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The Effect of Stocking Density Differences on the Survival and Growth of Nile Tilapia (*Oreochromis niloticus*) Juveniles in a Bucket Aquaculture System (Budikdamber)

Pengaruh Perbedaan Padat Tebar terhadap Kelangsungan Hidup dan Pertumbuhan Benih Ikan Nila (Oreochromis niloticus) dalam Sistem Budidaya Ikan dalam Ember (BUDIKDAMBER)

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Abstract

Nile tilapia is one of Indonesia's leading aquaculture commodities, with strong potential for development to support food security and improve community welfare. This study aimed to analyze the effect of different stocking densities and to determine the optimal density that supports the survival and growth of Nile tilapia juveniles reared in the Budikdamber system. The research method used was an experimental method with a Completely Randomized Design (CRD), consisting of five treatments and three replications. The treatments were as follows: (A) stocking density of 15 fish/70 L (control), (B) 20 fish/70 L, (C) 25 fish/70 L, (D) 30 fish/70 L, and (E) 35 fish/70 L, maintained for 40 days with a feeding rate of 3% of the total biomass. Probiotics were applied at a dose of 0.8 ml/L through the culture water to maintain good water quality. The results showed that treatment B (20 fish/70 L) produced the best outcomes in terms of growth and survival, with an average absolute length gain of 2.03 ± 0.26 cm, absolute weight gain of 8.52 ± 1.11 g, a positive allometric length-weight relationship, a survival rate of 91.7%, a specific growth rate of 1.68 ± 0.17%, a feed conversion ratio of 1.59 ± 0.24, and water quality parameters within the acceptable range based on the Indonesian National Standard (SNI).

Keywords: Budikdamber, Nile Tilapia, Survival Rate, Water Spinach

Abstrak

Ikan nila adalah salah satu komoditas unggulan Indonesia yang berpotensi dikembangkan untuk mendukung ketahanan pangan, dan meningkatkan kesejahteraan masyarakat. Penelitian ini bertujuan untuk menganalisis pengaruh perbedaan padat tebar serta menentukan jumlah padat tebar optimal yang dapat menunjang kelangsungan hidup dan pertumbuhan benih ikan nila yang dipelihara dalam sistem Budikdamber. Metode yang digunakan pada penelitian ini adalah metode eksperimental dengan Rancangan Acak Lengkap (RAL) yang terdiri dari lima perlakuan dan tiga kali ulangan. Perlakuan yang diberikan adalah (A) padat tebar 15 ekor/70 L (kontrol), (B) padat tebar 20 ekor/70 L, (C) padat tebar 25 ekor/70 L, (D) padat tebar 30 ekor/70 L, (E) padat tebar 35 ekor/70 L yang dipelihara selama 40 hari dengan jumlah pakan yang diberikan sebanyak 3% dari biomassa ikan. Aplikasi probiotik sebanyak 0,8 ml/L melalui media pemeliharaan dilakukan untuk menjaga kualitas air agar tetap baik. Hasil penelitian menunjukkan bahwa perlakuan B dengan padat tebar 20 ekor/70 L memberikan hasil pertumbuhan dan kelangsungan hidup terbaik, dengan rata-rata pertambahan panjang mutlak sebesar 2,03 ± 0,26 cm, pertambahan bobot mutlak sebesar 8,52 ± 1,11 gram, hubungan panjang-bobot bersifat allometrik positif, kelangsungan hidup sebesar 91,7%, laju pertumbuhan harian sebesar 1,68 ± 0,17%, rasio konversi pakan sebesar 1,59 ± 0,24% dan kualitas air yang masih dalam kisaran batas normal berdasarkan Standar Nasional Indonesia (SNI).

Kata kunci: Budikdamber, Ikan Nila, Kelangsungan Hidup, Kangkung

1. Introduction

Tilapia (*Oreochromis niloticus*) is one of Indonesia's leading fishery commodities with great potential for development to support national food security and improve the standard of living of the community. This fish also has biological advantages, such as rapid growth, high adaptability to poor environments, and tolerance to high salinity, making it an ideal choice for aquaculture (Rahmadi, 2021). Based on the latest data from the Ministry of Maritime Affairs and Fisheries, the production volume of tilapia aquaculture in Indonesia from January to June 2024 has reached 11.8 million tons. In particular, freshwater fish farming has become one of the rapidly growing subsectors. In the second quarter of 2022, tilapia was recorded as the aquaculture commodity with the highest production volume, namely 401 thousand tons, an increase of 8.01% compared to the previous period (KKP, 2023). Increased development and population growth over time have led to the expansion of residential areas, resulting in a reduction in the amount of land available for livestock and farming activities. To overcome land constraints, some communities utilize limited space by applying the technique of Fish Farming in Buckets (Budikdamber), as practiced by residents in Muara Bulian, Jambi Province (Aini et al., 2020).

Fish mortality rates can be minimized through good aquaculture management, one of which is by determining the appropriate stocking density. Optimal stocking density will support maximum fish survival rates. The higher the number of fish stocked, the higher the intensity of maintenance required. Stocking density plays a significant role in creating comfortable living conditions for fish. If it is too high, it can cause stress due to competition for food and oxygen, ultimately reducing water quality and inhibiting fish growth. Conversely, too low a stocking density results in suboptimal space utilization and impacts production efficiency.

One of the common obstacles in aquaculture is determining the optimal seed stocking density. Therefore, the application of appropriate technology is needed to improve the efficiency and economic value of aquaculture, especially in the Budikdamber system. If factors such as density and environmental quality are not managed properly, fish growth will be hampered due to high competition for food and oxygen (Ritonga, 2020). The purpose of this study is to analyze the effect of different stocking densities and determine the optimal stocking density that can support the survival and growth of tilapia fry raised in the Budikdamber system.

2. Material and Method

2.1. Time and Place

This research was conducted at Building 4, Faculty of Fisheries and Marine Sciences, Padjadjaran University, Jatinangor, and was carried out from February to March 2025.

2.2. Methods

The research design used was a Completely Randomized Design (CRD) with five treatments and three replications. The details are as follows:

A = Stocking density of 15 tilapia fry/70 L (Control)
B = Stocking density of 20 tilapia fingerlings per 70 L
C = Stocking density of 25 tilapia fingerlings/70 L
D = Stocking density of 30 tilapia fry/70 L
E = Stocking density of 35 tilapia fingerlings/70 L.

2.3. Procedures

Before sowing tilapia and water spinach seeds, the containers were prepared by cleaning, drying, filling with water, and adding BIOM-S probiotics to maintain water quality and improve feed efficiency. Water spinach plants were grown using plastic cups filled with rockwool, which were hung on the lid of a bucket with small holes for water circulation. The budikdamber installation consisted of 15 units of 80-liter buckets filled with 70 liters of water, arranged according to treatment and equipped with an aeration system.

2.4. Data Analysis

The observation data included growth, absolute length, daily growth rate, and survival rate (SR) using analysis of variance (ANOVA). If there were differences between each treatment, Duncan's test was applied. Linear regression analysis was used to determine the length-weight relationship. Water quality parameters and water spinach observations were analyzed using comparative descriptive analysis.

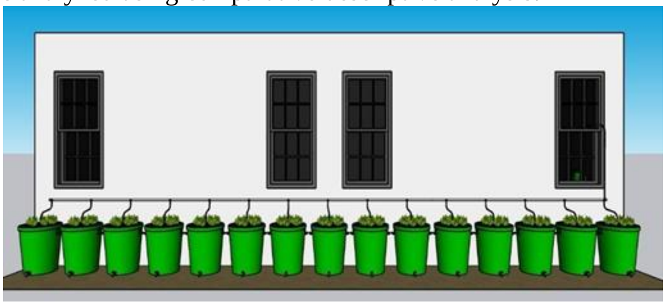

Figure 1. Research installation

3. Result and Discussion

3.1. Growth

Absolute length growth is the difference between the length of the fish at the end and beginning of cultivation, which is used to measure the increase in body size during cultivation. Based on the results of the ANOVA analysis, the absolute length growth of tilapia fry reared in the pond system was influenced by different stocking densities (P<0.05), can be seen in Figure 2. Treatment B, with a stocking density of 20 fish/70 L, produced the highest growth of 2.03 ± 0.26 cm, and treatment A, with a stocking density of 15 fish/70 L, produced the lowest growth of 1.41 ± 0.21 cm.

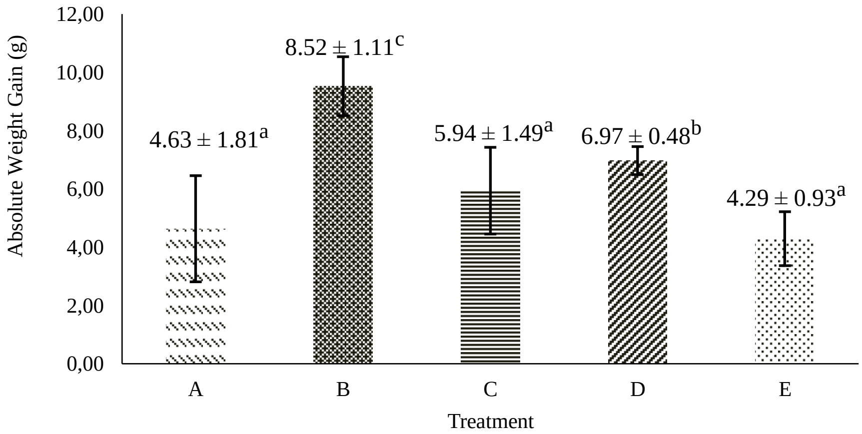

Figure 2. Length growth

According to Nursandi (2018), fish in buckets can grow 6–7 cm per week after the adaptation phase. This growth is influenced by the availability of feed, nutrient supply from plants, vitamin supplementation, and environmental factors such as pH and dissolved oxygen (Nofi et al., 2014). Absolute weight gain is the difference between the final weight and the initial weight of fish, which indicates an increase in biomass during the cultivation period (Effendie, 2003). Based on the results of ANOVA analysis, the absolute weight growth of tilapia fry raised in a pond system was influenced by different stocking densities (P<0.05), as shown in Figure 3. Treatment B, with a stocking density of 20 fish/70 L, produced the highest weight growth of 8.52 ± 1.11 g, and treatment E, with a stocking density of 35 fish/70 L, produced the lowest weight growth of 4.29 ± 0.39 g. The increase in biomass may decrease due to increased density. According to Salsabila & Suprapto (2018), farmed fish, especially tilapia, will show significant growth (weight gain) in the second week, while in the first week, the fry are generally still in the adaptive stage.

The specific growth rate is the rate of growth over time. Based on the results of the ANOVA analysis, the specific growth rate of tilapia fry raised in a pond system was influenced by different stocking densities (P<0.05), as shown in Figure 4. Treatment B, with a stocking density of 20 fish/70 L, produced the highest daily growth rate of 1.68 ± 0.17%, and treatment E, with a stocking density of 35 fish/70 L, produced the lowest growth rate of 1.14 ± 0.27%. A high daily growth rate reflects optimal environmental conditions and good cultivation management, enabling fish to utilize nutrients efficiently for biomass growth. Kristanto & Kusrini (2007) stated that a decrease in specific growth rate is caused by energy diversion. In general, energy from consumed feed will be used for maintenance, with the remainder used for growth.

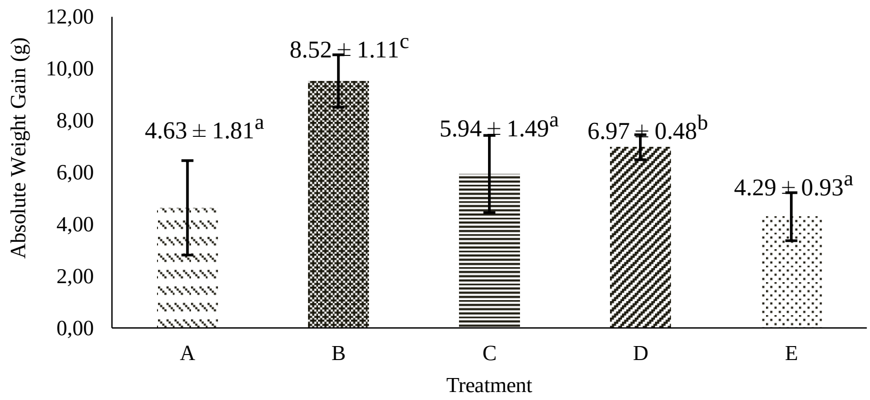

Figure 3. Absolute weight growth

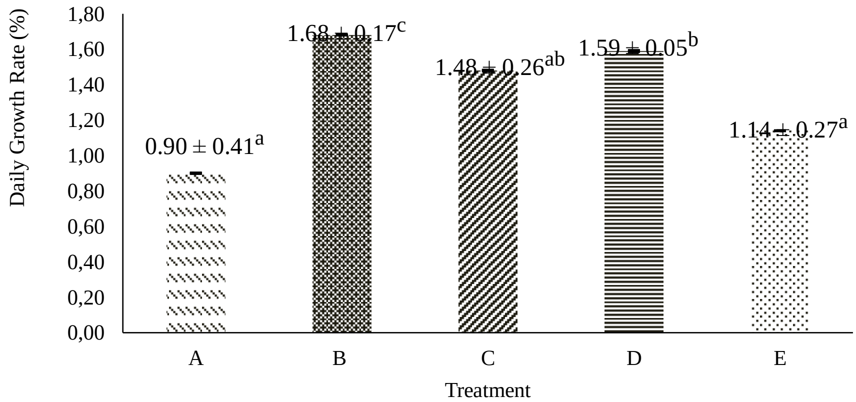

Figure 4. Specific growth rate

3.2. Length-Weight Relationship

The relationship between length and weight is an important indicator in assessing fish growth patterns. Based on Figure 5, it can be seen that the relationship between the length and weight of tilapia fry raised for 40 days in the Budikdamber system forms a linear pattern with the equation y = 4.7519x -29.908 with R2 = 0.8108, indicating that this growth is positive allometric b > 3, so the growth pattern of tilapia fry in the Budikdamber system is positive allometric. Positive allometric growth generally occurs in fish with short and tall body dimensions, such as tilapia, because mass accumulation is faster than body length (Effendie, 2002). Tilapia are omnivorous fish that tend to eat more when feed is available. The length and weight of tilapia determine feed and space utilization efficiency, so a cultivation system that optimizes these factors will increase productivity, especially in urban areas with limited land (Effendie, 1997).

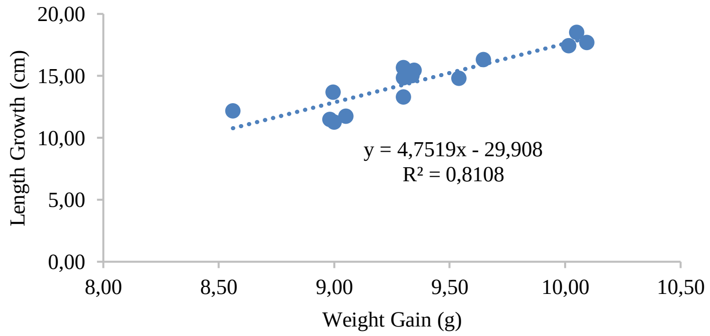

Figure 5. Length-weight relationship

3.3. Survival Rate

Survival rate is one of the main parameters that indicate success in maintaining an aquatic organism. Based on the results of ANOVA analysis, the survival rate of tilapia fry maintained in a pond system was influenced by different stocking densities (P<0.05), as shown in Figure 6. Treatment B, with a stocking density of 20 fish/70 L, produced the highest survival rate of 91.7 ± 2.9%, while treatment E, with a stocking density of 35 fish/70 L, produced the lowest growth rate of 71.4 ± 2.9%. Survival rates are influenced by internal factors such as water quality, feed competition, density, and disease, as well as external factors such as extreme weather (Wiryanta et al., 2010). According to Effendi et al. (2006), mortality occurs in fish farming with high stocking density because the space for movement becomes increasingly narrow, exerting pressure on the fish, causing stress, and increasing resistance.

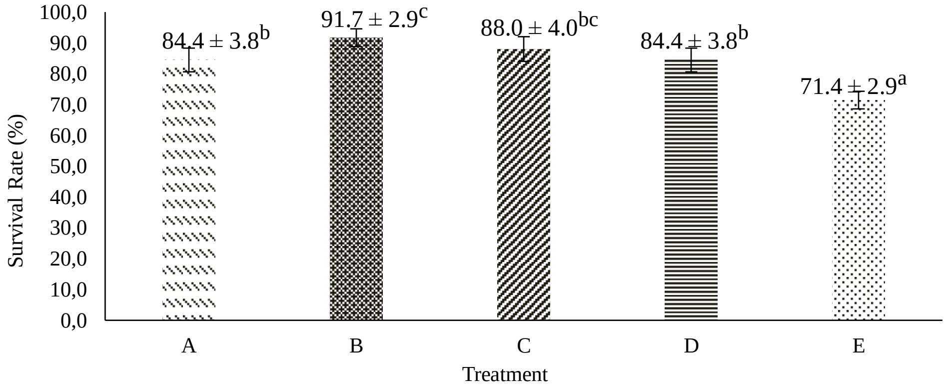

Figure 6. Survival rate

3.4. Feed Conversion Ratio

Feed conversion ratio is defined as the amount of feed consumed to produce each kilogram of weight gain. Based on the results of ANOVA analysis, the feed conversion ratio of tilapia fry raised in a pond system was influenced by different stocking densities ($P<0.05$), as shown in Figure 7. Treatment B, with a stocking density of 20 fish/70 L, produced the lowest feed conversion ratio of 1.59 ± 0.24%, and treatment A, with a stocking density of 15 fish/70 L, produced the highest growth of 3.80 ± 1.71%. Ardita et al. (2015) stated that the lower the FCR value, the more effectively fish utilize feed for growth, while a high FCR value indicates inefficient feed utilization.

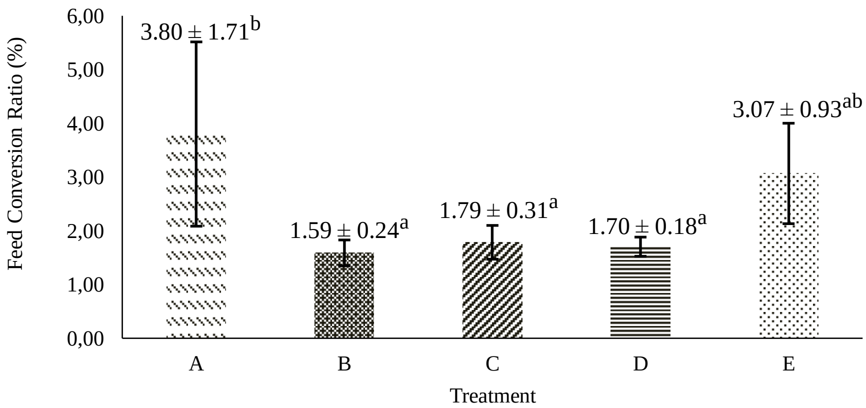

Figure 7. Feed conversion ratio

3.5. Water Quality

Water quality is a very important factor in fish farming. During the study, the water quality for tilapia fry cultivation was within an acceptable range and supported growth. Dissolved oxygen ranged from 5.0 to 7.6 mg/L, higher than the minimum limit of 3.0 mg/L according to SNI 7550 (2009), and supported fish survival (Colt et al., 2011). The temperature was 23.3–28.7°C, close to the optimal range of 25–32°C (Khairuman & Amri, 2011). The pH was recorded between 6.62–7.65, still within the ideal range for tilapia, which is 6.5–9. Ammonia concentration was 0.1–0.3 mg/L, slightly above the standard, but still safe with routine water management (Putri et al., 2022). Nitrite values ranged from 0.01–0.05 mg/L, still below the maximum limit of 0.06 mg/L (Dhiba et al., 2019), due to its temporary nature in the nitrification process (Fazil et al., 2017). Meanwhile, nitrate levels were measured between 0–0.10 mg/L, well below the maximum limit of 10 mg/L according to Government Regulation No. 82 of 2001, ensuring safety for tilapia.

Table 1. Water quality

Treatment	DO (mg/L)	Temperature (°C)	pH	Ammonia (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)
A	5.3–7.6	23.5-27.5	7.08-7.59	0-01	0-01	0-2
B	5.6–7.4	24.5-28.0	6.99-7.37	0-015	0-01	0-2
C	5.4-7.1	23.8-28.1	6.87-7.48	0-02	0-25	0-5
D	5.3–7.2	24.9-28.3	6.85-7.40	0-02	0-25	0-5
E	5.0-7.0	23.3-28.7	6.62-7.65	0-0.3	0-0.5	0-10
Quality Standard*	≥ 3	25-32	6.5-8.5	< 0.02	< 0.06	< 50

3.6. Water Spinach Growth

Cultivating water spinach on top of fish farming containers is an effort to maintain water quality as a medium for fish farming. Based on the cultivation results, the average number of leaves ranged from 30 to 35, the average leaf width ranged from 2.9 to 3.0 cm, the average leaf length ranged from 13 to 17.1 cm, the average root length ranges from 18.4-22.4 cm, the average stem length ranges from 38.2-52.1 cm, the average weight ranges from 129-165.8 g, and the average biomass ranges from 285-496 g. Low stocking density resulted in slow growth, presumably due to nutrient deficiency, particularly of nitrogen and phosphorus compounds. The increase in water spinach biomass at high stocking density indicates that nutrient accumulation (especially nitrate) in the water increased, allowing plants to utilize it optimally for growth.

Table 2. Water Spinach Growth

Treatment	Average Number of Leaves (fruits)	Average Leaf Width (cm)	Average Leaf Length (cm)	Average Root Length (cm)	Average Stem Length (cm)	Average weight (g)	Average biomass (g)
A	30	2.9	13	18.4	49.1	129	285
B	35	3.2	17.1	22.4	52.1	165.8	496
C	32	3.0	15.2	21	44.5	131	393
D	32	2.9	16	19	38.2	143	401
E	34	3.1	16.2	19.8	48.7	156	459

4. Conclusions

Based on the study's results, it can be concluded that stocking density affects the survival and growth of tilapia fry in the Budikdamber system. Thus, selecting the appropriate stocking density is an important factor in optimizing the growth of tilapia fry without reducing their survival rate. The results of the study show that treatment B with a stocking density of 20 fish/70 L gave optimal results with an average absolute length gain of 2.03 ± 0.26 cm, an absolute weight gain of 8.52 ± 1.11 g, a positive allometric length-weight relationship, a survival rate of 91.7%, a daily growth rate of 1.68 ± 0.17%, a feed conversion ratio of 1.59 ± 0.24%, and water quality that was still within the normal range based on Indonesian National Standards (SNI).

5. References

[KKP] Kementerian Kelautan dan Perikanan. (2023). Rilis Data Kelautan dan Perikanan Triwulan II 2022. https://sosek.info/wp-content/uploads/2023/02/Rilis-Data-Kelautan-dan-Perikanan-Triwulan-II-Tahun-2022-1.pdf

[SNI] Standar Nasional Indonesia. (2009). *Produksi Ikan nila (Oreochromis niloticus Bleeker) Kelas Pembesaran di Kolam Air Tenang.* Badan Standardisasi Nasional, Jakarta: Indonesia

Aini, F., Asra, R., Maritsa, H., Yusuf, A.I., & Sazali, A. (2020). Penerapan Teknik Budidaya Ikan dalam Ember (BUDIKDAMBER) di Lingkungan Masyarakat Desa Talang Inuman Muara Bulian. *Journal of Rural and Urban Community Empowerment*, 2(1):29–36.

Ardita, N., Budiharjo, A., & Sari, S.L.A. (2015). Pertumbuhan dan Rasio Konversi Pakan Ikan Nila (*Oreochromis niloticus*) dengan Penambahan Prebiotic. *Bioteknologi*, 12(1): 16-21

Arzad, M., Ratna, R., & Ahmad, F. (2019). Pengaruh Padat Tebar terhadap Pertumbuhan Ikan Nila (*Oreochromis niloticus*) dalam Sistem Akuaponik. *Median Jurnal Ilmu Ilmu Eksakta*, 11(2):39

Colt, J., Momoda, T., Chitwood, R., Fornshell, G., & Schreck, C. (2011). Water Quality in Tilapia Transport: from the Farm to the Retail Store. *North American Journal of Aquaculture*, 73(4): 426-434

Dhiba, A.A.F., Syam, H., & Ernawati, E. (2019). Analisis Kualitas Air pada Kolam Pendederan Ikan Lele Dumbo (*Clarias gariepinus*) dengan Penambahan Tepung Daun Singkong (*Manihot utillisima*) Sebagai Pakan Buatan. *Jurnal Pendidikan Teknologi Pertanian*, 17(12): 2087–2090.

Effendi, I., Augustine, D., & Widanarni, W. (2006). Perkembangan Enzim Pencernaan Larva Ikan Patin *Pangasius hypophthalmus*. *Jurnal Akuakultur Indonesia*, 5 (1):41-49

Effendie, M.I. (1997). *Biologi Perikanan*. Yayasan Pustaka Nusatama. Yogyakarta. 163 pp.

Effendie, M.I. (2003). *Biologi Perikanan*. Yayasan Pustaka Nusantara. Yogyakarta.

Effendie, M.I. (2002). *Biologi Perikanan*. Penerbit Yayasan Pustaka Nusantara. Yogyakarta. 163 pp.

Fazil, M., Adhar, S., & Ezraneti, R. (2017). Efektivitas Penggunaan Ijuk, Jerami Padi dan Ampas Tebu sebagai Filter Air pada Pemeliharaan Ikan Mas Koki (*Carassius auratus*). *Acta Aquatica: Aquatic Sciences Journal*, 4(1): 37-43.

Khairuman, K., & Amri, K. (2011). *2,5 Bulan Panen Ikan Nila.* Agromedia Pustaka. Jakarta

Kristanto, A.H., & Kusrini, E. (2007). Peranan Faktor dalam Pemuliaan Ikan. *Media Akuakultur*, 2:183-188.

Nofi, A., Rokhmah, C.S.A., & Sastro, Y. (2014). Mini Akuaponik untuk Lahan Sempit di Perkotaan. *Buletin Pertanian Perkotaan*, 4(2)

Nursandi, J. (2018). *Budidaya Ikan dalam Ember "Budikdamber" dengan Aquaponik di Lahan Sempit.* Prosiding Seminar Nasional Pengembangan Teknologi Pertanian.

Peraturan Pemerintah Republik Indonesia Nomor 82 Tahun 2001. Tentang Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air. Sekretaris Negara Republik Indonesia. Jakarta

Putri, D.A., Susanto, A., & Astuti, N.P. (2022). Efisiensi Pertumbuhan dan FCR Ikan Nila dalam Sistem Budikdamber pada Padat Tebar Berbeda. *Jurnal Akuakultur Tropis*, 10(1): 40–48.

Rahmadi, A. (2021). Adaptasi Benih Ikan Nila (*Oreochromis niloticus*) pada Kenaikan Salinitas yang Berbeda. *Jurnal Perikanan*, 11(2): 251-258

Ritonga, L.B.R. (2020). Pengaruh Padat Tebar yang Berbeda terhadap Laju Pertumbuhan Ikan Wader Cakul (*Puntius binotatus*). *Jurnal Chanos chanos*, 18(1): 1-6.

Salsabila, M., & Suprapto, H. (2018). Teknik Pembesaran Ikan Nila (*Oreochromis niloticus*) di Instalasi Budidaya Air Tawar Pandaan, Jawa Timur. *Journal of Aquaculture and Fish Health*, 7(3): 118-123.

Wiryanta, B.T.W., Sunaryo, S., Astuti, A., & Kurniawan, M.B. (2010). *Buku Pintar dan Bisnis Ikan Nila*. PT. AgroMedia Pustaka. Jakarta.