Concerning the growth phase, survival rates were 80.89 ± 14.39% for the fish farm area and 74.11 ± 9.85% in rice-fish area. These rates are similar to those of [35]. Furthermore, for the both crop systems, the allometric coefficient values are all less than 3 so fish growing in length. So the rice presence in fish ponds do not affect the growth mode of *O. niloticus* whatever their stage of development.

The rice yields in rice-fish crop obtained at the two varieties (1.67 ± 0.51 t/ha for Wita 12 ± 1.80 and 2.33 t/ha for Djoukèmin) show this crop area was more productive. This may be related to more ecological conditions created by the combination of rice and fish. In this system, fish, by their faeces recycle nutrients such as phosphorus and organic matter necessary for the development of rice [36]. However, these paddy yields are lower than those obtained by in rice irrigated system with Djoukèmin variety (2.83 t / ha) and [5] in rice intensification of wita 12 with fertilization. This low yield is in part related to the average water level of the ponds that are nearly all above the threshold of 1/5 (0,20) of the stem height of rice. These water level heights could hamper photosynthesis rice during her cycle. This same observation was made by an FAO study on improving the conditions for rice-fish farming.

5. Conclusion

The present study was carried to evaluate the combination of rice and fish pond. It appears the possibility of pre-growth and growth stage of *O. niloticus* in ponds with rice and fish together. The water physical and chemical parameters values (pH, conductivity, temperature, turbidity and nutrient compounds) are similar to those of fish and rice crop with the exception of dissolved oxygen, where there is a strong reduction over time. The rice-fish combination would not have significantly affected these parameters of the water which may influence the growth of *O. niloticus*. The biotic composition of this crop system is marked by a presence of planktonic taxa beneficial to secondary fauna proliferation. So, the presence of *Oxillatoria* was noted while there has been a lack of *Micrasterias*, *Pleurotaenium, Pediastrum* and *Euglena.* The best rice and fish production performance is obtained by rice-fish farming.

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