Productivity of white shrimp (Litopenaeus vannamei, Boone 1931) on semi-intensive cultivation ponds in Parangtritis Village, Bantul Regency

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Abstract. This study aimed to determine the productivity of white shrimp (Litopenaeus vannamei, Boone 1931) in semi-intensive ponds in Parangtritis Village, Bantul Regency. The study was conducted from January to February 2021. The study was conducted by direct observation of two ponds with a stocking density of average 95 shrimps larvae/m². The ponds studied had the same area of 2,000 m², the depth of pond water was 1 m at the edge and 1.5 m in the middle, and the water volume was about 2,500 m³. The source of water was pumped directly from the sea water of Parangtritis Beach, Indian Ocean. The data of ponds shrimp production were obtained from observations of shrimp harvests at that time (as primary data) and yields of several cycles from 2014 to 2020 (as secondary data). The results of data collection were presented descriptively. The results showed that the shrimps were reared in the ponds for each production cycle within 76 to 120 days (average 95 days), harvesting was done partially (1 to 4 times), with pond productivity ranging from 14,600 to 41,175 kg of shrimp/hectare/cycle (average 25,133 kg shrimp/hectare/cycle), feed conversion ratio 1.0 to 2.2 (average 1.3) and survival rate 67 to 100% (average 95%). The productivity of ponds at Parangtritis Village coastal were higher than other Bantul Regency coastal area. These were probably because of : the quantity and quality of water sources were better; the layout of the pond were not too crowded; and stocking densities could be higher and shrimp were partially harvested.

1. Introduction
Indonesia has established itself as one of the world's top shrimp producers, but competitors' low prices, stringent regulations, and environmental risks threaten its strong position. As disease outbreaks slowed production in Thailand and Vietnam over the past two decades, Indonesia strengthened its position to become the third largest shrimp producer in the world. The country's shrimp farming industry is expected to grow at 8% per year through 2022, outpacing the global growth rate of 5.6% [1].

Shrimp pond cultivation on coastal land in the Special Region of Yogyakarta is located in the Bantul Regency and Kulon Progo Regency. Bantul Regency has a coastline of approximately 10 kilometers and 4 coastal villages, namely: Poncosari, Gading Sari, Srigading and Parangtritis villages. The land along the coast of Bantul Regency is geomorphologically sand dunes and is located above the tides (Supratidal area). Parangtritis coastal village is known as a tourist destination. The coastal village of Parangtritis has a small number of ponds (30 plots) with a semi-intensive cultivation technology system. White shrimp were cultivated in the semi-intensive ponds with medium stocking
densities, ranging from 80 to 120 fish/m². The ponds were developed on sandy land with biocrete technology and coated with plastic. White shrimp cultivation in the ponds are expected to produce optimally, sustainably and environmentally friendly, in accordance with the carrying capacity of the environment. The coastal area of Bantul Regency has 321 ponds with a total area of 38.59 hectare. These ponds are located in 4 coastal villages, each with the following number and area: Poncosari Village 232 ponds (26.32 hectare); Gading Sari Village has 21 ponds (3.13 hectare); Srigading Village 38 ponds (3 hectare); and Parangtritis Village 30 ponds (6.14 hectare) [2]. The study was conducted to determine the productivity of white shrimp (Litopenaeus vannamei, Boone 1931) in semi-intensive ponds in Parangtritis Village, Bantul Regency, which was aquaculture in a specific location.

2. Material and methods
The study was carried out from January to February 2021. The research was conducted by direct observation of 2 (two) ponds in coastal area at Parangtritis village (see Figure 1d). The ponds used for research were located on the east coast of Parangtritis Village. The ponds were developed on sandy land with biocrete technology and coated with plastic. The ponds studied have the same area of 2,000 m², the depth of pond water was 1 m at the edge and 1.5 m in the middle, and the water volume was about 2,500 m³. The water sources were pumped directly from the sea water of Parangtritis Beach, Indian Ocean. The stocking density of white shrimp in the ponds were on average 95 shrimp post larvae/m². White shrimp were cultivated in the semi-intensive ponds with medium stocking densities. Pond shrimp production data were obtained from observations of shrimp harvests at that time (primary data) and yields of several cycles from 2014 to 2020 (secondary data). The results of data collection were presented descriptively.

3. Results and discussion
The layout of the pond, the number and area of white shrimp (Litopenaeus vannamei, Boone 1931) ponds on the coast of Bantul Regency can be seen in Map Figures 1 (1a to 1d) and Table 1. The coastal area of Bantul Regency have 321 ponds with a total area of 38.59 ha (see Table 1), with white shrimp productivity per cycle (see Table 2) of 17.7 tons/ha (13.0 to 18.8 tons/ha). The highest average productivity of white shrimp per cycles of 18.8 tons/ha was produced in the pond area strata of 1,000-2,000 m² (average pond area of 1,470 m²) [3].

Figure 1a. Layout of ponds at Poncosari village
Figure 1b. Layout of ponds at Gading Sari village
Figure 1c. Layout of ponds at Srigading village
Figure 1d. Layout of ponds at Parangtritis village

Figure 1. The layout of white shrimp \textit{(Litopenaeus vannamei}, Boone 1931) ponds on the coast of Bantul Regency [2].

Table 1. Number and area of white shrimp \textit{(Litopenaeus vannamei)} cultivation pond in the coastal villages of Bantul regency

| Coastal village | Total number (ponds) | Pond area (ha) | Number of (ponds) with area (m$^2$) |
|-----------------|---------------------|---------------|-------------------------------------|
|                 |                     |               | < 1,000 | 1,000 to 1,500 | > 1,500 |
| Poncosari       | 232                 | 26.32         | 158     | 37             | 37      |
| Gadingmsari     | 21                  | 3.13          | 4       | 8              | 9       |
| Srigading       | 38                  | 3.00          | 26      | 8              | 4       |
| Parangtritis    | 30                  | 6.14          | 2       | 4              | 24      |
| Bantul regency  | 321                 | 38.59         | 190     | 57             | 74      |

Source : [2].

The technical condition and productivity of white shrimp ponds on the coast of Bantul Regency are presented in Table 2 [2]. The technical condition of white shrimp ponds on the coast of Bantul Regency has an average area of 1,626 m$^2$ (690-3600 m$^2$). The stocking density of shrimp seeds was 156 post larvae/m$^2$ (120-173 post larvae/m$^2$). Pond productivity is 2,705 kg/pond/cycle (17.7 tons/hectare/cycle) or ranges from 13.0-18.8 tons/hectare/cycle. The feed conversion ratio value was 1.39 (1.30-1.46) [2].

Table 2. Techniques and productivity of white shrimp \textit{(Litopenaeus vannamei)} pond cultivation in the coastal villages of Bantul regency

| Parameter               | Unit             | Strata of pond area (m$^2$) | < 1,000 | 1,000-2,000 | > 2,000-3,000 | > 3,000 | <1,000->3,000 |
|-------------------------|-----------------|----------------------------|---------|-------------|---------------|---------|---------------|
| Populasi                | Ponds           |                           | 190     | 57          | 50            | 24      | 321           |
| Sample                  | Ponds           |                           | 24      | 33          | 10            | 10      | 77            |
| Area (average)          | m$^2$/pond      |                           | 690     | 1,470       | 2,411         | 3,600   | 1,626         |
| Stocking density        | post larvae/ m$^2$ |                         | 155     | 173         | 140           | 120     | 156           |
| Productivity            | kg/pond/ cycle  |                           | 1,299   | 2,747       | 3,958         | 4,687   | 2,705         |
|                         | ton/hectare/ cycle |                   | 18.6   | 18.8        | 16.5          | 13.0   | 17.7          |
| FCR                     | Unit            |                           | 1.3     | 1.2         | 1.1           | 1.46    | 1.39          |

Explanation = FCR : Feed conversion ratio [2].
The production of white shrimp in ponds on the coast of Parangtritis village from 2014 to 2020 year are presented in Table 3. The shrimps were reared in the ponds for each production cycle within 76 to 120 days (average 95 days), harvesting was done partially (1 to 4 times), with pond productivity ranging from 14,600 to 41,175 kg of shrimp/hectare/cycle (average 25,133 kg shrimp/hectare/cycle), feed conversion ratio 1.0 to 2.2 (average 1.3) and survival rate 67 to 100% (average 95%). The white shrimp culture in Bantul District coastal sandy soil area was an semi intensive system with average pond width 1,300 m². The highest productivity of shrimp was 19.7 ton/ha/cycle, which be cultured in the 1,000-1,500 m² ponds [4].

Table 3. Production of white shrimp in ponds on the coast of Parangtritis village from 2014 to 2020 year

| Stocking Date | Year of Harvest | Nu Ponds | Stocking Density (pl/m²) | DOC | FCR | SR (%) | Product/pond (kg/pond) | Productivity (kg/ha) |
|---------------|----------------|---------|--------------------------|-----|-----|--------|------------------------|----------------------|
| Dec 2020      |                | 1       | 113                      | 100 | 1.4 | 99     | 4,110                  | 20,550               |
|               |                | 2       | 113                      | 84  | 1.2 | 100    | 3,350                  | 16,750               |
| 08-Jul 2020   |                | 1       | 113                      | 98  | 1.4 | 81     | 4,150                  | 20,750               |
|               |                | 2       | 113                      | 98  | 1.3 | 81     | 4,410                  | 22,050               |
| 18-Feb 2020   |                | 1       | 113                      | 90  | 1.1 | 88     | 4,410                  | 22,050               |
|               |                | 2       | 113                      | 90  | 1.1 | 89     | 4,400                  | 22,000               |
| 06-Sep 2019   |                | 1       | 113                      | 102 | 2.2 | 67     | 3,088                  | 15,440               |
|               |                | 2       | 113                      | 102 | 2.0 | 85     | 3,035                  | 15,175               |
| 05-Jul 2018   |                | 1       | 100                      | 80  | 1.0 | 100    | 3,330                  | 16,650               |
|               |                | 2       | 100                      | 99  | 1.5 | 100    | 4,630                  | 23,150               |
| 22-Sep 2017   |                | 1       | 113                      | 109 | 1.2 | 100    | 7,410                  | 37,050               |
|               |                | 2       | 113                      | 109 | 1.3 | 100    | 6,750                  | 33,750               |
| 01-May 2017   |                | 1       | 125                      | 86  | 1.2 | 100    | 4,825                  | 24,125               |
|               |                | 2       | 125                      | 120 | 1.3 | 100    | 7,060                  | 35,300               |
| 23-Aug 2016   |                | 1       | 125                      | 92  | 1.1 | 100    | 5,780                  | 28,900               |
|               |                | 2       | 125                      | 92  | 1.1 | 100    | 5,115                  | 25,575               |
| 14-Feb 2016   |                | 1       | 125                      | 100 | 1.0 | 100    | 8,235                  | 41,175               |
|               |                | 2       | 100                      | 100 | 1.0 | 100    | 8,210                  | 41,050               |
| 03-Feb 2015   |                | 1       | 175                      | 76  | 1.7 | 100    | 2,920                  | 14,600               |
|               |                | 2       | 175                      | 76  | 1.3 | 100    | 3,480                  | 17,400               |
| 29-Dec 2014   |                | 1       | 175                      | 76  | 1.0 | 67     | 2,920                  | 14,600               |
|               |                | 2       | 175                      | 76  | 1.3 | 95     | 5,027                  | 25,133               |
|               |                | 1        | 175                      | 76  | 1.3 | 95     | 5,027                  | 25,133               |

Explanation = DOC : Day of Culture; FCR : Feed conversion ratio; SR: Survival Rate, pl : post larvae (sources : secondary data)
The characteristics and environmental carrying capacities of coastal area in Bantul Regencies were characterized by sand dune and beach ridge with sandy soil texture. Water sources of the coastal area were the sea, river, and ground water with the salinity of 31–37, 7–11, 7–31 ppt and pH of 7.4–8.4; 7.0–8.2 and 7.4–9.9, respectively. The coastal lands were used for seasonal/annual planting, ponds, fish landing sites, tourism areas and conservation areas. The coastal carrying capacity was rather suitable for aquaculture, especially in the sandy soil area. Aquaculture in that area can be done intensively for shrimp (\textit{Litopenaeus vannamei}), using biocrete (biological material) or plastic sheet [5].

Direct observations have been made on two semi-intensive vaname shrimp (\textit{Litopenaeus vannamei}) in Parangtritis District from December 2020 to February 2021. The results show that the two ponds were each with the same area: 2,000 m$^2$, water depth the pond at the edge of 1 m and in the middle 1.5 m, and the water volume was about 2,500 m$^3$, and the stocking density was 112 post larvae/m$^2$. The two ponds at harvest (days 100 and 84, with survival rates of 99 and 100%) had an average white shrimp productivity of 23,925 kg/hectare, with an average feed conversion ratio of 1.29.

Pond water quality during shrimp rearing days 15 to 81 showed salinity ranging from 17.7 to 22.7 ppt; organic matter 20-78.4 mg/L; brightness 52- 94 cm; water temperature 25.4-31.9 oC; degree of acidity (pH) 7.3-8.7; dissolved oxygen content 3.3-8.8 mg/L; free carbon dioxide 0-60 mg/L; alkalinity of 140-358 mg/L, which were optimal and suitable for white shrimp culture. The value of precipitated solids ranges from 0.1-0.5 ml/L, including less than optimal and not suitable for vaname shrimp culture [6].

| Parameter                  | Unit | Area of Ponds | Average |
|----------------------------|------|---------------|---------|
|                           |      | 1             | 2       | 2,000  |
| Pond Area                  | m$^2$| 2,000         | 2,000   |
| Shrimp Seeds               | ekor | 225,000       | 225,000 |
| Stocking density           | m$^2$| 112           | 112     |
| Shrimp harvest             |      |               |         |
| Partial I (59 days)        | kg   | 300           | 310     | 305    |
| Partial II (70 days)       | kg   | 330           | 330     | 330    |
| Partial III (83 days)      | kg   | 420           | 420     | 420    |
| Final harvest              | kg   | 4,110         | 3,350   | 3,730  |
| Total harvest              | kg   | 5,160         | 4,410   | 4,785  |
| Productivity               | kg/ha| 25,800        | 23,050  | 23,925 |
| Feed Total                 | kg   | 7,000         | 5,442   | 6,221  |
| FCR                        |      | 1.35          | 1.23    | 1.29   |
| SR                         | %    | 99            | 105     | 102    |
| DOC                        | Days | 100           | 84      | 92     |

Explanations:
- DOC : Day of Culture;
- FCR : Feed Conversion Ratio;
- SR: Survival Rate;
- ha : hectare [6].

Table 4. White shrimp pond performance in Parangtritis village during cultivation
Tabel 5. Water quality of white shrimp pond in Parangtritis village during cultivation

| Parameter         | Unit  | Result         | Optimal standard |
|-------------------|-------|----------------|------------------|
| Salinity          | ppt   | 17.7-22.7      | 15-25            |
| Organic material  | mg/L  | 20.0-78.4      | <90              |
| Sedimented suspension | ml/L | 0.1-0.5        | 15               |
| Transparancy      | cm    | 52-94          | >45              |
| Temperature       | °C    | 25.4-31.9      | 28-33            |
| Acidity degree (pH) | Unit | 7.3-8.7         | 7.5-8.5          |
| Dissolved O₂      | mg/L  | 3.3-8.8        | >4               |
| Free CO₂          | mg/L  | 0-60           | <50              |
| Alkalinity        | mg/L  | 140-358        | 20-500           |

Explanation = [6].

4. Conclusion
The productivity of ponds at Parangtritis coastal were higher than other Bantul Regency coastal area. The shrimps were reared in the ponds for each production cycle within 76 to 120 days (average 95 days), harvesting was done partially (1 to 4 times), with pond productivity ranging from 14,600 to 41,175 kg of shrimp/hectare/cycle (average 25,133 kg shrimp/ hectare/cycle), feed conversion ratio 1.0 to 2.2 (average 1.3) and survival rate 67 to 100% (average 95%). These were probably because of: 1) the quantity and quality of water sources were better; 2) The layout of the pond were not too crowded; and 3) Stocking densities could be higher and shrimp were partially harvested.

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