p-ISSN 2579-4752
e-ISSN 2620-7397

Akuakultura 10:1 (2026): 19–22

AKUAKULTURA

Growth of Nile Tilapia *(Oreochromis niloticus)* and Giant Freshwater Prawn (Macrobrachium rosenbergii) under Different Legowo Planting Systems in Integrated Rice-Fish Culture

Pertumbuhan Ikan Nila (*Oreochromis niloticus*) Dan Udang Galah (*Macrobrachium rosenbergii*) Terhadap Perbedaan Legowo Pada Sistem Minapadi

Received: September 2026, Revised: March 2026, Accepted: May 2026
DOI: 10.35308/ja.v10i1.13349

Raihan Ramadhan Hasibuan [a] , Yusran Ibrahim [a] , Mahendra [a]

[a] *Aquaculture Study Program, Faculty of Fisheries and Marine Sciences, Teuku Umar University, Jl. Alue Peunyareng, Ujong Tanoh Darat, Meureubo, West Aceh, Aceh*

Abstract

Minapadi is an integrated fish farming system carried out in rice fields concurrently with rice cultivation. The purpose of this study was to enhance farmers' income, boost rice productivity, and support the cultivation of endemic fish species. The research employed an experimental approach using a Completely Randomized Design (CRD), consisting of four treatments and three replications. The treatments included: A1B1 (giant prawns with a legowo 2:1 planting system), A1B2 (tilapia with a legowo 2:1 system), A2B1 (giant prawns with a legowo 4:1 system), and A2B2 (tilapia with a legowo 4:1 system). This study was conducted over a period of 90 days (3 months) in rice fields located in Lango Village, Pante Ceureumen District, West Aceh Regency. Three key parameters were observed: rice yield, fish survival rate, and fish growth. The results showed an average rice yield of 5 kg per plot. The best growth performance for prawns was observed in treatment A2B1, with an average weight of 3.62 grams. Meanwhile, the highest growth for tilapia was recorded in treatment A1B2, averaging 19.56 grams. Overall, the findings indicate that applying the Minapadi system with giant prawns and tilapia has a significant positive impact on the observed variables ($P<0.05$) and holds potential to improve farmers' income.

Keywords: Minapadi, Legowo, Productivity, Endemic Fish

Abstrak

Minapadi merupakan metode budidaya ikan yang dilakukan di lahan sawah secara bersamaan dengan penanaman padi. Penelitian ini bertujuan untuk meningkatkan pendapatan petani, meningkatkan hasil panen padi, serta mendorong produksi ikan endemik. Penelitian menggunakan metode eksperimen dengan Rancangan Acak Lengkap (RAL), yang terdiri dari 4 perlakuan dan 3 ulangan. Adapun perlakuan yang diterapkan meliputi: A1B1 (udang galah dengan sistem legowo 2:1), A1B2 (ikan nila dengan sistem legowo 2:1), A2B1 (udang galah dengan sistem legowo 4:1), dan A2B2 (ikan nila dengan sistem legowo 4:1). Penelitian dilaksanakan selama 90 hari (3 bulan) di lahan persawahan Desa Lango, Kecamatan Pante Ceureumen, Kabupaten Aceh Barat. Tiga parameter utama yang diamati dalam penelitian ini adalah produktivitas padi, tingkat kelangsungan hidup ikan, dan pertumbuhan ikan. Hasil penelitian menunjukkan bahwa rata-rata produktivitas padi mencapai 5 kg per petak lahan. Perlakuan A2B1 memberikan hasil pertumbuhan terbaik untuk udang galah dengan bobot rata-rata 3,62 gram, sedangkan perlakuan A1B2 menunjukkan hasil optimal untuk pertumbuhan ikan nila dengan bobot rata-rata 19,56 gram. Secara keseluruhan, hasil penelitian ini menunjukkan bahwa penerapan sistem minapadi dengan kombinasi udang galah dan ikan nila memberikan pengaruh positif yang signifikan terhadap parameter yang diamati ($P<0,05$), serta berpotensi meningkatkan pendapatan petani.

Kata kunci: *Minapadi, Legowo, Produktifitas, Ikan Endemik*

1. Introduction

The COVID-19 pandemic has caused instability across all economic sectors, including the fisheries and agriculture sectors. To boost the economy during the COVID-19 pandemic, we must also work extra hard to meet our families' food needs. One approach to meeting the community's food needs is through aquaculture (Saputri and Rachmawatie, 2020). Rural communities can meet their protein needs by farming fish in various locations such as ponds, the sea, rivers, lakes, or other aquaculture media. However, as development in rural areas grows, land available for fish farming is becoming increasingly limited. One alternative activity that can be undertaken to meet economic needs as well as animal protein intake to strengthen the body's immune system is by implementing the Minapadi system.

***** *Correspondence: Aquaculture Program, Faculty of Fisheries and Marine Sciences, Teuku Umar University, Jl. Alue Peunyareng, Ujong Tanoh Darat, Meureubo, West Aceh, Aceh*
e-mail: raihanramadhan336@Gmail.com

Rice-fish farming is a method that combines rice cultivation and fish farming in a single paddy field simultaneously. The objective of this technique is to increase farmers' income by boosting rice yields and local fish production (Mahendra et al., 2019). Several fish species highly suitable for cultivation in the minapadi system include local tilapia and giant river prawns, both of which are endemic species and flagship commodities of Aceh (DKP Aceh, 2015).

The jajar legowo (jarwo) planting technique in the minapadi system provides a wider growing space and increases plant density. The application of this method helps plants obtain optimal sunlight and good air circulation. Additionally, fertilization and weed control become more efficient. According to BPTP Jambi (2013), the optimal jarwo configurations to support the productivity of the minapadi system are the 4:1 and 2:1 patterns.

The potential for developing the minapadi system in Indonesia remains very significant. Data from the Directorate General of Aquaculture indicates that out of a total potential area of 1,538,479 hectares, only approximately 127,944 hectares have been utilized for the minapadi system. This means that the land utilization rate has only reached around 8.3%. Therefore, the Ministry of Marine Affairs and Fisheries, through the Directorate General of Aquaculture, is once again promoting the integrated aquaculture-rice farming technology program to encourage increased aquaculture production (KKP, 2018). This program also aims to empower local communities and improve economic well-being through innovative development and accelerated growth of endemic fish using the jajar legowo integrated aquaculture system approach.

2. Materials and Methods

2.1. Time and Location

This research was conducted from July to September 2021 on rice fields located in Lango Village, Pante Ceureumen Subdistrict, West Aceh Regency, over a three-month period or 90 days.

2.2. Research Design

In this study, the methods used were the experimental method and a completely randomized design (CRD) with 2 treatments and 3 replicates.

Table 1.
Research Treatments

Treatment (A1B1)	: Giant Prawns, 2:1 Legowo System
Treatment (A1B2)	: Tilapia, 2:1 legowo system
Treatment (A2B1)	: Giant Prawn, 4:1 Legowo System
Treatment (A2B2)	: Tilapia, 4:1 legowo system

The first treatment to be tested is:
A1 = 2:1 row-and-row system
A2 = 4:1 row-and-row system

The second treatment to be tested is:
B1 = Giant Prawn
B2 = Tilapia

This study used a completely randomized design with four treatments, namely A1B1, A1B2, A2B1, and A2B2.

2.3. Research Procedure

The initial stage of land preparation involved constructing rice field embankments with dimensions of 60 cm in height, 60 cm at the base, and 30 cm at the top. Meanwhile, ditches were constructed according to the legowo system, with widths ranging from 30 to 60 cm and a depth of 40 cm. The research location is shown in (Figure 1(A)).

Planting was carried out using the transplanting method (tapin) as shown in (Figure 1(B)). The rice seedlings used were 25 to 30 days old. The selected variety was MAPAN, known for its tolerance to waterlogging as well as pest and disease attacks. The planting spacing applied was 25 x 12.5 cm, with 2 to 3 seedlings per clump. The water level in the field was maintained at 10 cm.

Figure 1. Rice field: A. Study site; B. Rice transplanting (Tapin)

Fish stocking was conducted when the plants were 30 days old (Figure 2(B)), with a water depth of at least 10 cm, a stocking density of 5–10 fish/m², and fish size of 5–8 cm (KKP, 2018).

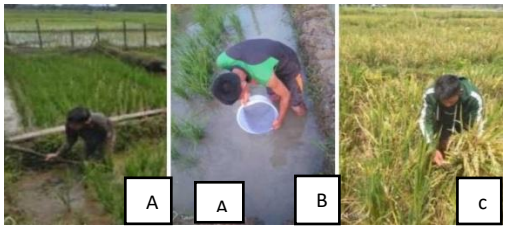

Figure 2. *Minapadi Cultivation Procedure*: A. Rice Plant Growth Over 30 Days; B. Stocking of Tilapia and Giant River Prawns; C. Harvesting of Rice, Tilapia, and Giant River Prawns

The fish cultivation period in the rice-fish system lasts three months (90 days), with feeding conducted twice daily, in the afternoon and evening. Feed is provided at the maximum dosage, which is 3% of the total fish weight, adjusted according to the feeding frequency.

The harvest of shrimp and fish will be conducted 90 days after planting the rice (Figure 2(C)). The rice to be harvested will be selected based on its productivity. Meanwhile, fish and shrimp are assessed based on their growth.

2.4. Measurable Performance Indicators

a. Rice Productivity

According to (Silamat et al., 2014), rice productivity can be calculated using the following formula:

$$Produktivitas\ Padi = \frac{Jumlah\ Produksi\ (Kg)}{Luas\ Lahan\ (ha)}$$

b. Weight Gain

Weight gain, according to Mahendra (2015), is calculated using the formula:

$$W = Wt - Wo$$

Notes:
W = Average weight gain per fish (grams)
Wt = Average fish weight at the end of the trial period (grams)
Wo = Average fish weight at the start of the test period (grams)

2.5. *Data Collection Techniques*

The data collection technique used in this study involved data collection. Data collection was divided into two categories: primary and secondary data. Primary data were obtained from observations and active participation, while secondary data were obtained from literature and previous research reports. The collected data resulted from the use of experimental research techniques by comparing the control group and the treatment group.

2.6. *Data Analysis*

The collected data was then analyzed using an ANOVA statistical test with the aid of SPSS software to determine the effect of the treatments administered. If the analysis results indicated a significant difference, a Tukey post-hoc test was conducted to identify the treatment that yielded the best results.

3. Results and Discussion

3.1. *Rice Productivity*

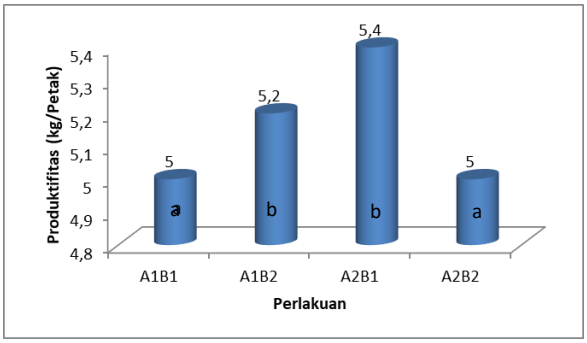

Figure 3. *Rice Productivity Graph*

Productivity is a process that transforms a product's characteristics to yield a final good. Productivity reflects the difference in the quantity of goods produced relative to the area used. Based on the research results shown in (Figure 3), the highest rice productivity was achieved in treatment A2B1 (the 2:1 Legowo planting system with giant river prawns), with an average yield of 5 kg per plot. This result aligns with Julistia's (2017) findings, which state that the implementation of the rice-fish farming system can increase productive area, where the harvest yield increased from 5,652 kg/ha to 7,612 kg/ha, or by 1,987 kg/ha. The area of rice fields is the same as the area of minapadi, but the percentage of minapadi is higher than the percentage of fish farming.

(Tysno, L. F. I. 2018) states that the success of rice-fish farming depends on whether the rice yield increases compared to before the system was implemented; the land used plays a significant role in producing high-quality products through this system. Efforts to improve productivity are achieved by enhancing soil conditions through the application of products that control pests and diseases.

The high effect of rice in the A2B1 treatment is likely due to the fact that the pellet feed provided was not consumed by the shrimp; the pellets used were the FF999 brand intended for fish, so the shrimp were more attracted to the abundant natural food in the area. The leftover pellets will accumulate as residue that will be absorbed by the rice plants. (Kaya, E. 2013) states that nitrogen is a nutrient that plays a crucial role in plant growth, with plant roots serving as the mechanism for processing NO3 (nitrate) and NH4 (ammonium) in plants. A lack of nitrogen can have adverse effects on plants, including slow growth, yellowing of leaves, and limited root spread. Conversely, an adequate supply of nitrogen has positive effects on rice growth, such as healthy plant development, upright plant structure, and protection against pests and diseases. Meanwhile, pellets containing nitrogen promote more effective rice growth.

3.2. *Weight Gain of Giant River Prawns*

The results of the study comparing legowo treatment and giant river prawns on the growth of giant river prawns are presented in (Figure 4).

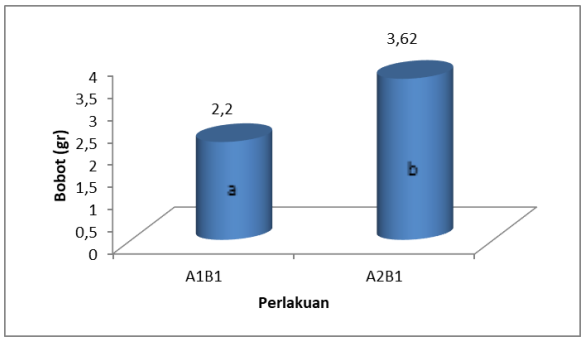

Figure 4. *Graph of Giant Prawn Weight Gain*

The results of the analysis in (Figure 4) show that the legowo farming system combined with giant river prawn cultivation has a significant effect on prawn weight gain. The treatment with the lowest yield was recorded in A1B1 (2:1 legowo with giant river prawns) at 2.2 grams, while the highest yield was found in A2B1 (4:1 legowo with giant river prawns) at 3.62 grams. These data demonstrate that the application of the legowo system can enhance the weight gain of giant river prawns during a 90-day rearing period.

The weight gain of giant river prawns in the 4:1 legowo system is higher. This is likely because the giant river prawns in the 4:1 legowo system are less active/move less due to the greater number of rice rows; this benefits the prawns because the less they move, the more nutrients obtained from feed are directed toward growth rather than energy.

3.3. *Growth in Tilapia Weight*

Based on the study of variations in the improvement of tilapia weight growth using the legowo system, a significant effect was found (F calculated < F table at 0.05 and 0.01).

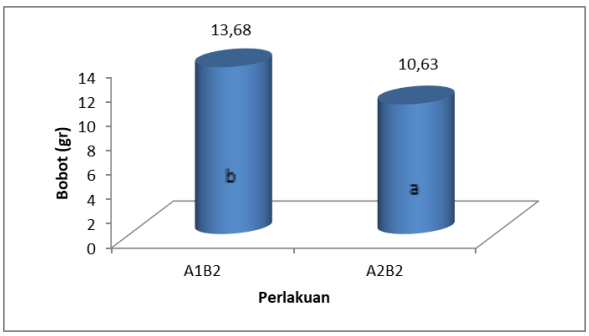

Figure 5. Graph of Tilapia Weight Gain

Based on the results of the study in (Figure 5), the highest increase in tilapia weight was found in treatment A1B2, namely the 2:1 legowo system with tilapia, with a weight reaching 19.56 grams. Meanwhile, the lowest growth was recorded in treatment A2B2, namely the 4:1 legowo system with tilapia, with a weight of 17.11 grams. The data obtained indicate that the use of the legowo system has an impact on the weight gain of tilapia during the 90-day rearing period.

The high growth rate of tilapia is believed to be due to the fact that tilapia in a 2:1 water-to-fish ratio have more room to move, as tilapia are generally active swimmers in their natural habitat. In general, fish living in tanks that mimic their natural habitat grow faster than those in tanks that are too small or do not resemble their natural habitat.

4. Conclusion

Based on the results of this study, it can be concluded that rice productivity yielded an average of 5 kg per plot, and the best treatment for giant river prawn growth was treatment A2B1, which achieved an average weight of 3.63 grams. Meanwhile, the best treatment for tilapia was A1B2, with an average weight of 19.56 grams. The findings of this study indicate that the application of the rice-shrimp integrated farming system in giant river prawn cultivation has a significant impact on the observed parameters ($P<0.05$) and holds great potential for increasing the profitability of farming operations for farmers.

Acknowledgments

The author expresses his deepest appreciation to the Ministry of Education and Culture-Directorate General of Higher Education (KEMENDIKBUD-DIKTI) for the funding provided to carry out this research. The author would also like to thank Teuku Umar University, particularly the Aquaculture Study Program under the Faculty of Fisheries and Marine Sciences, for all forms of support and contributions provided throughout the research process.

References

Balai Pengkajian Teknologi Pertanian Jambi. 2013. Sistem Tanam Padi Jajar Legowo. Balai Besar Pengkajian Dan Pengembangan Teknologi Pertanian. Badan Penelitian Dan Pengembangan Pertanian. Kementerian Pertanian. ISBN : 978-602-1276-01-3.

Batubara dan Gustianty. 2016. Laju Pertumbuhan Dan Kelangsungan Hidup Udang Galah (Macrobranchium rosenbergii de Man) Skala Laboratorium. Universitas Asahan. Kisaran.

Dinas Kelautan dan Perikanan Aceh. 2015. Identifikasi Jenis-Jenis Ikan Endemik Di Perairan Aceh Wilayah Barat Selatan (Aceh Barat). Laporan Akhir. Banda Aceh.

Julistia, D. R. 2017. Analisis Pendapatan Usahatani Minapadi Di Desa Margoluwih Kecamatan Seyegan Kabupaten Sleman. [Skripsi]. Bogor: Institut Pertanian Bogor.

Kaya, E. 2013. Pengaruh Kompos Jerami dan Pupuk NPK Terhadap N-Tersedia Tanah, Serapan-N, Pertumbuhan, Dan Hasil Padi Sawah (Oryza sativa L). Agrologia, 2 (1): 43-50.

Kementerian Kelautan Dan Perikanan. 2018. Budidaya Ikan Sistem Minapadi. Direktorat Jenderal Perikanan Budidaya. Jakarta.

Mahendra, 2015. Kombinasi Kadar Kalium Dan Salinitas Media Pada Performance Juvenil Udang Galah (Macrobachium rosenbergii de Man). Jurnal Perikanan Tropis. 2 (1):55-71.

Mahendra dan Widyanti, R.N. 2018. Pertumbuhan Dan Sintasan Benih Lobster Air Tawar (Cherax quadricarinatus) Yang Diberi Pakan Silase Limbah Viseral Ikan. Jurnal Akuakultura. 2 (1):52-60.

Mahendra.,Saputra F., Febrina C.D., dan Islama D. 2019. Teknologi Milenial (Minapadi Legowo Dengan Ikan Lokal) Secara Berkelanjutan di Kecamatan Beutong Nagan Raya. Jurnal Karya Abdi Masyarakat. 3 (2): 286 – 298.

Silamat, E., Yuwana., dan Yuliarso, M.Z. 2014. Analisis Produktivitas Usahatani Padi Sawah Dengan Menggunakan Traktor Tangan Dan Cara Konvensional Di Kabupaten Rejang Lebong. Universitas Bengkulu. ISSN: 1412-8837.

Saputri, S.A.D dan Rachmawatie, D. 2020. Budidaya Ikan Dalam Ember: Strategi Keluarga Dalam Rangka Memperkuat Ketahanan Pangan Di Tengah Pandemi Covid-19. Jurnal Ilmu Pertanian Tirtayasa, 2(1) : 102 – 109.

Tysno, L. F. I. 2018. Analisis Pendapatan Usahatani Minapadi. [Skripsi]. Bogor: Institut Pertanian Bogor.

Zaidy, A.B. 2007. Pendayagunaan Kalsium Media Perairan dalam Proses Ganti Kulit dan Konsekuensinyabagi Pertumbuhan Udang Galah (Macrobrachium rosenbergii de Man). Disertasi. Institut Pertanian Bogor, Bogor.