

GROWTH PERFORMANCE OF CATFISH (*Clarias* sp.) IN IoT-BASED CULTIVATION

Performa Pertumbuhan Lele (*Clarias* sp.) Pada Budidaya Berbasis IoT

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ABSTRACT

One of the widely cultivated aquaculture commodities is catfish (*Clarias* sp), making it one of the prioritized species for aquaculture development. The development efforts can incorporate IoT technology to control water quality in the culture tanks. Therefore, the aim of this study was to observe the growth performance of catfish (*Clarias* sp) using an IoT-based water quality control system. This study was conducted for 9 weeks and consisted of two stages. The first stage involved setting up the IoT device system using temperature and TDS sensors, which were then installed in the culture container. The next stage was monitoring growth and water quality. Based on the monitoring results, the average temperature in the culture tank was 27.56 °C and the TDS level was 230 ppm during IoT-based monitoring, with the device accuracy reaching 90%. Growth performance showed an increase in body length of 1.5–2.5 cm per week, with a survival rate of 80%.

Key words: Cultivation, Iot, Catfish, Growth, Technology

ABSTRAK

Salah satu komoditas yang banyak dibudidayakan adalah ikan lele (*Clarias* sp.) sekaligus menjadikannya sebagai sebagai salah satu komoditas budidaya perikanan yang pengembangannya diunggulkan. Pengembangan yang dilakukan dapat menggunakan teknologi Iot (*Internet of Things*) dalam mengontrol kualitas air pada wadah budidaya. Sehingga tujuan dari penelitian ini adalah untuk mengamati performa pertumbuhan ikal lele (*Clarias* sp.) berbasis Iot dalam kontrol kualitas airnya. Penelitian ini dilakukan selama 9 minggu yang terdiri dari 2 tahapan. Tahap pertama adalah setting rangkaian alat Iot yang menggunakan sensor suhu dan TDS, kemudian dipasang pada wadah budidaya. Tahap berikutnya adalah

pemantauan pertumbuhan dan kualitas air. Dan dari pemantauan tersebut diperoleh bahwa suhu rata-rata pada wadah budidaya adalah 27,56 °C dan TDS sebesar 230 ppm selama pemantauan menggunakan IoT dengan keakuratan alat mencapai 90%. Kemudian performa pertumbuhan diperoleh peningkatan panjang tubuh yang mencapai 1,5 – 2,5 cm perminggu dengan tingkat kelulushidupan mencapai 80%.

Kata Kunci: Budidaya, Iot, Lele, Pertumbuhan, Teknologi

INTRODUCTION

Fishery cultivation can be defined as the cultivation and breeding of aquatic commodities, both fish and aquatic plants. This sector has significant potential for development because it can drive the economy and even absorb labor (Oktavianna *et al.*, 2019; Putri *et al.*, 2021). One of the most widely cultivated commodities is catfish (*Clarias* sp.), making it a leading aquaculture commodity (Negara *et al.*, 2015; Herlina *et al.*, 2024; Rahmadhani & Putri, 2025). However, exploiting this potential inevitably leads to fundamental challenges in aquaculture activities. A crucial issue often faced by fisheries entrepreneurs in the aquaculture sector is water quality control, which can hinder the growth performance of cultivated commodities (Yunior & Kusri, 2019; Octaviani & Is, 2024). Yunior and Kusri (2019) state that 60%–70% of productivity decline is caused by poor water quality control.

In aquaculture, maintaining water quality at the desired level is a crucial factor in cultivating aquatic commodities (Aravindha *et al.*, 2024). This is because aquatic organisms are highly dependent on water for both growth and all other bodily functions (Iwasaki *et al.*, 2024; Aravindha *et al.*, 2024). Furthermore, the survival and growth of aquatic organisms can be determined by water quality (Scabra & Setyowati, 2019). Good water quality can directly impact the health of cultivated commodities. Poor water quality negatively impacts survival rates. It also reduces feed consumption, leading to stunted growth. Therefore, monitoring is essential to prevent such conditions (Suhaili *et al.*, 2023; Songpayome *et al.*, 2025).

This situation has certainly encouraged innovations in aquaculture activities aimed at increasing productivity and minimizing problems such as poor water quality (Putri *et al.*, 2021). One such technology is IoT, a technology in the electronics sector that plays a role in the creation of equipment that can work automatically and efficiently. One example of this IoT technology application is in monitoring water quality in aquaculture activities (Anindita *et al.*, 2022; Indrawati *et al.*, 2024). IoT (Internet of Things) itself is a shared and integrated communication model, where software sensors and physical devices are interconnected via the internet so that the control system can be monitored using a smartphone in real time and remotely (Anindita *et al.*, 2022; Herlina *et al.*, 2024). Therefore, the purpose of this study is to observe the growth performance of catfish (*Clarias* sp.) in IoT-based aquaculture.

RESEARCH METHODS

The research was conducted in the fisheries workshop of the Agribusiness Study Program of Fisheries and Marine Sciences of Sambas State Polytechnic, which took place from August to September 2025. The materials needed were catfish seeds and feed, and the equipment used during the research was an IoT circuit with temperature and TDS sensors and standard water quality measuring instruments. The research began with the preparation of an IoT circuit to monitor water quality, and the sensors used in this circuit were temperature and TDS sensors. After the IoT circuit was assembled, it was then installed in a cultivation container. With the size of the catfish (*Clarias* sp.) seeds that were stocked was 8-10 grams per fish. After the seeds were stocked, the growth performance of the commodity was observed for 9 weeks, as well as monitoring the water quality in the cultivation container that had been installed with the IoT

circuit. Then, the growth performance was observed, which consisted of several parameters. Where, the observed growth performance parameters included (Hastuti *et al.*, 2016):

a. Pertumbuhan relatif, dihitung dengan persamaan

$$P_m = P_t - P_o$$

Description:

P_m : Average relative growth of fish (cm)

P_t : Final fish length growth (cm)

P_o : Initial relative growth of fish (cm)

b. Weight growth, calculated using the equation

$$W = W_t - W_o$$

Description:

W : Average weight growth of shrimp (grams)

W_t : Final fish weight growth (grams)

W_o : Initial fish weight growth (grams)

c. Daily growth rate, calculated using the equation

$$DGR = \frac{W_f - W_i}{t}$$

Description:

DGR : Daily Growth Rate (DGR) grams/day

W_f : Final wet weight (grams)

W_i : Initial wet weight (grams)

t : Number of observation days (days)

d. Relative growth (Growth Rate / GR), calculated using the equation

$$GR = \frac{W_t - W_0}{W_0} \times 100$$

Description:

GR : Relative growth (100%)

W_t : Final weight (grams)

W_0 : Initial weight (grams)

e. Survival Rate (%), calculated using the equation

$$SR (\%) = \frac{N_t}{N_o} \times 100$$

Description:

SR : Survival

N_t : Number of fish at the beginning of the treatment (tails)

N_o : Number of fish at the end of the treatment (tails)

RESULTS

Installation of IoT circuit for monitoring water quality parameters temperature and TDS

The results of installing the IoT circuit in this study can be seen in the image below.

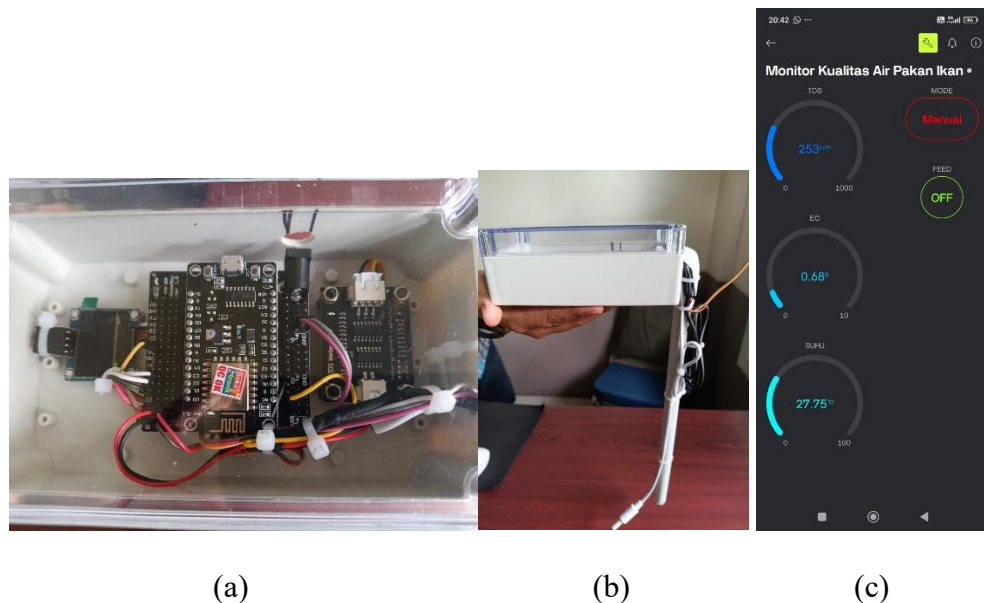


Figure 1. Results of the IoT circuit, (a) top view; (b) side view; (c) results displayed on the application installed on the cellphone

The results of quality monitoring using this circuit can be accessed remotely via the Blink IoT app, which can be installed on a mobile phone. The results of the observations can be seen in the table below.

Table 1. Results of temperature and TDS parameter observations using IoT

No	Observation Parameters	Results
1	Average Temperature	27.56 °C
2	Average TDS	230 ppm
3	Temperature Difference	0.19 °C
4	TDS Difference	1 ppm
5	Temperature Error	0.68%
6	TDS Error	0.43%
7	Temperature Accuracy	99.31%
8	TDS Accuracy	99.56%

Observation of growth performance of catfish (*Clarias sp.*)

The growth of catfish (*Clarias sp.*) can be seen from the increase in weight and increase in body length during the 9-week observation period, which can be seen in Figure 2 below.

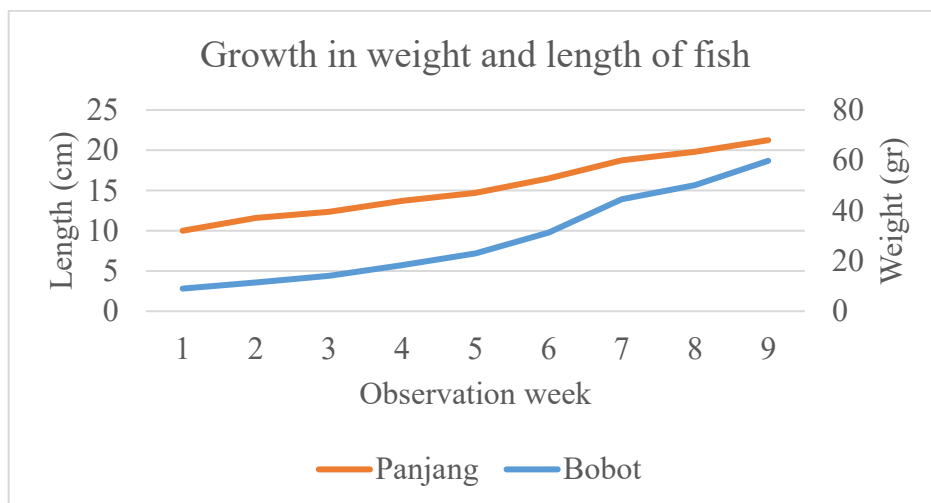


Figure 2. Growth graph of weight and length of catfish (*Clarias* sp.)

Meanwhile, the growth performance of catfish (*Clarias* sp.) during observations can be seen in the following table.

Table 2. Growth performance of catfish (*Clarias* sp.) during observation

No	Parameters	Value
1	Length growth	11.25 cm
2	Weight growth	50.8 grams
3	Daily growth rate	0.907 grams/day
4	Relative growth	5.64%
5	Survival rate (SR)	80.00%

DISCUSSION

The results of water quality monitoring for temperature and TDS parameters using IoT in cultivation activities show that the values are still optimal for catfish (*Clarias* sp.) cultivation activities with an average value of 27.5 °C and 230 ppm. In the temperature parameter, the value tends to be not too high because the cultivation container is in the hatchery and at the time of observation it was already entering the rainy season which caused the temperature to not be too high either. Changes in water quality can be caused by natural factors such as weather and seasons (Agustina & Atina 2022; Ihtisyamuddin *et al.*, 2023). In addition, Kisworo *et al* (2021) and Resiona *et al* (2024) stated that the optimal temperature and TDS parameter criteria for catfish (*Clarias* sp.) growth are in the range of 25 - 32 °C and < 1000 ppm. Meanwhile, when water quality is suboptimal, it will impact fish growth and can even lead to mass mortality in aquaculture tanks (Ihtisyamuddin *et al.*, 2023). Compared to water quality checkers, the error rates for temperature and TDS monitoring were 0.68% and 0.43%, respectively. In other words, the accuracy between temperature and TDS monitored using IoT and water quality checkers reached over 90%. Kainama and Purnomo (2025) stated that the accuracy of temperature and TDS sensors on IoT devices can reach 98% and 99%, respectively.

Meanwhile, the growth performance of catfish (*Clarias* sp.) using IoT for water quality monitoring showed an increase in length of 1.5–2.5 cm per week. Resiona *et al.* (2024) reported that the length increase of catfish (*Clarias* sp.) using IoT for water quality control reached 1.5–2.5 cm. Body weight gain and weight gain during the observation period were 11.25 cm and 50.8 grams, respectively, with a relative growth rate of 5.64% and a survival rate of 80%.

Liswahyuni *et al.* (2021) also stated that the survival rate of catfish (*Clarias* sp.) can reach 80% or more, depending on several factors, such as stocking volume and feed intake. In this cultivation activity, feeding is carried out twice daily using the "until-full" method.

CONCLUSION

These results conclude that water quality monitoring using IoT technology in catfish (*Clarias* sp.) cultivation yields nearly identical results to using a water quality checker, suggesting it is quite accurate. Furthermore, growth performance with IoT water quality control indicates an increase in length and weight, with length increases reaching 1.5–2.5 cm per week.

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