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Innovation in Underwater Fishing Lamps Using Floating Fish Aggregating Devices in Wandoka Utara, Wakatobi

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ABSTRAK

Program pengabdian kepada masyarakat ini bertujuan memperkuat kapasitas teknologi nelayan skala kecil yang mengoperasikan rumpon terapung di Desa Wandoka Utara, Kabupaten Wakatobi, melalui pengenalan, perakitan, dan penerapan Lampu Celup Bawah Air (LACUBA) sebagai alat pemikat ikan. Mitra menghadapi rendahnya efektivitas lampu permukaan saat angin kencang dan laut bergelombang, keterbatasan pengetahuan praktis teknologi penangkapan, serta lemahnya jaringan pemasaran hasil tangkapan ikan pelagis kecil. Program menggunakan pendekatan transfer teknologi partisipatif yang meliputi identifikasi kebutuhan, sosialisasi prinsip penangkapan berbasis cahaya, pelatihan perakitan dan penggunaan LACUBA, pendampingan lapangan, serta evaluasi awal. Sosialisasi diikuti oleh 20 nelayan, sedangkan pelatihan diikuti oleh 16 nelayan. Hasil evaluasi menunjukkan waktu pengumpulan ikan menurun dari 60–300 menit menjadi 30–60 menit, sementara hasil tangkapan meningkat dari 30–100 ekor menjadi 60–180 ekor per perjalanan. Penggunaan lampu dan baterai juga menjadi lebih efisien. Temuan ini menunjukkan bahwa LACUBA dapat meningkatkan produktivitas, efisiensi operasional, dan kemandirian teknologi nelayan skala kecil.

ABSTRACT

This community engagement program aimed to strengthen the technological capacity of small-scale fishers operating floating fish aggregating devices in Wandoka Utara Village, Wakatobi Regency, through the introduction, assembly, and application of underwater fishing lamps (LACUBA) as fish attractors. The partner group faced limited effectiveness of surface lamps during strong winds and rough seas, insufficient practical knowledge of fishing technology, and weak market linkages for small pelagic catches. The program applied a participatory technology-transfer approach comprising needs identification, dissemination of light-based fishing principles, training in LACUBA assembly and use, field mentoring, and preliminary evaluation. The dissemination session involved 20 fishers, while the technical training was attended by 16 fishers. Evaluation results showed that fish aggregation time decreased from 60–300 minutes to 30–60 minutes, while catches increased from 30–100 fish to 60–180 fish per fishing trip. Lamp

and battery use also became more efficient. These findings indicate that LACUBA can improve productivity, operational efficiency, and technological self-reliance among small-scale fishers.

INTRODUCTION

Wakatobi Regency is an archipelagic area in which marine space constitutes the main ecological setting and economic foundation for coastal communities. The community service report indicates that approximately 94% of Wakatobi's territory consists of marine waters, making capture fisheries a central livelihood sector for fishing households. Nevertheless, the use of fisheries resources in this area has remained strongly concentrated in coral reef fisheries, while several indicators suggest declining catch quality and quantity, including increasingly distant fishing grounds, smaller fish sizes, and lower catch volumes (Arami, 2006; Widodo et al., 2023).

This condition requires a strategic shift toward the more effective use of small pelagic fish resources through fishing technologies that are efficient, affordable, and compatible with the operational capacity of small-scale fishers. In Wandoka Utara Village, fishers use simple floating bagan or raft-based fish aggregating devices to concentrate small pelagic species such as scads, mackerel, trevallies, and squid. In local practice, the term bagan does not refer solely to a conventional lift net; rather, it denotes a simple raft-like aggregating structure combined with a surface gillnet. The system relies on the positive phototactic response of certain fish species, namely their tendency to move toward a light source.

The principal technical constraint faced by the partner group was the limited effectiveness of surface lighting. Petromax lamps, incandescent bulbs, and other commercial lamps installed above the water surface are highly vulnerable to wind and adverse weather, produce unstable illumination, and experience light reflection at the air-water interface, thereby reducing light penetration into the water column. As a result, bagan operations are effective only during particular seasons. During peak fishing months, fishers may generate sales of more than IDR 1,000,000 per trip, whereas during less favorable seasons the value of the catch may decline to approximately IDR 50,000-100,000 per trip, often failing to cover operating costs.

Underwater Fishing Lamps, locally known as Lampu Celup Bawah Air (LACUBA), offer an appropriate technological alternative because the light source is positioned directly within the water column. This configuration can reduce light reflection, improve illumination stability, accelerate fish aggregation, and lower operational costs. Previous studies have shown that underwater lamps or light-emitting diode (LED) systems in light-based fisheries can increase catch performance compared with petromax, fluorescent, or other surface lamps (Brown et al., 2013; Thenu, 2014; Taufiq, 2015; Li et al., 2025; Maidin et al., 2026).

On this basis, the community engagement program was designed to improve fishers' knowledge of light-based fishing principles, strengthen their skills in assembling LACUBA units, provide field mentoring for the use of LACUBA in bagan operations, and introduce strategies for strengthening market networks. This article presents the program outcomes in the format of a GSCE scientific article, emphasizing the integration of appropriate technology, fisher empowerment, and operational efficiency in small-scale fisheries.

METHODS

The program was implemented with a group of floating bagan fishers in Wandoka Utara

Village, Wangi-Wangi District, Wakatobi Regency, Southeast Sulawesi Province, Indonesia. The target partners were small-scale fishers who operate simple floating bagan or raft-based aggregating devices to capture small pelagic fish. The intervention adopted an educational-participatory approach that combined knowledge transfer, technical practice, field mentoring, and joint evaluation.

The first stage consisted of a preliminary survey and coordination. This stage was conducted to introduce the program to the partner group and village government, identify the initial condition of fishing technology, prepare the activity site, and provide the materials and equipment required for training. The preliminary assessment confirmed that fishers needed a lighting device that was more stable, weather-resistant, and capable of operating below the water surface.

The second stage comprised dissemination on LACUBA and its application in fishing operations. The dissemination activity was attended by 20 fishers from Wandoka Utara Village. The materials covered the basic principles of light as a fish attractor, the limitations of surface lamps, the advantages of underwater lamps, and opportunities for improving operational efficiency. The third stage involved technical training in LACUBA assembly, attended by 16 participants. The training combined a concise lecture, demonstration, and direct practice in assembling key components, including LED lamps, cables, pipes, protective tubes, adhesives, connectors, and the power-supply system.

The fourth stage consisted of field mentoring for the application of LACUBA on bagan. The implementing team assisted fishers in transporting the device to the fishing ground, lowering the lamp into the water column, positioning it properly within the bagan structure, and observing the fish aggregation process. The fifth stage introduced preliminary support for market-network development through the use of e-business and e-commerce applications. Program evaluation compared selected indicators before and after the intervention, including catch per trip, sales value, fish aggregation time, number of lamps used, lamp durability, lamp price, and battery endurance.

RESULTS AND DISCUSSION

Results

The program results show that all major stages were successfully implemented, including the preliminary survey, dissemination session, technical training in LACUBA assembly, field testing on bagan, and preliminary evaluation. During the survey stage, the team identified the model of bagan or raft-based aggregating devices used by fishers, the type of surface lamps previously used as attractors, and the surface gillnet employed in fishing operations. These baseline conditions provided the empirical basis for designing training materials and adapting the LACUBA prototype to local fishing needs (Fig. 1).

The dissemination session generated a positive response from fishers because the material directly addressed the operational constraints they commonly experienced. Participants were not merely introduced to LACUBA as a technological product; they were also guided to understand the underlying mechanism of light attraction in fish aggregation (Fig. 2). During the technical training, participants gained practical experience in assembling underwater lamps using materials that were relatively accessible, affordable, and safe for fishing operations.

Field mentoring demonstrated that LACUBA could be applied to the bagan or raft-based aggregating devices used by local fishers. The team and partner fishers prepared for the fishing trip (Fig. 3 a,b), travelled to the fishing ground, lowered the lamp into an appropriate position, and observed the aggregation of fish around the light source (Fig. 3). The preliminary evaluation indicated improvements in several technical and economic indicators, as presented in Table 1.

Table 1. Evaluation of fishing activities among floating bagan fishers before and after the community engagement program

No.	Indicator	Unit	Before program	After program
1	Catch per trip	fish	30–100 (5–20 kg)	60–180 (12–36 kg)
2	Catch sales value	IDR/trip	100,000	150,000–200,000
3	Fish aggregation time after lamp deployment	minutes	60–300	30–60
4	Number of lamps used	unit	2	1
5	Lamp durability	months	4–5	>12
6	Purchase price	IDR/unit	90,000	300,000
7	Battery endurance	trip/night	3	5–7

Source: Community engagement evaluation results, processed from the program report.

Figure 1. Initial condition of the bagan or raft-based fish aggregating devices used by fishers in Wandoka Utara Village.

Figure 2. Dissemination and technical training on LACUBA assembly with partner fishers.

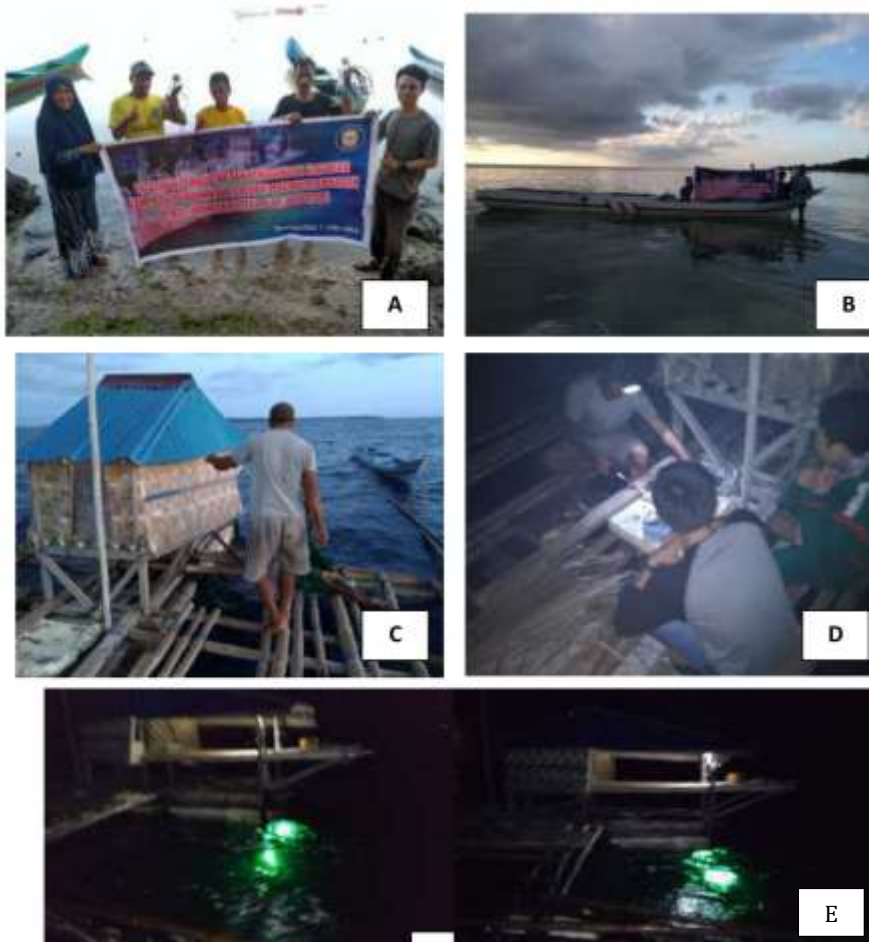

Figure 3. Field testing of the underwater fishing lamp on bagan: (A-B) preparation and travel to the fishing ground; (C) arrival at the fishing ground; (D) preparation for lowering the underwater lamp; (E) underwater lamp positioned within the bagan structure**.**

Discussion

The increase in catch from 30-100 fish to 60-180 fish per trip indicates that placing the light source below the water surface improved the effectiveness of fish aggregation. Technically, light emitted within the water column can reach the catchable area more directly than surface lighting, which is partially reflected at the air-water interface. This result is consistent with the phototactic behavior of small pelagic fish and with previous studies reporting the advantages of underwater lamps in light-based fishing systems (Brown et al., 2013; Thenu, 2014; Taufiq, 2015).

Time efficiency was another important outcome. Before the intervention, the time required to aggregate fish ranged from 60 to 300 minutes. After the use of LACUBA, this period decreased to 30-60 minutes. This acceleration has direct operational implications for fishers because it reduces uncertainty during night fishing, shortens waiting time, and increases the opportunity to conduct fishing operations in a more predictable manner. Efficiency was also reflected in the reduction in the number of lamps used, from two surface lamps to one underwater lamp, and in the increase in battery endurance from three trips to five to seven trips.

From an empowerment perspective, the program did not simply deliver a technological product; it also strengthened fishers' capacity to understand, assemble, use, and evaluate the device. The training model, which integrated explanation, demonstration, hands-on practice, and field mentoring, enabled fishers to internalize the operating principles of the technology.

Accordingly, LACUBA should not be viewed as a one-time technological input, but as an appropriate technology that can be learned, maintained, and further adapted by the fisher group.

Several limitations nevertheless require consideration. Catch evaluation could not be conducted across multiple seasons because weather, currents, and waves constrained bagan operations during parts of the program period. In addition, digital marketing support remained at the introductory and account-creation stage; therefore, its effect on catch sales value could not yet be comprehensively assessed. Future programs should therefore prioritize multi-season monitoring, routine recording of catch and operational costs, equipment maintenance, and the strengthening of market networks for small pelagic catches.

CONCLUSION

The community engagement program on underwater fishing lamp assembly and field mentoring for floating bagan fishers in Wandoka Utara Village strengthened fishers' knowledge and skills in adopting supporting technology for fishing operations. The use of LACUBA produced positive preliminary outcomes, including higher catch volume, faster fish aggregation, a reduced number of lamps used, longer lamp durability, and more efficient battery use. Socially, the program enhanced fishers' capacity to receive, practice, and evaluate appropriate technology that responds to local needs. Given its relatively simple design, the accessibility of its components, and the participatory training approach used for its assembly and operation, LACUBA has considerable potential to be scaled up and replicated in other small-scale fishing communities that employ light-based fishing methods and face similar operational constraints. However, replication should be accompanied by local adaptation of the lamp specifications, power supply, deployment method, fishing gear, target species, and environmental conditions. Similar programs should therefore be continued through multi-season monitoring, systematic recording of catch and operational costs, equipment maintenance, capacity-building for local technicians, and market-network development so that increased production can be translated into greater and more sustainable economic value for fishers.

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REFERENCES

Arami, H. (2006). Seleksi teknologi penangkapan ikan karang dalam rangka pengembangan perikanan tangkap berwawasan lingkungan di Kepulauan Wakatobi, Sulawesi Tenggara [Selection of coral reef fishing technology for the development of environmentally responsible capture fisheries in the Wakatobi Islands, Southeast Sulawesi] (Master's thesis). Graduate School of Bogor Agricultural University, Bogor.

Brown, A., Isnaniah, & Domitta, S. (2013). Perbandingan hasil tangkapan kelong (lift net) menggunakan lampu celup bawah air (LACUBA) dan petromaks di Perairan Desa Kote Kecamatan Singkep Kabupaten Lingga Propinsi Kepulauan Riau [Comparison of kelong (lift-net) catches using underwater fishing lamps (LACUBA) and petromax lamps in Kote Village waters, Singkep District, Lingga Regency, Riau Islands Province]. Jurnal Akuatika, 4(2), 149-156.

Li, F., Hua, C., & Zhu, Q. (2025). Evaluating the illumination performance of LED fishing lamps with different configurations in Pacific saury fishery. PLOS ONE, 20, e0328676. https://doi.org/10.1371/journal.pone.0328676

Madyunin. (2016). Lampu celup dalam air (LACUDA) teknologi aplikatif untuk optimalisasi pemanfaatan sumberdaya kemaritiman [Underwater lamps (LACUDA) as an applied technology for optimizing maritime resource utilization]. Balai Diklat Perikanan Banyuwangi.

Maidin, M. S. R., Mustapha, M., & Harun, N. A. (2026). Comparative effects of surface and underwater lighting methods on coastal fishery resources in Terengganu. Scientific Reports, 16. https://doi.org/10.1038/s41598-026-43944-4

Mgana, H., Kraemer, B. M., O'Reilly, C., Staehr, P., Kimirei, I., Apse, C., Leisher, C., Ngoile, M., & McIntyre, P. (2019). Adoption and consequences of new light-fishing technology (LEDs) on Lake Tanganyika, East Africa. PLOS ONE, 14(5), e0216580. https://doi.org/10.1371/journal.pone.0216580

Taufiq. (2015). Pengembangan lampu celup LED (super bright blue) untuk perikanan bagan apung di Perairan Patek Kabupaten Aceh Jaya [Development of super-bright blue LED underwater lamps for floating bagan fisheries in Patek waters, Aceh Jaya Regency] (Master's thesis). Graduate School of Bogor Agricultural University, Bogor.

Thenu, I. M. (2014). Aplikasi lampu LED (light emitting diode) pada perikanan bagan tancap [Application of light-emitting diode lamps in fixed bagan fisheries] (Master's thesis). Graduate School of Bogor Agricultural University, Bogor.

Widodo, A., Wilcox, C., Sadiyah, L., Satria, F., Wudianto, Ford, J. H., & Hardesty, B. D. (2023). Developing indicators to detect the use of fish-aggregating devices. Marine and Freshwater Research. https://doi.org/10.1071/MF22055