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Water Quality Meter Module to improve shrimp production quality in Mojopuro Gede Village, Gresik

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ABSTRACT

Shrimp cultivation is a very profitable business in Gresik. However, shrimp farmers in Mojopuro Gede Village, Gresik admitted that they did not carry out their cultivation process optimally. The farmer did not realize that water quality is essential to be considered in aquaculture. Based on these problems, the team held a community service in Mojopuro Gede Village, Gresik by introducing the water quality meter module and giving it to several shrimp farmers in the area. This activity was carried out so that the farmers can improve their cultivation process which has not been optimal and also introduce them to technological developments. Technology use in cultivation process is expected to increase the quality of the farmers' crops. The implementation methods used in this activity are socialization and training. In this community service program, education have been given to the farmers so that they understand and care about the condition of their ponds in the cultivation process. The purpose of this program is for introducing the importance of technology in the cultivation process, even though it is actually not easy to provide education to shrimp farmers, especially traditional farmers. Therefore, related parties (NU Gresik Maritime Institute and Maritime Affairs and Fisheries Office of East Java Province) are expected to be more active in providing understanding to the farmers regarding the importance of applying technology in the cultivation process.

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1. INTRODUCTION

Aquaculture business has great potential in Indonesia, because Indonesia is a country which has very long coastline (Arianto, 2020). The success of aquaculture in Indonesia will be achieved if people around the coast make optimal use of it. One area that can take advantage of this potential is Gresik Regency by developing an aquaculture business. However, farmers in Gresik Regency admit that they have not been optimal in carrying out the cultivation process.

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Water quality is a matter that needs to be considered while conducting aquaculture (Widiana et al., 2022). Furthermore, the success also lies in properly monitoring pond water quality (Rozario & Devarajan, 2020). Water quality monitoring aims to improve the efficiency and accuracy of the data collected (Aziz et al., 2016). There are several parameters that must be considered in monitoring water quality, including temperature, salt content, and pH. Each type of cultivated fish has different water quality standards (Pauzi et al., 2020). Monitoring is very important to do to analyze the dynamics of changes in water quality parameters and see the effect on harvested fish (Tahar et al., 2018).

There are several researchers who have continuously monitored pond water quality. However, the collection of pond water quality data is still done manually (Pratama et al., 2019) and this is a tedious job and highly dependent on human intervention (Srivastava et al., 2018). Several researchers have developed a water quality monitoring system for aquaculture ponds based on Internet of Things (Huan et al., 2020). One of them is by using the website (Zamzami et al., 2021). In water quality monitoring, logging data is needed to record all sensor data before it is displayed on the human interface that has been designed beforehand (Ramadhan et al., 2020).

Aquaculture that is mostly found in Gresik district is shrimp farming. However, shrimp farmers in Gresik district admit that they do not monitor water quality intensely. The cultivation process only includes planting seeds, changing water, providing waterwheels, feeding, and harvesting after a few months. The results obtained often experience losses. Farmers do not realize that the problem that causes losses is the incompatibility of water quality during the cultivation process (Junaidi & Kartiko, 2020). The low economic level of shrimp farmers in Mojopuro Gede Village has resulted in most shrimp farmers carrying out conventional cultivation processes that do not require a lot of money. The process of measuring pond water quality is usually done instinctively by tasting pond water samples. Measurements based on instinct certainly produce severely inaccurate data.

Based on several studies, it was found that water quality is very important to note in aquaculture. Each parameter of pond water quality has its own standard value. The standard values for shrimp pond water quality can be seen in Table 1.

Table 1. The standard value of shrimp pond water quality parameters

Parameter	Unit	Range
Temperature	°C	28.5 – 31.5
Salinity	g/l	15 – 25
pH	-	7.5 – 8.5
Dissolved oxygen	mg/l	3.5
Alkalinity	mg/l	100 – 150
Organic material	mg/l	55
Total ammonia	mg/l	0.01
Nitrite	mg/l	0.01
Nitrate	mg/l	0.5
Phosphate	mg/l	0.1
Water level	cm	120 – 200
Water turbidity	cm	30 - 45

Source: Aziz et al. (2016)

Maintaining pond water parameter values rather a complicated thing to do. To get optimal yields, shrimp farmers must carry out continuous monitoring (Aziz et al., 2016). A pond water quality monitoring system based on Internet of Things technology is urgently needed so that pond water quality monitoring activities can be carried out optimally and efficiently (Encinas et al., 2017). Several researchers have utilized IoT in the process of monitoring water quality (Gunawan et al., 2022) by making a water quality control tool and automatic feed spreader for IoT-based shrimp ponds. In addition, IoT has also been used to monitor vannamei shrimp ponds based on Android using NodeMCU (Anwar & Abdurrohman, 2020). A monitoring and control system for shrimp ponds with the IoT concept has also been carried out using the Message Queuing Telemetry Transport protocol (Eridani et al., 2020).

Some farmers in Indonesia have measured water quality conventionally and recorded water quality parameters on paper. However, this is very ineffective and tiring, so farmers do not do it regularly. Even records of these measurements are often lost.

This problem should be used as an evaluation for several related government agencies to improve the quality of aquaculture processes in coastal areas. Based on these problems, community service was carried out in Mojopuro Gede Gresik Village. Partners in this community service program are shrimp farmers in Mojopuro Gede village, NU Maritime Institute Gresik, Maritime Affairs and Fisheries Service of East Java Province, Maritime Affairs and Fisheries Service of Gresik Regency, and PCNU Gresik.

The contribution of the service team is to make a water quality meter module and give it to shrimp farmers and several representatives of partner institutions. With the help of technology, a portable pond water quality monitoring system will be created whose parameters include salinity, pH, and temperature. The three parameter measurement data is then sent to the database. Measurement results for each pond are displayed on the website to facilitate the analysis process in cultivation.

This community service program aims to introduce the role of technology to traditional farmers in improving the quality of the shrimp farming process. Shrimp farmers are expected to be more concerned and pay attention to the condition of water quality which is the main key in successful cultivation. Therefore, it is hoped that related institutions can be more active in providing education to fishery cultivators in coastal areas regarding the importance of improving the cultivation process by applying technology.

2. METHODS

This community service program is carried out using several methods, including presentations and module demos, practice and discussion, and the creation of guidebooks. While the stages of the activity consist of preparation, implementation, and evaluation. Partners in this program are shrimp farmers in the village of Mojopuro Gede, the NU Gresik Maritime Institute, the Maritime Affairs and Fisheries Service for East Java Province, the Maritime Affairs and Fisheries Service for Gresik Regency, and PCNU Gresik. Four shrimp farmers and one representative from each related institution received a water quality meter module as well as hands-on training in operating the modules. This activity was carried out on August 27 2022 at RT 13, RW 4, Mojopuro Gede Village, Bungah District, Gresik Regency.

Activity Methods

Broadly speaking, the implementation of community service activities consists of outreach and training. Furthermore, this activity was carried out using three methods, namely through presentations and demos, practice and discussion, and provision of guidebooks.

Presentations and demos

The presentation was made to explain the water quality meter module as well as the web that had been made by the service team. Then followed with module and web demos to increase the understanding of program participants, especially shrimp farmers. Presentations and demos are held at 11.15 – 12.00. The purpose of the presentation and demo is to provide an initial understanding to the farmers regarding the water quality meter module that has been granted.

Practice and discussion

The practice was carried out so that shrimp farmers could use the modules that were granted. The module was directly practiced by the shrimp farmers when the service team conducted a tool demonstration. In the practice process, each farmer is accompanied by a committee from the service team. During practice, farmers can also hold discussions with the committee regarding matters that are still not understood. Practices and discussions are held at 12.00-12.30.

Guidebook

Guidebook or manuals are made to make it easier for shrimp farmers to forget about using tools and web. The contents of the guidebook are made in language that is easily understood by readers, especially shrimp farmers. This guidebook can also be downloaded from the aquaculture website that has been created (https://aquaculturepens.com/). The cover and table of contents of the guidebook can be seen in Figure 1.

Figure 1. Guidebook "Water Quality Meter Module and Aquaculture EEPIS Website"

Activity Stages

In general, the stages of this community service program consist of the preparation stage, the implementation stage, and the evaluation stage.

Preparation stage

In the preparatory stage, the water quality meter module was made including the manual book of the module, web design, and weekly committee meetings related to modules and the web as can be seen in Figure 2. Prior to the event, a committee briefing was held to remind the jobdesk of each committee. Next, the process of installing the projector and its screen, installing the X-Banner, setting up several tools along with pond water samples to do a demo of the tool, and preparing a laptop. Then, coordination was carried out with the MC who is a resident of Mojopuro Gede Village to re-agree on a rundown time for activities. Preparations in the form of making water quality meter modules, web, guidebooks, and banners were carried out a month before the day of the activity. While preparations for the day of the activity are carried out at 07.00-08.00. This preparatory stage is very important to ensure success in the entire series of activities (Salmiati et al., 2018).

Figure 2. Preparations

Implementation stage

The implementation of activities is carried out offline in an open space. All facilities such as tents, benches, stage, sound system, banners and consumption have also been prepared beforehand. Offline activities with partners are carried out while adhering to health protocols. Each series of activities in the community service program uses visualization facilities to support presentations, demonstrations and discussions to make it easier for the public to understand explanations regarding the tools to be donated. By using this facility, it is hoped that all processes can also be carried out systematically (Hadiyanti, 2008). A description of the implementation of community service activities can be seen in Table 2.

Table 2. Schedule of community service events

Time	Activities
08.00 – 08.10	Opening
08.10 – 08.20	"Indonesia Raya" Song
08.20 – 08.30	*Yalal Waton*
08.30 – 08.45	Remarks by the Head of Mojopurogede Village
08.45 – 09.00	Remarks by NU Maritime Institute Gresik
09.00 – 09.15	Remarks by Director of PENS
09.15 – 09.30	Remarks by Kadiskanla Jatim
09.30 – 09.45	Remarks by Kadiskanla Gresik
09.45 – 10.15	Remarks by Head of PCNU Gresik
10.15 – 10.45	MoU Signing between PENS and LKNU Gresik and Cooperation Agreement
10.45 – 11.00	Handover Modul Water Quality Meter Tools
11.00 – 11.15	Closing / Prayers
11.15 – 12.00	Presentation and Demo of Modul Water Quality Meter Tool
12.00 – 12.30	Practice and Discussion Regarding the Use of the Water Quality Meter Module

The event consisted of remarks by several parties, signing of the MoU, handing over the water quality meter module, presentations and demos, as well as practice and discussion. The core event of this community service program is the signing of the MoU by several partner representatives and the handover of the water quality meter module. In addition, the last two events are also very important events in this community service program. The presentation and demo aims to provide instructions on the use of the water quality meter module along with the PENS aquaculture web to farmers who receive module grants. While the practice and discussion aims to give farmers the opportunity to try the modules themselves accompanied by a service team. That way, farmers can immediately ask if there are difficulties in operating the module.

Evaluation stage

After carrying out an activity, the evaluation stage is a very important stage and should not be missed. The evaluation phase aims to review the activities that have been carried out. Information regarding the advantages and disadvantages of an activity is then used as a reference for further community service activities. The advantages of an activity can be imitated and improved for the next activity. While the shortcomings of an activity can be corrected in carrying out further activities. It can also be said that the evaluation stage aims to find useful information in assessing a program or strategy to achieve predetermined goals (Andriani & Afidah, 2020).

3. RESULTS AND DISCUSSION

The implementation of the activity consisted of giving remarks, signing the EEPIS and LKNU Gresik MoU, presentations related to the water quality meter module, as well as explanations regarding the EEPIS aquaculture web.

Presenting Remarks

Remarks at community service events were given by representatives of several partners, one of which can be seen in Figure 3.

Figure 3. Remarks from representatives of the invited institutions

The six remarks were given with lots of information and messages. The information conveyed included regarding the conditions of aquaculture in Gresik Regency, especially in Mojopuro Gede Village, which explained some of the shortcomings of aquaculture in Gresik Regency.

MoU Signing by the PENS and LKNU Gresik MoU and Handover of the Water Quality Meter Module by Several Partner Representatives

In granting several modules to a party, a MoU or agreement between the two parties is required. Representatives who signed the agreement were the Chairperson of the NU Maritime Institute Gresik and the Head of the PENS Electrical Engineering Masters Study Program. Then, the event continued with the signing of a grant certificate by eight recipients of the water quality meter module set. The signing of the MoU can be seen in Figure 4.

Figure 4. The signing of the PENS and LKNU Gresik MoU and the Cooperation Agreement

Explanation Regarding the Water Quality Meter Module

The water quality meter module that has been made consists of a small box with a keypad and LCD on the top surface and three sensors. The keypad is used to input the SSID and WiFi Password as well as

the pool number, while the LCD is used to display input based on the keypad and all measurement data. The keypad used can be seen in Figure 5.

The keypad consists of 4 columns and 4 rows. The rightmost column is disabled. Meanwhile, the first 3 columns can be used as numbers or letters by determining the number of key presses. The way it works is the same as the keypad on older cell phones. For example, if you want to enter the letter a, the way to do this is to press the 2 button 2 times in a row. If you want to enter the letter v, the way to do this is to press the 8 button 4 times in a row. An image of the water quality meter module as a whole can be seen in Figure 6.

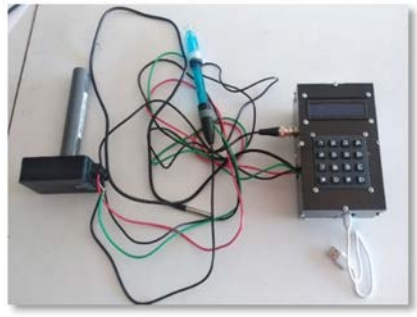


Figure 5. Water quality meter keypad
Figure 6. Water quality meter module

The tool needs to be supplied with a voltage supply from the power bank that has been placed underneath. After the tool gets a voltage supply, the LCD will turn on with the words "WiFi User Input". Then, the SSID of the WiFi can be entered by continuing to enter the password. The button can be pressed after each input data is finished. Then it is necessary to input the number of the pool where the pond water will be measured. The measured values will then be displayed on the LCD. To send measurement results to the cloud, it is done by pressing the button. If the data has been sent, then the LCD will display a statement that the data has been sent as can be seen in Figure 7.

Figure 7. Example of data display and indication that data has been sent

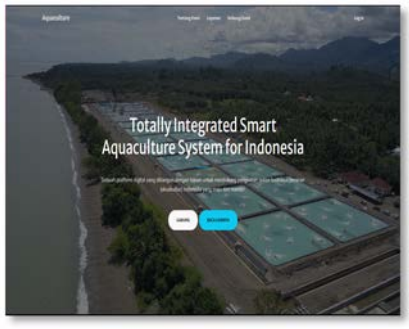
An explanation of the water quality meter module by the community service team can be seen in Figure 8. The detailed explanation is followed by a module demo.

Figure 8. Explanation regarding the water quality meter module

Explanation related to the PENS Aquaculture website

Aquaculture pens is a web-based application that can measure data from a pond using an IoT tool that aims to determine the value of the conditions of a pond, such as temperature, pH and salinity. The initial appearance of the PENS aquaculture website can be seen in Figure 9.

Logging in is required in order to be able to access the web that is connected to the tools that are already available. Shrimp farmers can log in using the registered account name and password. If the account has not been registered, it is necessary to register on the registration link. After registering and logging in, a dashboard page will appear which can be seen in Figure 10.



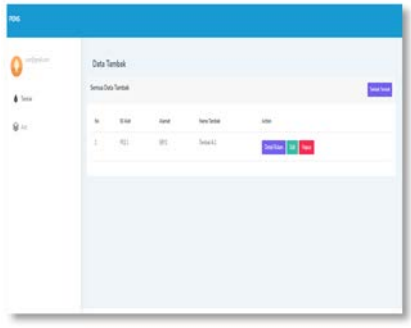


Figure 9. Website homepage
Figure 10. Website dashboard

If the user is new, then the dashboard page will be blank. The user then needs to add the farm (*tambak*) name, address, and hardware ID that has been specified on the tool. After adding pond data, then the user can add pond data by first pressing the pond details button. One pond can consist of several ponds. So that on the web, the user needs to add several pools in the pond and fill in the pool data description which includes the name of the pool, the length of the pool, the width of the pool, and the depth of the pool. After adding some pool data, users can view data from those pools by pressing the pool details button. If the module has sent measurement data, the results will be displayed in the pool details. The results include readings from pH, salinity, and temperature sensors. Explanation regarding the PENS aquaculture website was carried out by a service team as shown in Figure 11.

Monitoring of Pond Water Quality by Shrimp Farmers

The community service program is expected to be able to educate and have a positive impact on shrimp farmers in Mojopuro Gede Village, Gresik. The module that has been granted is expected to be very helpful in monitoring pond water quality. The results of water quality measurements that have been carried out can be seen in Figure 12.

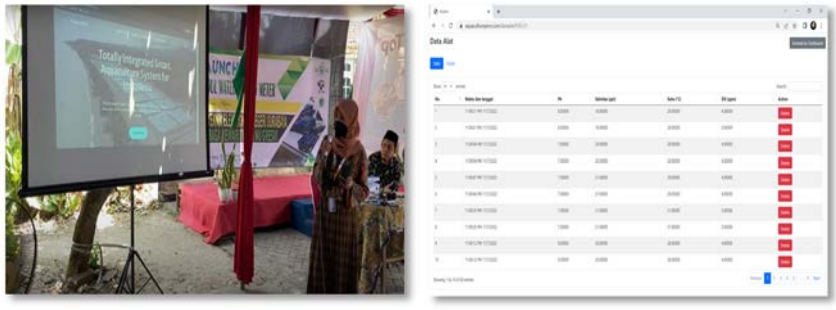


Figure 11. Explanation regarding the PENS Aquaculture website
Figure 12. Pond water quality measurement results

After getting the results of pond water quality measurements, they can be seen in graphical form as shown in Figure 13 and Figure 14. By using the graphs, increases and decreases in value can be seen very clearly. So that if there is a continuous decrease or continuous increase, the farmers become more vigilant and take action. If the increase and decrease in abnormal parameter values is allowed, the shrimp will get sick or even die. This will result in losses for farmers.

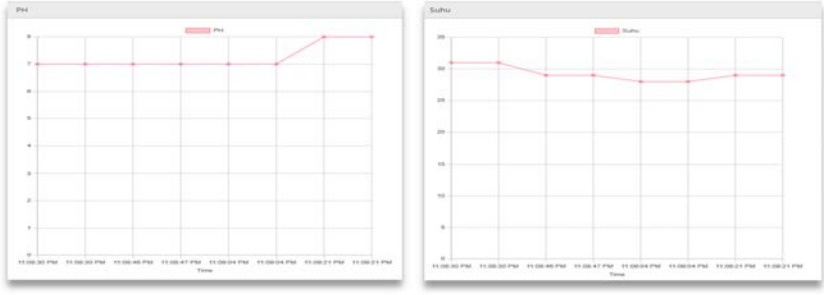


Figure 13. Graph of pH and temperature measurements in pond water

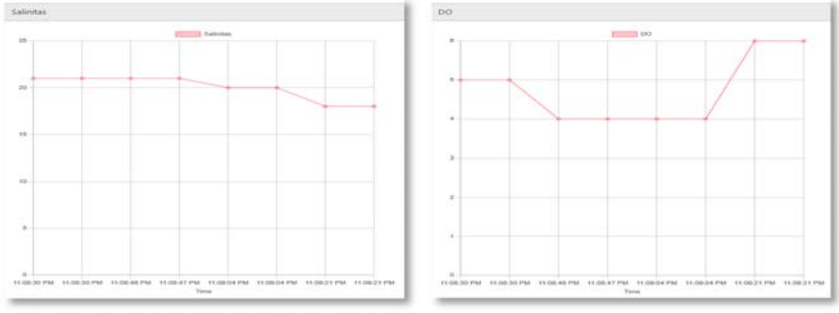


Figure 14. Graph of measurement of salinity and DO in pond water

By knowing the quality of pond water and comparing it with standard pond water parameter values, farmers can take action as quickly as possible if the measurement results in ponds are still far from the standard value. This of course greatly affects the quality and quantity of the harvest later. Farmers will get a lot of crops with much better quality. That way, farmers will get more benefits.

4. CONCLUSION AND RECOMMENDATIONS

The community service activities carried out by the service team went smoothly and received a good response from all partners and activity participants, both from the Mojopuro Gede Village community, especially shrimp farmers, the NU Maritime Institute Gresik, and the Maritime Affairs and Fisheries Office of East Java Province. In this activity, an educational process has taken place so that farmers understand and care more about the condition of the shrimp ponds. This community service program is used as a means to provide understanding to farmers that currently the role of technology is very important in the cultivation process, even though it is actually not easy to provide education to shrimp farmers, especially traditional farmers. Therefore, all related institutions are expected to be more active in providing education to farmers regarding the importance of applying technology in the cultivation process.

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