Design and Implementation of *Budikdamber* with Solar-Powered Water Circulation System in Nanggulan, Kulon Progo

Iswandi*, Silmi Fauziati, Prapto Nugroho

Department of Electrical Engineering and Information Technology, Faculty of Engineering, Universitas Gadjah Mada, Indonesia.

*Corresponding author's email: iswandi@ugm.ac.id
doi: https://doi.org/10.21467/proceedings.151.23

ABSTRACT

Budikdamber is the acronym for "*budidaya ikan dalam ember*", an Indonesian term for a small-scale aquaponic system in a plastic bucket. This equipment is famous for its compact size and easy implementation to cultivate fish in households, especially for those with limited space resources. *Budikdamber* can be seen as the proper solution to support one of Kulon Progo's critical programs to reduce its poverty rate. The number of animal protein intake in each local community family is one indicator to measure the poverty rate. Hence, *Budikdamber* allows lower-income families to cultivate fish in their houses to fulfill their animal protein needs. This paper reported the community-based activity to design and implement *Budikdamber* of giving guidance to low-income families. The general problems of implementing *Budikdamber* for the community service program were the low fish productivity and sustainability of the people using granted *Budikdamber*. This program introduced *Budikdamber,* equipped with a water circulation system to improve fish productivity, hopefully increasing people's interest in using *Budikdamber*. The design included a solar panel to prevent additional maintenance costs of required electricity for *Budikdamber*—which has been successfully manufactured into a prototype by the student community service program. A series of activities (including socialization, operation tutorial, and a hearing from Kulon Progo district's stakeholders) were conducted to bring the design and prototype to Tanjungharjo, Nanggulan, Kulon Progo local community.

Keywords: Aquaponic, *Budikdamber*, Freshwater cultivation, Kulon Progo district, Poverty rate reduction.

1 Introduction

One of Kulon Progo district's most concerned programs is the attempt to reduce poverty, which is still relatively high compared to other areas of Yogyakarta. The COVID-19 pandemic may also significantly impact the increasement in the poverty rate [1]. Therefore, various alleviation and prevention must be carried out in multiple aspects, especially poverty measurement indicators.

According to survey standards of the Central Bureau of Statistics, one of the indicators in divining the poverty rate is food sufficiency intake measured by the total kilocalories of the community's consumption [2]. Thus, increasing animal protein consumption becomes very important since animal protein is a significant component in calculating kilocalories. Sources of animal protein that are highly accessible and can be consumed by all levels of society are freshwater fish [3]—in which the cultivation of both large and small scales becomes the most realistic and efficient attempt to increase fish consumption in a local community.

Various freshwater fishponds can be found in the community, including fixed ponds, non-permanent ponds, and even ponds made by buckets (commonly known as Budikdamber), as shown in Figure 1. The fixed and non-permanent ponds are suitable for commercial fish cultivation as they need vast space and intensive maintenance. However, in terms of the attempt to reduce poverty, *Budikdamber* is the most reasonable solution for families with low incomes as they generally have limited living space.

Proceedings DOI: 10.21467/proceedings.151; Series: AIJR Proceedings; ISSN: 2582-3922; ISBN: 978-81-961472-6-6

Budikdamber has been carried out by some prior community service programs, such as in [4, 5]. Nevertheless, it was developed without any supporting tools, resulting in an obstacle that arose during the implementation, including a high fish mortality rate and slow fish growth. Furthermore, sustainability issues exist as people used *Budikdamber* infrequently after it was granted.

(a) (b) (c)

Figure 1: *Various types of freshwater fishponds, such as (a) fixed pond, (b) semi-permanent pond, and (c) Budikdamber.*

It is most likely also because of the *Budikdamber*'s low productivity, mainly caused by improper water management and feed management—which is why it is needed to improve farmers' competency and assistance with technological matters to gain community interest and encouragement [6].

This paper proposed a community service program to increase animal protein consumption in underprivileged communities. The activity was carried out by promoting fish farming in buckets, namely *Budikdamber*, especially for people who cannot afford to consume fish regularly. This technology was chosen by considering its aspects, namely relatively cheap and easy to manufacture and maintain, so that all levels of society can implement it. Considering the issue of *Budikdamber*'s low productivity, which was previously explained, the current work also proposed adding the technology to increase productivity by introducing a water circulation system. The prototype of *Budikdamber,* along with its solar-power water circulation system, was introduced and implemented at the community member of Nanggulan village in Kulon Progo. The execution process was carried out by the student community service program of Universitas Gadjah Mada (KKN-UGM) in 2021 and 2022.

2 Methodology

This paper reported a community service program aimed at designing and implementing *Budikdamber* with a solar-powered water circulation system in Nanggulan, Kulon Progo. The procedure can be listed as follows.

- Design the *Budikdamber* with solar-powered water circulation.
- Perform the usage of *Budikdamber*'s tutorial.
- Forum group discussion with the users and stakeholders.

The proposed *Budikdamber* design is explained in the next section, whereas the execution processes are stated in the results and discussions section.

3 Budikdamber's Design

Budikdamber, which will be discussed here, has a shape similar to what we commonly find in the community but was equipped with an aerator system and a pump for water circulation powered by solar electricity. A unique electronic system was designed and shown in Figure 1. The system was applied by equipping aerators and electric engines to circulate water in bucket ponds. Fish growth is expected to be healthier as the oxygen

supply is sufficient and the water circulation works appropriately. In addition, the installed solar panel will provide any additional electrical resources necessary, which is not meant to burden the people economically. The electronics system mainly consisted of a solar cell, a solar-charged controller, a battery, an aerator, and

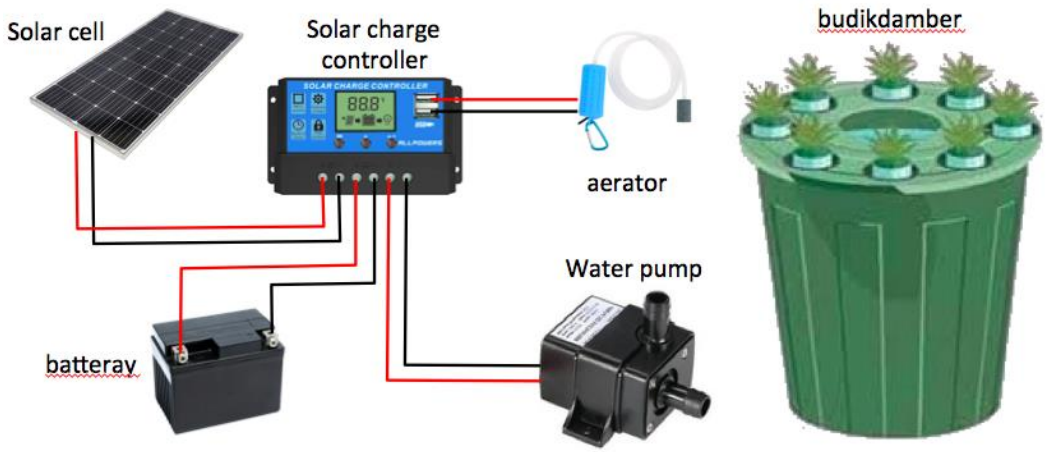

Figure 2: *Design of electronic system for supporting the Budikdamber.*

Table 1: *Components of electronics systems for Budikdamber and their specifications.*

Electronic components	Specifications
Solar cell	monocrystalline, 12-volt, 20-watt peak
Solar-charged controller	pulse width modulation (PWM), 10 amperes
Battery	valve regulated lead acid (VRLA), 12-volt, 7.5 ampere-hour
Aerator	6 volt (USB-type), 300 milliampere
Water pump	Power head type, 12-volt, 3 ampere

a water pump. The solar cell or solar panel was used to transform the energy from sunlight into electricity. Each component's specification is listed in Table 1. The electricity was transmitted to the solar-charged controller (SCC) to manage the electricity stored in the battery and used by the aerator and water pump. The SCC was also used to prevent the battery from overcharging and over-discharging. The aerator and water pump were chosen for appropriate use in the electricity managed by the SCC.

4 Results and Discussions

After the proposed *Budikdamber* had been successfully designed and fabricated, it was brought to the users for implementation. The tutorial on how to use *Budikdamber* was held. Afterward, a focus group discussion was conducted with the users and stakeholders to receive input on the program implementation.

The *Budikdamber* prototype and its electronic devices have been successfully tested for use in the community service program, which was finally handed over to the community in Nanggulan, Kulon Progo. The general tutorial on assembling, operating, and maintaining the *Budikdamber* was also conducted to ensure the comprehension of fish cultivation with *Budikdamber,* as shown in Figure 3.

Proceedings DOI: 10.21467/proceedings.151
ISBN: 978-81-961472-6-6

Series: AIJR Proceedings
ISSN: 2582-3922

Figure 3: *General tutorial on how to assemble, operate, and maintain the proposed Budikdamber*

After the practices are accomplished, the performance is evaluated through forum group discussions with the users and stakeholders. The forum group discussion aims to perceive the program's suitability to local government programs and the effectiveness of the proposed equipment, as depicted in Figure 4. This occasion invited the regional planning office of Kulon Progo District (BAPPEDA Kulon Progo) and the maritime and fishery office of Kulon Progo District (DKP Kulon Progo) as the representative of the local government. The discussion suggests future actions to improve the current equipment, such as expecting *Budikdamber* can be equipped with a central tap to ease the process of taking out pond waste. The results of those evaluations are used as a reference to improve the design by conducting possible future research.

Figure 4: *Forum group discussion on the implementation of Budikdamber among the team, BAPPEDA Kulon Progo, DPK Kulon Progo, and the community in Nanggulan.*

The *Budikdamber* prototype and its electronic devices were successfully tested for use in the community. This program's work was also to evaluate the effectiveness of designed tools resulting in the productivity of *Budikdamber*. This part is still ongoing. Based on the current results, it can be concluded that the solar-power water circulation system for *Budikdamber* has been successfully designed, fabricated, and sent to the community for application.

5 Conclusions

This paper delivers the community service activity and research to design and implement *Budikdamber* with solar-powered water circulation systems. The proposed equipment was implemented in Nanggulan, Kulon Progo. The modified *Budikdamber* was successfully designed and developed into prototypes—delivered to underprivileged families in Nanggulan to participate in the local government program. A series of implementation activities were carried out in cooperation with the student community service program of Universitas Gadjah Mada (KKN-UGM), which includes usage tutorials and forum group discussions with

the users and stakeholders. The program has been successfully executed and received enthusiastic reactions and acceptance from the users and stakeholders.

5.1 Publisher's Note

AIJR remains neutral with regard to jurisdictional claims in published map and institutional affiliations.

How to Cite

Iswandi *et al.* (2023). Design and Implementation of Budikdamber with Solar-Powered Water Circulation System in Nanggulan, Kulon Progo. *AIJR Proceedings*,154-158. https://doi.org/10.21467/proceedings.151.23.

References

[1] Suparmono, "Estimating the Impact of the Covid-19 Pandemic on Poverty Levels in Kulon Progo Regency , Yogyakarta Special Region , Indonesia," J. Ekon. dan Bisnis, vol. 14, no. 2, pp. 83–89, 2020.

[2] Badan Pusat Statistik (BPS), "Kemiskinan dan Ketimpangan," 2022. Accessed on 7 December 2022 at https://www.bps.go.id/subject/23/kemiskinan-dan-ketimpangan.html.

[3] Lindawati and S. Saptanto, "Analisis Tingkat Kemiskinan dan Ketahanan Pangan berdasarkan Tingkat Pengeluaran Konsumsi pada Rumah Tangga Pembudidaya Ikan," J. Sos. Ekon. Kelautan, dan Perikan., vol. 9, no. 2, pp. 195–206, 2014, [Online]. Available: http://ejournal-balitbang.kkp.go.id/index.php/sosek/article/view/1221/1118.

[4] J. K n, G. I. Baskoro, and N. Khairunnisa, "Penerapan Budidaya Ikan dalam Ember ' Budikdamber ' pada Lahan Sempit dengan Aquaponik di Yayasan Al-Ikhlas Cinere," Semin. Nas. Pengabdi. Masy. LPPM UMJ, no. E-ISSN: 2714-6286, pp. 1–4, 2020.

[5] T. A. Haidiputri and M. S. H. Elmas, "Pengenalan BUDIKDAMBER (Budidaya Ikan Dalam Ember) untuk Ketahanan Pangan di Kecamatan Dringu Kabupaten Probolinggo," J. Abdi Panca Mara, vol. 2, no. 1, pp. 42–45, 2021, doi: 10.51747/abdipancamara.v2i1.737.

[6] M. B. Syamsunarno and M. T. Sunarno, "Budidaya ikan air tawar ramah lingkungan untuk mendukung keberlanjutan penyediaan ikan bagi masyarakat," Semin. Nas. Perikan. dan Kelaut. 2016. Pembang. Perikan. dan Kelaut. dalam Mendukung Kedaulatan Pangan Nas., no. January 2016, pp. 1–16, 2016. https://www.researchgate.net/publication/324417919