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Pengaruh Sistem Tandon terhadap Produktivitas Budidaya Udang Windu (*Penaeus monodon* Fab.) di Jawa Barat

The Influence of the Tandon System on the Productivity of Giant River Prawn (Penaeus monodon Fab.) Cultivation in West Java

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ABSTRAK

Sistem tandon telah menjadi salah satu metode yang diakui dalam manajemen air pada budidaya udang windu (*Penaeus monodon* Fab.) guna meningkatkan produktivitas dan mengurangi risiko penyakit. Penelitian mengenai penerapan sistem ini semakin berkembang seiring dengan meningkatnya kebutuhan untuk menjaga kualitas air yang optimal di tambak. Artikel review ini bertujuan untuk meninjau berbagai studi yang telah dilakukan mengenai pengaruh sistem tandon terhadap produktivitas budidaya udang windu di Jawa Barat, serta mengidentifikasi faktor-faktor kunci yang mempengaruhi keberhasilan sistem tersebut. Studi-studi terdahulu menunjukkan bahwa penggunaan sistem tandon mampu meningkatkan kualitas air melalui sirkulasi yang lebih baik, penyaringan limbah, serta stabilisasi parameter fisik-kimia air tambak. Hasil dari beberapa penelitian di berbagai tambak udang di Jawa Barat memperlihatkan adanya peningkatan signifikan dalam produktivitas, termasuk peningkatan laju pertumbuhan, kelangsungan hidup udang, serta hasil panen yang lebih tinggi. Selain itu, sistem tandon juga terbukti efektif dalam menekan risiko penyakit yang seringkali menjadi kendala utama dalam budidaya udang, seperti penyakit white spot syndrome. Meskipun demikian, terdapat beberapa tantangan dalam implementasi sistem tandon, seperti biaya investasi awal yang tinggi dan kebutuhan akan manajemen teknis yang lebih baik. Artikel ini menyimpulkan bahwa sistem tandon memiliki potensi besar untuk diadopsi secara luas di tambak udang windu, terutama di daerah Jawa Barat, asalkan didukung oleh pelatihan dan dukungan teknologi yang memadai. Selain itu, perlunya penelitian lebih lanjut untuk mengeksplorasi dampak jangka panjang dan potensi pengembangan sistem ini di berbagai kondisi lingkungan yang berbeda.

ABSTRACT

The reservoir system has become one of the recognized methods in water management in tiger shrimp cultivation (*Penaeus monodon* Fab.) to increase productivity and reduce the risk of disease. Research on the implementation of this system is growing along with the increasing need to maintain optimal water quality in ponds. This review

article aims to review the various studies that have been conducted on the influence of the reservoir system on the productivity of tiger shrimp cultivation in West Java, as well as to identify the key factors that affect the success of the system. Previous studies have shown that the use of reservoir systems can improve water quality through better circulation, waste filtration, and stabilization of physico-chemical parameters of pond water. Results of several studies in various shrimp ponds in West Java showed a significant increase in productivity, including increased growth rates, shrimp survival, and higher crop yields. In addition, the reservoir system has also been proven to be effective in reducing the risk of diseases that are often the main obstacle in shrimp farming, such as white spot syndrome. However, there are several challenges in the implementation of the reservoir system, such as high initial investment costs and the need for better technical management. This article concludes that the reservoir system has great potential to be widely adopted in tiger shrimp ponds, especially in the West Java region, provided it is supported by adequate training and technological support. In addition, further research is needed to explore the long-term impacts and potential development of these systems in a variety of different environmental conditions.
Keywords: Review, reservoir system, productivity, tiger shrimp, water management, West Java.

Kata Kunci	*Review, Sistem Tandon, Produktivitas, Udang Windu, Manajemen Air, Jawa Barat.*
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INTRODUCTION

Tiger shrimp cultivation is one of the fisheries activities that is relied on in fulfilling fishery production targets in Indonesia for local consumption and export commodities. The West Java region, especially the north coast of Java, is the base for the development of shrimp cultivation because it has a fairly large pond area (Utami & Indrayani, 2018).

Tiger shrimp cultivation (*Penaeus monodon*) has an important role in Indonesia, both in terms of economy, environment, and social. Tiger shrimp is one of Indonesia's leading export commodities. The demand for tiger shrimp in the international market, especially in Asian countries, Europe, and the United States, is very high. This shrimp export generates large foreign exchange and helps national economic growth (Primyastanto, 2014). Tiger shrimp cultivation is the main source of livelihood for many pond farmers, especially in coastal areas. Through successful cultivation, farmers can earn significant income, improve their standard of living, and reduce poverty in coastal areas. Many coastal areas in Indonesia are less fertile for ordinary agriculture, but they are very suitable for fisheries, especially tiger shrimp. This cultivation is able to transform less productive land into a valuable economic source. Tiger shrimp has a high selling value and is in great demand in the domestic and international markets, so the price of this commodity tends to be stable and offers promising business opportunities for farmers. In addition, tiger shrimp plays an important role in supporting Indonesia's food sovereignty program by meeting the needs of domestic animal protein and becoming a significant export product (Purwanti, 2017).

With the growth of the world population and the increasing demand for quality fishery products, the market potential for tiger shrimp is getting bigger. Indonesia as a country with the second longest coastline in the world has great potential to continue to develop this sector. Good and sustainable management can help maintain the balance of coastal ecosystems and prevent environmental damage (Putra *et al*., 2023). This is important to ensure the availability of marine resources for future generations. With great potential, tiger shrimp cultivation has a significant impact on the national economy and the welfare of coastal communities in Indonesia.

The rapid development of pond cultivation which is in line with the increase in seawater pollution by domestic, agricultural, industrial and mining waste as well as waste from the ponds themselves has caused many problems to arise. The problem that stands out is the high mortality rate of shrimp when passing the stocking stage in ponds. The results of the study showed that one of the causes of death was poor water quality from the water supplied to the pond area, resulting in shrimp fry that were still relatively small (PL 12-15) and the acclimatization rate was low, which would be susceptible to diseases (Munaeni *et al*., 2023).

The purpose of this review journal is to provide a comprehensive review of the reservoir system in tiger shrimp farming, including a comprehensive analysis of its implementation in the fisheries sector. This journal also aims to clearly identify the advantages and disadvantages of the reservoir system, so that it can provide better insights for pond farmers and stakeholders in increasing productivity and sustainability of tiger shrimp farming in Indonesia.

METHODS

This article uses a secondary data collection method, namely data obtained from previously available sources. This secondary data comes from various literature, such as scientific journals, books, research reports, articles, and official documents from related institutions. These sources provide relevant information and support the analysis conducted in the research. By utilizing secondary data, researchers can review various perspectives, theories, and existing research results to enrich the study and build a robust analytical framework.

CHARACTERISTICS AND NATURAL HABITAT OF PENAEUS MONODON

Tiger shrimp is one of the largest shrimp species in the world, with a body length that can reach 30–33 cm at optimal conditions. The weight can reach 200-300 grams per head. The body of the tiger shrimp is blue to bluish-green with brown or black horizontal stripes. The shell looks shiny with a purplish or green color that looks attractive. Tiger shrimp have reddish legs, as well as a pair of long antennae that are used to detect the surrounding environment. Tiger shrimp have a life cycle that includes several phases, namely egg, larva, post-larvae, juvenile, and adult. Each phase of life requires a different environment, especially in terms of water salinity and food availability (Takarina, 2009).

Figure 1. Windu Shrimp (Peneaus monodon)
(Wakida-Kusunoki *et al*., 2016)

Tiger shrimp are typically found in shallow coastal waters, especially in mangrove areas, river estuaries, and lagoons, where freshwater and seawater meet. They like environments with muddy or sandy substrates rich in organic matter. Tiger shrimp live in waters with a depth of 0-150 meters, but are more often found at depths of less than 50 meters. The optimum temperature for tiger shrimp growth is 26–30°C, with salinity levels between 15–25 ppt (parts per thousand), although they are able to survive higher or lower salinity. Tiger shrimp are omnivorous animals, which feed on different types of small organisms such as plankton, detritus, mollusks, and worms. At night, they are more active in foraging at the bottom of the water (Farchan dan Mulyono, 2011).

Tiger shrimp are widespread in the Indo-Pacific region, including beaches in Southeast Asia, East Africa, India, and Australia. In Indonesia, the natural habitat of tiger shrimp is found in the coastal areas of Sumatra, Kalimantan, Java, and Sulawesi, which have mangrove ecosystems and shallow waters (Munaeni *et al*. 2023). Tiger shrimp grow optimally in habitats with good water quality, smooth water circulation, and stable environmental conditions. Due to the specific habitat needs, tiger shrimp farming requires extra attention in terms of water and feed quality management to ensure good growth and maximum yield.

THE ROLE AND FUNCTION OF RESERVOIRS IN SHRIMP FARMING

One way to improve the quality of water supplied to the pond is with a reservoir system. Reservoir plots are an important part of a pond with intensive technology, where in this case the reservoir functions as a temporary reservoir for seawater before it is then flowed to each cultivation plot (Rizky *et al*., 2022).

This reservoir system is one of the Government's (Ministry of Marine Affairs and Fisheries of the Republic of Indonesia) program in terms of increasing pond productivity in Indonesia, which is famous for the Shrimp Culture Health Management (SCHM) Program. In detail, the functions of the reservoir are: (1) water reserve container; (2) settling and filtering water (physical treatment) before entering the pond plots; (3) a container for chemical and biological treatment. To facilitate the application of pond farmers, the reservoir is only used as sedimentation, filtration and biological treatment, without chemical treatment.

Sedimentation and filtration are intended to reduce water turbidity, stabilize pH, DO, salinity and ammonia levels as well as filter disease carriers. Meanwhile, biological treatment, where this will be in the reservoir, types of shellfish, milkfish or shellfish or seaweed of the Gracillaria spp. This biological treatment is intended if there are pathogens carried by water, then they are screened first by living things in the reservoir before entering the pond plots. Thus, it is hoped that the water that enters the pond plots is water with excellent water quality and free from pathogens, so that in turn it can increase pond productivity.

Activities in reservoir system pond cultivation involve several important tools and materials (Utojo *et al*., 2016). The reservoir plot used is 20 meters x 5 meters, and this reservoir is divided into two parts, namely the plot for physical treatment and the plot for biological treatment. In biological treatment, several types of organisms are used, namely shellfish, milkfish, and seaweed of the Gracillaria sp. In addition, the enlargement plot has a size of 0.5 hectares. The tiger shrimp seeds used are tokolan-sized, and during maintenance, commercial feed is given. To monitor water quality, several tools such as thermometers, pH meters, DO meters, and ammonia test kits are used. In the sampling process, tools such as anco, nets, and shovels are also used.

The procedure in pond cultivation of the reservoir system begins with land preparation before sowing seeds. The first step is the eradication of pests, diseases, and predators using Brestan pesticides. After that, liming is carried out with a dose of 1 ton per hectare and fertilization using SP-36 fertilizer with a dose of 100 kg per hectare and manure as much as 1 ton per hectare. The applied shrimp seed stocking density is 20,000 shrimp per hectare. During the maintenance period, the feed given is in the form of commercial feed with a protein content of 3-5%, with a frequency of feeding three times a day. Monitoring and evaluation of water quality is carried out routinely on reservoir plots and enlargement plots, both in reservoir system ponds and community-owned ponds (non-reservoir systems) as a comparison. The parameters measured include water temperature, pH, DO, salinity, and ammonia levels. Harvesting is carried out after a maintenance period of 90 days (Munaeni *et al*., 2023).

EVALUATION OF THE RESERVOIR SYSTEM ON TIGER SHRIMP PRODUCTION

Tiger shrimp is a bentic organism or lives at the bottom of ponds, so the condition of water and bottom sludge must be managed properly to maintain a decent environmental quality for shrimp life and growth (Boyd, 2008). According to Bachtiar (1994), the determining component of the feasibility of the pond as a habitat for tiger shrimp is water quality and sediment.

Table 1. Recommended tiger shrimp pond water quality parameters

Water Quality Parameters	Level Optimum	Information
Water temperature	26-30	Daily fluctuations ‹3
Ph	7,7-8,5	Daily Fluctuation ‹0.5
Salinity	10-25	Daily fluctuations ‹5
Water depth	80-120	Depends on technology Plankton
Water brightness	30-40	density indicator It should not be
DO	5-6	less than 4 Water pH stabilizer
Alkalinity	› 80	Dangerous in acidic conditions
H2S	‹ 0,03	Harmful at pH and high
NH3	‹ 0,01	temperatures
Ratio C : N : P	106 : 16 : 1	Fertilizer dosage determinant

Meanwhile, the pond water quality requirements that are ready according to Shigueno (1975) are presented in the Table 2.

Table 2. Pond Water Quality Requirements for Ready for Stocking

Water Quality Parameters	Level Optimum
Water temperature	28-32oC
Ph	7,8-8,5
Water depth	›70 cm
Water brightness	35-45 cm (green/light brown)
DO	› 3 ppm
Alkalinity	90-140 ppm
Total Organic Matter (TOM)	‹150 ppm

Efforts to maintain water quality to suit the needs of shrimp can be done in several ways, including by using reservoirs as water source reservoirs before being drained into ponds. Recirculation and reservoir technology began to be developed in 1993 for pond farmers in Indonesia. Improving water quality in reservoirs includes sedimentation, filtration, and biological and/or chemical treatments. The reservoir area is recommended to be 30-40% of the total area of the cultivated pond, and use a recirculation system so that it can save water and prevent disease transmission from the source water (Damanik *et al*. 2018).

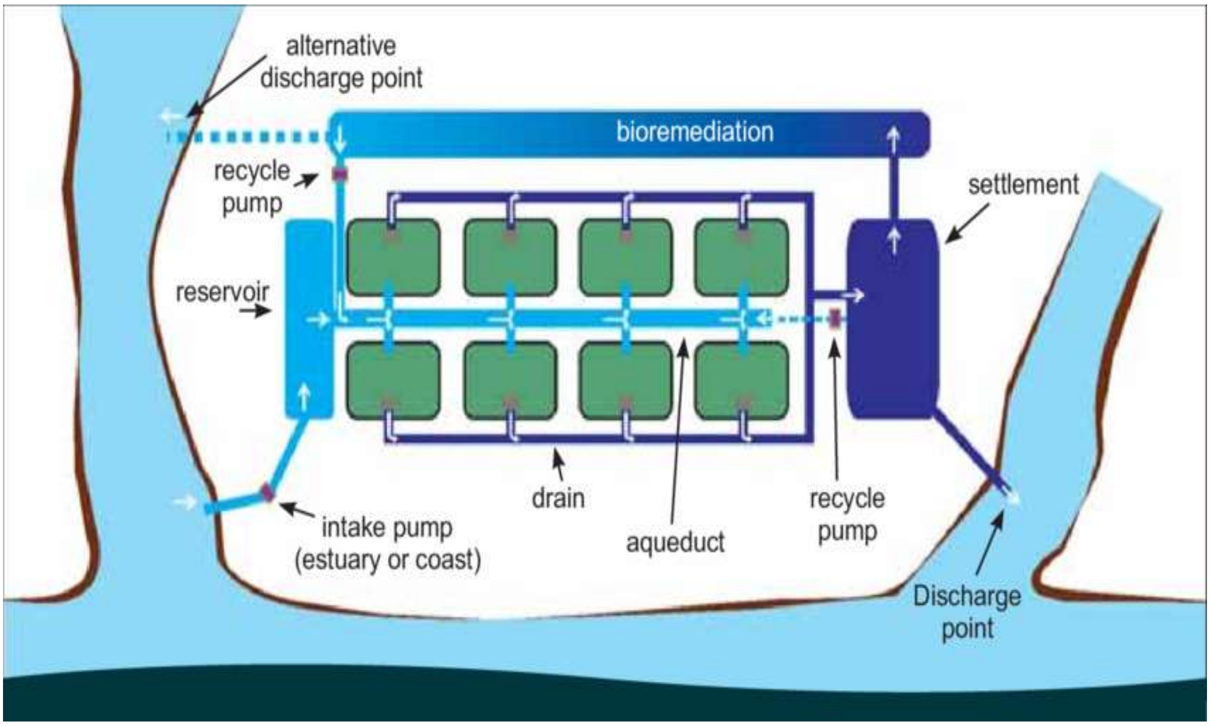

Figure 2. Lay-out of ponds equipped with reservoirs (Chong *et al*., 2006)

Biological water treatment can be done by utilizing aquatic organisms. According to Atmomarsono *et al*., (1995), the use of milkfish, shellfish, and Gracilaria sp seaweed as biofilters is effective in improving the quality of water to be used in tiger shrimp ponds. Some shellfish, oysters and seaweed are known to be able to absorb bacteria from the waters (Table 3) and are effective in absorbing heavy metals that are toxic to shrimp, while milkfish is used as a bioscreening against diseases that will attack shrimp.

Table 3. The ability of shellfish to absorb bacteria

Parameters	Optimal Range	Information
pH Organic matter (%) Potential redox (mV) NH3 (ppm) Phosphate (ppm) Texture (fraction)	6,0-8,0 ‹ 9,0 ‹ minus 220 0,03 – 0,05 0,05 – 0,10 clay (60-70% dan sand (30-40%)	All soil quality parameters should be at the optimal range

Mangrove oysters (*Crassostrea iredalei*) with a shell size of 5-7 cm at a density of 0.75 kg/m2 are able to accumulate Pb and Cu respectively 1.185% and 473% of the initial content of Mangampa et al (1997) and Ismawati (1995) in Atmomarsono (2005) stated that mangrove mussels (*Geloina coaxan*) with a shell width of 4-5 cm with a density of 6 fish/m2 have high absorption of phytoplankton (98%), heavy metals Ni (89%), Cr (28%), zinc (43%) and bacteria (69%) from the initial concentration. In addition, mangrove mussels were able to reduce the total organic matter (BOT) content in pond water from 12.5 to 2.25 ppm during 3 months of maintenance. Seaweed *Gracilaria* sp. able to absorb heavy metals Pb and Cu 1.187 and 1.867% of the initial concentration respectively.

Several studies show that the use of reservoirs is able to increase tiger shrimp production. Atmomarsono *et al*., (1995) stated that shrimp production in ponds equipped with reservoirs (103.15 kg/250 m2) is much higher than in ponds without reservoirs (50.5 kg/250 m2). Meanwhile, Gunarto *et al*., (2017) reported that the use of reservoirs was able to increase tiger shrimp production to 147 kg/500 m2. The reservoir system also indirectly provides an opportunity to increase profits from the production of biofilter organisms contained in the reservoir.

IMPLEMENTATION OF RESERVOIR SYSTEM IN WEST JAVA

The implementation of reservoir systems for tiger shrimp cultivation in West Java is widely carried out in coastal areas such as Karawang, Subang, and Indramayu Regencies (Handiani *et al*., 2017). These areas have coastal characteristics that are suitable for aquaculture due to their proximity to the coast and the availability of pond land. The main characteristics of this cultivation area include the coastal area of West Java tends to be flat with a muddy soil substrate that is ideal for shrimp ponds. It has tropical temperatures with an average range of 27–32°C, which is ideal for tiger shrimp growth. Areas that have direct access to seawater and freshwater, allow for salinity regulation that is important for shrimp farming.

ADVANTAGES AND DISADVANTAGES OF THE RESERVOIR SYSTEM

The reservoir system uses a water reservoir (reservoir) as a clean water storage medium that will be used in the pond (Kurniawan *et al*., 2021). Water that enters the pond passes through the reservoir first to ensure better water quality, free from pollutants, waste, or harmful organisms. This water is then circulated regularly. Water quality management is more controlled because the water in the reservoir can be filtered and ensured to be free of pathogens, improving shrimp health. Better water quality control, higher productivity, and lower risk of shrimp disease and mortality.

Meanwhile, the shortcomings of the construction of the reservoir system require a considerable initial investment cost. It includes the construction of reservoir ponds, installation of pumping systems, water filters, and other supporting technologies such as aeration systems. The reservoir system requires more intensive maintenance than traditional methods (Amri, 2005). Reservoir ponds must be cleaned regularly to prevent the accumulation of mud or organic matter that can reduce water quality. In addition, technical equipment such as pumps and filters must also be monitored and maintained to keep them functioning optimally. The success of reservoir systems is highly dependent on water management technologies, such as water filtration, aeration, and circulation systems. If there is damage to these devices, the system can fail to function properly, which can have an impact on the water quality in the pond and the health of the shrimp. The construction of water reservoirs requires extra land around the pond, which can be a challenge if the available land is limited, especially in coastal areas that are dense or have been used for various other purposes. Reservoir systems also require a continuous supply of clean water to maintain water quality in reservoirs and ponds. In some areas, the availability of clean water can be an obstacle, especially during the dry season or in areas with unstable seawater salinity (Tamim *et al*., 2023).

Although reservoir systems improve control over water quality, they are also vulnerable to external disturbances such as extreme weather changes or pollution of water sources. If the water source is polluted, the entire system can be disrupted, which can affect the productivity of cultivation. Overall, although the reservoir system offers significant advantages in tiger shrimp farming, these shortcomings indicate that its implementation requires careful consideration and readiness in terms of capital, technology, and management.

CONCLUSSION

The application of the reservoir system is one of the approaches to improve water quality, which in turn increases the survival rate of tiger shrimp, by optimizing water treatment biologically. The amount of land used for reservoirs will be covered by increasing pond production, one of which is with by-products produced from reservoirs. The implementation of the reservoir system is expected to have a positive impact on increasing tiger shrimp cultivation in West Java.

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