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Towards feed independence: Types of auto-feeder technologies for efficient fish farming

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Abstract
Efficient feeding plays a vital role in the success of fish farming operations. In recent years, there has been a growing need to develop auto-feeder technologies that not only optimize feed utilization but also reduce labor costs and environmental impact. This abstract explores the various types of auto-feeder technologies that contribute to achieving feed independence in fish farming. The paper delves into three primary categories of auto-feeders: demand-based feeders, time-based feeders, and sensor-based feeders. Demand-based feeders employ advanced algorithms to dispense feed based on the fish's appetite, ensuring optimal feeding rates and minimizing wastage. Time-based feeders provide feed at pre-determined intervals, offering a more straightforward approach but requiring careful calibration. Sensor-based feeders utilize real-time data from environmental sensors, such as water quality parameters and fish behavior, to adjust feeding schedules and quantities accordingly. The abstract highlights the advantages and limitations of each auto-feeder type, considering factors such as feed conversion efficiency, growth performance, and labor requirements. Furthermore, it discusses the potential integration of artificial intelligence and machine learning algorithms to enhance the auto-feeder technologies' performance and adaptability. The findings suggest that auto-feeder technologies have the potential to revolutionize fish farming practices by enabling feed independence. These technologies contribute to reducing feed waste, improving growth rates, and optimizing feeding strategies. However, further research is needed to overcome challenges such as accurate appetite estimation, sensor calibration, and cost-effectiveness. Ultimately, the abstract emphasizes the importance of auto-feeder technologies in achieving sustainable and efficient fish farming practices, paving the way for increased productivity and reduced environmental impact in the aquaculture industry.

Keywords: Auto-feeder, cultivation, benefit, technology

Introduction
In fish farming, the thing that needs to be considered is fish feeding [1]. Because in fish farming the important thing is growth, and is usually influenced by feed [2]. According to [3] in [2] states that changes in fish such as weight and length at a certain time are part of fish growth. Feeding must be on time and with a controlled amount [4].

In general, fish feed is given manually by humans [4]. The disadvantage of this method is that the feeding is not on time and the amount of feed is not appropriate [2, 1]. Fish growth will be poor due to malnutrition if the feed is too little, but it will cause pollution if the feed is too much, resulting in food scraps being discarded [1]. As [5] said, more feed makes more costs and the remaining feed that is not eaten can reduce the quality of cultivation waters.

Based on the above problems, the method of feeding must be improved by paying attention to the timeliness of feeding and the amount of feed [6]. Technology is needed to feed fish automatically and can set a fish feeding schedule to help cultivation [7]. In [7] explained that the use of automatic feed technology can help provide fish feed in managing aquaculture so that it helps its workers. They also explained that the use of automatic feeding technology makes fish feeding more efficient and effective. In addition, the labor required by workers is also not extra. In accordance with [8] which states that an effective feeding technology will avoid waste of feed so as to increase the utilization of fish feed.

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Materials and Methods
This research uses literature study and qualitative analysis methods to collect and analyze data related to the implementation of auto-feeder technology in fish. Data were obtained from literature sources such as journals, books, and related websites, as well as research reports and case studies related to the implementation of auto-feeder technology in fish. The data collected was then analyzed using a qualitative approach, by identifying key issues related to auto-feeder technology in fish, as well as evaluating the advantages and challenges in implementing this technology.

Discussion
Development of self-feeding technology
Auto-feeder technology was developed to improve fish feed selection so that fish receive higher food intake and increased growth compared to manual feeding [9]. Auto-feeder technology has been developed since the 90s, based on studies on fish feeding effectiveness. For example, [10] used an auto-feeder installed on each tank. The rotating food container is driven by a synchronous motor, so that after each fish request, the food container rotates 360° which then supplies pellets. Then the feeder is activated by the fish through a tactile sensor with a white rubber tip hanging about 0.5 cm below the water surface. The food requests made by the fish are sent to a computer for continuous recording.

Types of self-feeding technology
In research conducted by [6] automatic feeding of fish using technology connected to an electric timer system. This technology can provide automatic feed with an electric timer

system designed in it. In operation, this machine uses an Arduino system that is connected to the internet, then controls it through an application on a mobile phone. Besides through mobile phones, it can also be controlled manually on the feed machine. According to them, the use of this machine is the frequency of fish feeding to be controlled.

Whereas in the research of [8] feeding technology uses a device equipped with software to record and analyze data to evaluate the daily diet of fish. Research using similar technology was also conducted by [11]. The fish feeding activity recorded in the device was analyzed using the software of [8] software to plot the daily average of fish feeding time. The results obtained were used to adjust the timing of fish feeding in these waters [11].

The fish feeding technology used in the study by [12] was equipped with sensors to monitor the feeding activity of the fish, and cameras to record videos of the fish feeding. With this technology, it is possible to investigate the exact feeding activity by analyzing the video recordings. Therefore, feeding preference, total food intake and feeding activity can be studied. In this technology, the feeding machine will dispense feed when there is triggering activity by the fish.

Research by [13] on diet selectivity in rainbow trout was conducted using auto-feeder technology with feeders equipped with sensors. The top of the sensor for each feeder is placed above the water surface, and covered with rubber tips of different colors on each tank to help fish distinguish their own feeders, equipped with an electronic timer. In terms of operation, the auto-feeder is equipped with a synchronous motor, sensor, and computer.

Table 1: Types and benefits of auto-feeder technology

Commodity	Technology Type	Benefit	Reference
Rainbow trout	auto-feeder equipped with synchronous motor, sensor, computer	Selecting feed requirements	[10]
Pirarucu fish, Sparus aurata fish	automatic feeding equipped with computer software	Fish can select feed as needed based on time activity	[8, 14]
Rainbow trout	auto feeder equipped collection, sensor, timing	Selecting fish dietary requirements	[13]
Parrot fish	automatic feeder equipped with an electric timer	Improve feed management	[6]
Sole fish	software-equipped automatic feeder completes with mobile-phone-connected software	Supports a consistent daily diet	[11]

Conclusion
Based on this journal review, self-feeding technology in fish farming can increase production effectiveness because it increases the efficiency of feeding fish, reduces operational costs incurred, reduces feed wastage and feed waste production, and improves the quality of fish produced. Thus, the use of self-feeding technology in fish farming can increase production efficiency and effectiveness in a sustainable and environmentally friendly manner. Cell-feeding technology has various types and different functions. They include synchronous motors, sensors and electronic devices to monitor feed consumption.

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