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INTEGRASI PENGETAHUAN SAINS DAN KEARIFAN LOKAL: MODEL PENGABDIAN BERBASIS KO KREASI PADA KOMUNITAS NELAYAN ARGAWANA, KABUPATEN SERANG

Integration of Scientific Knowledge and Local Wisdom: a Co-Creation-Based Community Service Model for the Argawana Fishing Community, Serang Regency

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Kata Kunci :

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Abstrak :

Inisiatif pengabdian kepada masyarakat ini dilaksanakan untuk memperkuat literasi saintek serta pemanfaatan teknologi tepat guna di kalangan komunitas nelayan Desa Argawana, Kecamatan Puloampel, Provinsi Banten. Mitra program menghadapi beberapa tantangan utama, antara lain keterbatasan akses terhadap informasi kelautan, rendahnya pemahaman mengenai teknologi pemantauan laut, serta belum optimalnya penggunaan data untuk menentukan waktu dan lokasi penangkapan ikan. Program ini dijalankan melalui beberapa tahapan, meliputi asesmen kebutuhan, pelatihan, demonstrasi teknologi, pendampingan, serta evaluasi menggunakan instrumen pre-test dan post-test. Hasil evaluasi menunjukkan peningkatan pengetahuan peserta yang sangat signifikan, dengan skor rata-rata meningkat dari 42 persen pada pre-test menjadi 87 persen pada post-test, yang mengindikasikan efektivitas pelatihan dalam meningkatkan literasi teknologi. Dampak program terlihat dari meningkatnya kemampuan masyarakat dalam mengenali dan memanfaatkan produk saintek dalam aktivitas melaut, serta penggunaan data untuk menentukan waktu melaut yang lebih aman dan akurat. Perubahan ini berkontribusi pada penurunan risiko gagal tangkap, pengurangan biaya operasional, dan peningkatan efisiensi bahan bakar. Selain itu, program ini

	mendorong munculnya warga sebagai produsen sekaligus pengguna pengetahuan (citizen science) dalam pengelolaan sumber daya pesisir.
Key word :	**Abstract :**
Fishermen, Appropriate Technology, Scientific Literacy, Empowerment, Citizen Science	This community service initiative was carried out to strengthen scientific literacy and the use of appropriate technology within the fishing community of Argawana Village, Puloampel Subdistrict, Banten Province. The partners face several core challenges, including limited access to oceanographic information, low comprehension of marine monitoring technologies, and insufficient use of data to guide decisions on when and where to fish. The program was implemented through a series of steps, including needs assessment, training sessions, technology demonstrations, mentoring, and evaluation using pre-test and post-test instruments. The evaluation results show a substantial improvement in participants' understanding, with the average score increasing from 42 percent in the pre-test to 87 percent in the post-test, indicating the effectiveness of the training in enhancing technological literacy. The program's impact can be seen in the community's improved ability to identify and apply scientific and technological tools in their fishing practices, as well as their use of data to determine safer and more precise fishing times. These changes contribute to reducing the likelihood of unsuccessful trips, lowering operational expenses, and improving fuel efficiency. In addition, the program fosters the development of citizens as both producers and users of knowledge (citizen science) within coastal resource management.

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INTRODUCTION

Fishing communities are social groups that play a crucial role in ensuring the availability of national food resources, yet they simultaneously face various structural challenges related to access to information, technological literacy, and the ability to adapt to changing marine ecological conditions (Maulana & Haryono, 2024; Pahlevi *et al*., 2025; Wibowo *et al*., 2025). In the Indonesian context, traditional fishers still rely heavily on local knowledge passed down through generations to determine the timing and location of fishing activities (Ansaar, 2019; Arief *et al*., 2021). While this practice is culturally embedded, it contributes to uncertainty in catch outcomes and high operational costs. Limited access to weather monitoring and ocean condition technologies makes fishers vulnerable to climate variability, high waves, and unpredictable seasons. These conditions indicate an urgent need to enhance scientific literacy and the use of appropriate technologies among coastal communities, particularly in areas that have not been adequately reached by digital innovation.

Various studies emphasize that information and communication technologies hold strategic value for supporting the sustainability of fishers' livelihoods (Asirin & Argo, 2017; Verawati *et al*., 2025). Asirin & Argo (2017) show that the use of ICT enables fishers to obtain real-time information, expand socioeconomic networks, and strengthen livelihood resilience amid social and environmental changes. Research on traditional fishing communities highlights that the digitalization of catch recording improves data accuracy, enhances operational efficiency, and provides a stronger basis for decision-making (Pahlevi *et al*., 2025). Studies on the adoption of appropriate technologies in the fisheries sector also show that innovations such as renewable energy-based cooling systems can improve post-harvest quality and increase the productivity of small-scale fishers (Ansaar, 2019). These findings strengthen the argument that science and technology-based interventions can make a significant contribution to improving the well-being of coastal communities.

Similar challenges are found among the Argawana fishing community in Puloampel District, Banten Province. This region is part of the southern coastal area with considerable fishery potential, yet most fishers still operate by relying on intuition and traditional information. The limited use of marine monitoring technologies, whether in the form of weather applications, wave data, or digital catch-recording systems, has resulted in low fishing efficiency. Many fishers return with insufficient catch due to misjudging the departure time, misinterpreting weather conditions, or lacking historical data that could support strategic planning. Dependence on conventional methods often increases fuel consumption costs. These costs could be reduced using science-based and technology-supported information.

The fishing community in this area also faces challenges related to the low level of technological literacy. Most fishers are not familiar with using digital devices such as smartphones or internet-based applications that could help them monitor weather conditions, wind patterns, and ocean currents. This situation aligns with the findings of Wibowo *et al*., (2025), which show that many traditional fishers in Indonesia struggle to access technological innovations due to low digital literacy, limited facilities, and a lack of continuous assistance. These conditions cause fishing communities to fall further behind as the marine and fisheries sectors move toward digitalization.

Another challenge that emerges is the absence of a systematic mechanism for community-based ocean data recording. Information such as catch results, fishing locations, seasonal patterns, and weather conditions is typically not documented in a structured way. Studies on citizen science highlight that community participation in data collection can strengthen community resilience, enhance adaptive capacity to climate change, and provide a more accurate base of local ecological knowledge (Verawati *et al*., 2025). Involving fishers as both producers and users of data allows them to develop fishing patterns that are safer, more measurable, and more efficient.

Given these issues, it becomes clear that a community service intervention is needed to help Argawana fishers improve their capacity to utilize science and appropriate technologies. Programs must be designed to bridge technical needs with human resource development through training, mentoring, and hands-on demonstrations. Community service activities are highly relevant because they create a meeting point between academic knowledge and the practical needs of coastal communities. In line perspective on participatory approaches, collaboration between academics and communities enables two-way knowledge transfer that positions the community not only as recipients but also as key actors in the empowerment process.

Strengthening technological capacity in coastal sectors is crucial because empirical evidence shows that access to marine and meteorological information can reduce accident risks, enhance safety, and improve the efficiency of fishing operations. For example, the study by Asirin & Argo, (2017) indicates that information technology in determining fishing locations contributes to increased catch productivity and reduced operational costs. In the context of Argawana, technologies such as weather monitoring applications, wave detection instruments, and digital catch-recording systems have strong potential to improve fishers' welfare.

This community service program also aims to introduce the concept of citizen science to the fishing community. The approach encourages residents to actively participate in collecting marine data that can later be used for decision-making. Community participation as producers of knowledge has been shown to strengthen community-based natural resource governance, as explained by Aminudin (2020) in their study on the role of citizen science in environmental research. In other words, the program not only introduces technology but also provides opportunities for fishers to engage in scientific processes relevant to their daily lives.

The community service initiative is designed as a response to the real challenges faced by Argawana fishers, particularly their low scientific literacy and limited use of technology in fishing activities. Through training, mentoring, and the application of tools and data, the program aims to enable fishers to use science-based information to determine fishing times more accurately and safely. Another expected outcome is improved fuel efficiency and reduced risk of failed catch, which are common issues among traditional fishers. The program is also intended to support social transformation toward a fishing community that is more adaptive and modern in utilizing technology.

Based on the explanation above, the purpose of this community service program is to improve scientific literacy and the capacity to use appropriate technologies among Argawana fishers. The program aims to strengthen fishers' abilities to access and utilize marine data, enhance the efficiency and safety of fishing activities, and develop community participation as producers and users of knowledge through a citizen science approach. In addition, this initiative is directed at building a foundation for sustainable empowerment so that the fishing community can obtain long-term benefits from the technologies introduced.

METHOD

The implementation method for this community service program was designed to provide complete technical and procedural information so that the entire process can be replicated by readers. The activities were conducted from October to November 2025 in Argawana Village, Puloampel District, Serang Regency. The main partner in this program was the Komunitas Nelayan Argawana fishing community, which consists of 30 active fishers. The program was carried out using a co creation approach that positioned fishers not only as beneficiaries but also as active partners in planning, implementation, and evaluation. Co creation was chosen because this approach allows the integration of local fishing knowledge with academic knowledge, resulting in innovations that are relevant and sustainable.

The activity design was developed based on an initial needs assessment through field observations, informal conversations, and preliminary discussions with the leaders of the fishing group. Primary data were collected through short interviews on fishing patterns, weather reading habits, levels of technological literacy, and other operational challenges. Secondary data were obtained from village documents, the fishing group profile, past training reports, and literature on the use of appropriate technology for fishers. The tools used in the program included marine condition monitoring sensors, Android-based weather applications, field documentation equipment, and evaluation instruments in the form of pretest and posttest sheets.

The first stage was coordination with the Argawana Village Government, the Komunitas Nelayan Argawana leadership, and local community figures. Coordination was carried out to ensure alignment between the program and partner needs, to agree on technical procedures, and to build collective commitment. At this stage the team explained the principles of co creation and the importance of active fisher participation at each stage of the program. Several coordination meetings were conducted to ensure that all parties shared the same understanding of the plan and program objectives.

The second stage was a Focus Group Discussion or FGD that aimed to explore the experience and local knowledge of fishers related to wind patterns, ocean currents, fish seasons, and fishing strategies. The FGD was conducted using participatory methods to identify the most urgent technological needs, the level of readiness for innovation adoption, and potential barriers. Information from the FGD served as the basis for adjusting the equipment, training curriculum, and mentoring system so that they truly reflected the local context.

The third stage was technical training which included instruction on the use of marine monitoring technologies, weather applications, and digital recording of fishing catches. The training was conducted through interactive presentations, hands-on demonstrations, and direct field practice.

During this stage, installation of the marine monitoring equipment was carried out at a location agreed upon by the fishers. Members of Komunitas Nelayan Argawana were involved in the installation process so they could understand the function, mechanism, and maintenance of the equipment. This approach ensured that technology transfer was carried out comprehensively.

The fourth stage was monitoring and evaluation. Monitoring was conducted periodically to check equipment performance, the level of technology utilization by fishers, and any challenges that emerged during use. Evaluation was carried out using pretest and post test instruments to measure increases in participants' knowledge and understanding. Qualitative evaluation was also conducted through short interviews and observation of fishing behavior. In this stage the principle of co creation was reinforced because feedback from the fishers was used to improve the system, adjust the mentoring process, and ensure that the technology genuinely benefited the Komunitas Nelayan Argawana community.

RESULT AND DISCUSSION

General Overview of the Program Implementation

This community service program was implemented over a two-month period, from October to November 2025. This timeframe was selected to align with the local fishing season so that the activities would not interfere with the daily economic routines of the fishers. All stages of the program, including coordination, Focus Group Discussions, technical training, and monitoring and evaluation, were carried out gradually to ensure optimal knowledge transfer and sustain fisher participation. Each stage was designed to reflect the principle of co creation, which emphasizes direct collaboration between the academic team and the fishing community in identifying needs, developing solutions, and practicing the use of marine monitoring technologies that are relevant to the local context.

The program was conducted in Argawana Village, Puloampel District, Serang Regency, Banten Province. This village is a coastal area whose residents depend heavily on marine resources as their primary source of livelihood. Argawana is also an area with high potential for capture fisheries, yet it remains vulnerable to extreme weather, shifting ocean currents, and limited access to oceanographic information. These geographic conditions make Argawana an appropriate location for implementing co creation based marine monitoring technologies because the need for accurate information is closely linked to improving fishing safety and operational efficiency. The accessibility of the village also supported effective mentoring and ongoing monitoring by the academic team.

The main partner in this program was the Komunitas Nelayan Argawana fishing community, an active group consisting of 30 traditional fishers. This group was selected due to its strong social cohesion, well-structured leadership, and readiness to participate in technology-based capacity building initiatives. Komunitas Nelayan Argawana functions not only as a conventional fishing group but also as a collective space where members discuss issues, organize learning activities, and respond collaboratively to changes in coastal conditions. Their readiness and enthusiasm were key to the success of the co creation approach because the technological innovations introduced were shaped through dialogue and the direct experiences of the fishers as primary users.

Prior to the implementation of the program, the initial condition of the fishers indicated that their understanding of scientific knowledge, particularly related to marine monitoring technologies, was still very limited. Most fishers relied on generational experience to determine fishing times, interpret natural signs, and predict wave conditions. Weather and ocean current information was usually obtained informally from other fishers or online sources that were not always accurate or tailored to local needs. The initial assessment showed that most fishers had never used or operated digital marine monitoring devices. Overall technological literacy among the community was relatively low, especially in interpreting weather data, understanding current maps, and reading sensor based environmental information. These conditions formed an important foundation for designing a co creation-based program because the mentoring process needed to begin with strengthening the most basic levels of scientific literacy before advancing toward practical skills in using technology.

Coordination Stage and Co Creation Planning

The coordination stage served as the foundational phase of this community service program because the entire activity flow was formulated based on direct interaction between the academic team, village officials, and the fishing community. The initial meeting became an important moment for understanding the local context of Argawana Village and for exploring the stakeholders' early perspectives on the urgency of using marine monitoring technology. This coordination activity was not merely an opportunity for the academic team to deliver information. It also functioned as a two-way dialogue space to align perceptions regarding the objectives, benefits, and operational procedures of the co creation approach. At this stage, the involvement of Argawana Village officials demonstrated strong support for efforts to enhance fisher capacity through technological interventions. Meanwhile, the Komunitas Nelayan Argawana fishing group shared their empirical experiences related to ocean dynamics, common risks encountered at sea, and the need for more accurate weather and current information. The initial meeting provided an essential foundation for building trust, encouraging community openness, and ensuring that all parties understood their respective roles in the co creation process.

Figure 1. Coordination with Stakeholders and Partners

The figure above illustrates the process of identifying technological needs through a participatory approach that allowed fishers to be directly involved in determining the types of information, tools, and forms of assistance most relevant to them. In this session, the academic team began with an open discussion about the technical challenges fishers commonly face at sea, such as unexpected changes in wind direction, high waves, and uncertainty regarding fish locations. The fishers were then asked to describe their daily activities in detail, including how they read natural signs, decide on departure times, choose routes, and manage fuel. This approach enabled the academic team to understand the problems more comprehensively rather than viewing them solely from an academic perspective. Several key needs emerged from this identification process. First, the fishers required real-time information on weather conditions and wave height. Second, they needed more systematic knowledge on how to interpret ocean current maps. Third, they required easy-to-use monitoring tools with simple yet accurate data displays. Fourth, they needed training that was not limited to a single session but delivered repeatedly so that their skills could develop gradually. These findings became the basis for designing the technological components and technical training materials.

Reaching an agreement on the activity design was the next step to ensure alignment between partner needs and the mentoring plan of the academic team. At this stage, all parties were involved in determining the program phases, setting schedules, and distributing roles based on their respective capacities. The academic team was responsible for providing technological equipment, training modules, and experts who understood the scientific and technical aspects of marine monitoring. Village officials served as administrative facilitators and provided spaces for activities such as the FGD and technical training. Meanwhile, the Komunitas Nelayan Argawana fishing group played a role in organizing member attendance, supporting the field trials, and providing continuous feedback related to the use of the monitoring devices. During this agreement process, equity between the academic team and the fishers was maintained to prevent dominance by any single party. Co creation requires that innovation is not merely transferred from the university to the community, but rather built collaboratively through experience, local practice, and the ecological knowledge held by fishers. For this reason, the activity design agreement was not only administrative but also a crucial moment for ensuring that all parties felt a sense of ownership over the program.

Strengthening the commitment to co creation constituted the core of this coordination stage. This commitment was built through continuous communication, mutual understanding of limitations, and respect for differences in knowledge between academics and fishers. During the commitment-building session, the academic team emphasized that the program was not intended to replace the fishers' traditional knowledge but to reinforce it by integrating scientific and technological information. The fishers welcomed this approach because they recognized that changing ocean conditions in recent years could no longer be predicted solely through traditional methods. Instead, they needed additional tools to make fishing decisions more safely and efficiently. Village officials also expressed strong support because the program aligned with community needs and contributed to improving safety and economic resilience among fishing families. This strengthened commitment was formalized through jointly agreed schedules, follow-up planning, and the development of feedback mechanisms. These mechanisms ensured that all parties had space to provide regular evaluations, whether related to technical difficulties, additional needs, or aspects of mentoring that required improvement.

The coordination and co creation planning stages demonstrate that the success of this program depended not only on technological transfer but also on the social negotiation processes that took place throughout implementation. The active involvement of fishers, the support of village officials, and the facilitative role of the academic team created an inclusive and responsive framework tailored to the actual needs of the coastal community. Through the co creation approach, the marine monitoring technology introduced was not treated merely as an external product but became part of the fishers' daily practice developed through collaboration, shared experience, and equitable learning. This coordination stage thus became an essential social and institutional foundation for the sustainability of the technical training, tool application, monitoring, and evaluation in the subsequent phases of the program.

FGD and the Formation of the Data Management Team

The Focus Group Discussion stage was conducted as an essential part of refining the technological needs for marine monitoring that had been identified during the initial coordination phase. In this session, the academic team, village officials, and the Komunitas Nelayan Argawana fishing community participated actively in an open discussion to gather deeper information about fishing patterns, challenges encountered, and the risks that frequently arise during fishing activities. The FGD also functioned as a democratic space in which fishers could directly share their field experiences, while the academic team facilitated joint analysis. This approach was crucial within the co creation framework because it ensured that the technology developed would not be top down in nature but grounded in the actual needs experienced by the primary users. In addition, the FGD resulted in a strategic decision to establish a data management team from within the fishing community, which would independently operate, collect, and organize information from the marine monitoring device.

The main findings from the FGD indicated that the fishing patterns of Argawana fishers are influenced by two major factors, ecological conditions and economic pressures. Fishers typically depart in the early morning based on generational knowledge, such as observing wind direction, water color, and cloud movement. However, in recent years they have encountered shifts in wind and wave patterns that have become increasingly difficult to predict. This situation has heightened the risk of maritime accidents, particularly during the west monsoon season when high waves often appear suddenly. Another challenge identified was the lack of accurate information regarding fish presence, which led some fishers to incur losses after long trips that yielded disproportionately low catch results. The discussion also revealed technical risks such as engine damage caused by extreme weather and excessive fuel consumption when fishers were forced to alter routes abruptly. These findings reinforced the urgency of using marine monitoring technologies that provide real-time data on weather, waves, ocean currents, and other relevant conditions for improving fishing safety and efficiency.

Figure 2. FGD with fishers

The fishers' input regarding the features of the marine monitoring technology became one of the most important components of the FGD. The fishers emphasized that the device to be installed must be simple, easy to read, and should not require complex technical skills. They also expressed the need for clear visual displays, such as color indicators to mark levels of wave risk or wind speed. More experienced fishers suggested that the device should provide information on changes in surface current patterns at specific times, since these shifts strongly influence the location where fish tend to gather. Younger fishers highlighted the importance of a mobile device-based application that would allow them to access data both on land and at sea. Overall, the feedback illustrated that the fishers wanted technology that was relevant, uncomplicated, and understandable without requiring extensive technical training.

Based on this input, the process of agreeing on the device design was carried out using the principle of co creation. The academic team presented several technological alternatives that could be used, including wave sensor devices, weather data readers, and access to current maps from official oceanographic sources. The fishers were then asked to provide feedback on each alternative based on their field experiences. This approach positioned the empirical knowledge of the fishers as a primary source of understanding, ensuring that the device design did not merely adopt available technologies but was adapted to local practices and operational conditions. This agreement model reflects citizen science practices, in which community members are not only recipients of technology but also contributors of information and co designers in the decision-making process.

One of the most significant outcomes from the FGD was the formation of a data management team selected from members of the Komunitas Nelayan Argawana group. This team consisted of five representatives chosen based on their ability to read basic information, their fishing experience, and their commitment to being involved in the mentoring process. The data management team is responsible for operating the device regularly, collecting the data produced, and discussing data interpretation with the academic team during subsequent monitoring sessions. The establishment of this team is a strategic step to ensure program sustainability because it allows knowledge transfer to occur internally within the fishing community. In addition, the presence of the data management team strengthens the co creation model by creating a participatory structure that enables fishers to serve as key actors in producing scientific information beneficial to their own community.

Through this FGD, the co-creation approach was evident not only in discussion processes but also in decision-making, technology design, and the creation of a collective working structure. The entire process reinforces the idea that relevant marine monitoring technology must be constructed from the experiences, needs, and ecological knowledge of the fishers. The FGD ensured that their voices were fully integrated into the program design so that the resulting technology would not function merely as an additional tool but as an integral component of a safer, more productive, and data-driven fishing strategy. In this way, the FGD became a crucial point in building an equitable collaboration between academics and the coastal community and served as a foundation for the success of subsequent stages of the program.

Technical Training and Equipment Installation

The technical training stage was essential for ensuring that the fishers understood how the marine monitoring device worked and were able to operate it independently. The attendance rate during this stage demonstrated a high level of enthusiasm. Out of the 30 members of the Komunitas Nelayan Argawana group, 27 attended consistently across the two main training sessions. The remaining members participated in follow-up sessions facilitated by the academic team and the internal data management team. This high level of participation indicated the readiness of the partner community to adopt technological innovations relevant to their fishing activities. Village officials were also present to provide administrative support and ensure that the sessions ran smoothly. The strong attendance further reflected the success of the coordination phase in building a shared sense of ownership over the program.

A significant improvement in technical understanding was observed throughout the training. In the first session, most fishers were not familiar with reading indicators such as wind speed, wave height, or current direction displayed in simple graphical form. However, after participating in data interpretation exercises and simulated decision-making scenarios, their comprehension increased gradually. The academic team facilitated the learning process through a hands-on approach in which participants were asked to interpret daily weather data, predict ocean conditions, and discuss appropriate fishing decisions based on the information provided. This participatory approach made the fishers feel more confident in understanding technology that they had previously considered complex. In addition, the internal data management team formed during the FGD played an active role as an intermediary between participants and the academic team, contributing to more effective knowledge transfer.

Figure 3. Technical Training and Equipment Installation

The installation and testing of the equipment were carried out collaboratively between the academic team, technical support personnel, and the fishers. The installed devices included weather monitoring instruments, wave sensor modules, and access to sea water quality data from official platforms that had been integrated into a simple display system. Installation was conducted at two strategic points along the Argawana coastline based on fisher input regarding locations that were accessible and safe from potential damage. During the installation process, the fishers were directly involved, beginning with cable inspection, device connection, and ensuring that the equipment received a stable power supply. After installation was completed, a joint trial was conducted to ensure that the system functioned properly. The fishers were also invited to examine each indicator displayed on the screen and compare the data with the actual ocean conditions on that day. This field testing strengthened their understanding of the correlation between scientific data and the phenomena they observe directly during fishing activities.

Documentation of the co-creative process was an integral part of this stage because it demonstrated that the fishers were not only users of technology but also producers of knowledge. During the technical training and installation process, the academic team documented interactions, corrections, and ideas contributed by the fishers. Some fishers provided input regarding sensor placement to ensure better protection from large waves, while others suggested adding a reminder feature for fishing times based on afternoon wind shifts. These notes were later incorporated into adjustments to the training modules and user manuals. The documentation also highlighted how members of the data management team began practicing their new roles as information operators, including reading sensor outputs and discussing the data with fellow fishers. This showed that the co creation process was taking place in practice, not only during the planning stage, but also during technical implementation in the field.


Figure 4. Pre and Post Test Administration

After the training and technical guidance were completed, a post-test was conducted to measure changes in the fishers' technical and scientific understanding. The post-test results showed a very significant improvement, with the average score reaching 87 percent. Most participants were able to answer questions related to reading wave indicators, wind speed, and interpreting ocean current data. The fishers also demonstrated improved ability to simulate fishing decisions based on the data provided. In addition, members of the data management team achieved the highest scores because they received additional in-depth sessions and played an active role during the installation and testing of the equipment.

Table 1. Pre-Test and Post-Test Results of Fishermen's Understanding

No.	Assessment Aspect	Pre-Test (%)	Post-Test (%)	Increase (%)
1	Basic understanding of climate and weather changes (questions 1, 3, 5)	40	86	+46
2	Knowledge of weather instruments and water quality (questions 2, 4, 6, 7, 8, 9, 10)	38	88	+50
3	Understanding of local wisdom concepts and data integration (questions 11, 12, 13, 14)	45	90	+45
4	Understanding the benefits of data for fishing decision-making (question 15)	50	92	+42
Overall Average		**42**	**87**	**+45**

The table above shows significant improvement across all aspects of the fishers' understanding after participating in the technical training and demonstrations of the marine monitoring device. Basic understanding of climate and weather changes increased from 40 percent to 86 percent. Participants demonstrated better ability to recognize signs of extreme weather, the relationship between wind direction and wave formation, and its implications for fishing safety. Knowledge of weather instruments and water quality showed the highest increase, rising from 38 percent to 88 percent. This improvement was driven by hands-on practice using wave sensors, refractometers, and digital weather indicators during the training sessions. Understanding of scientific data integration with local wisdom also increased substantially from 45 percent to 90 percent. This indicates the effectiveness of the co creation approach in aligning fishers' local experience with scientific information to support decision-making. Understanding the benefits of data for coastal management rose from 50 percent to 92 percent. Fishers are now able to explain how daily information can support fishing planning, safety, and village coastal management. Overall, there was an average improvement of 45 percent, demonstrating that the technical guidance, practical exercises, and active involvement of the data management team successfully strengthened the scientific literacy of the Komunitas Nelayan Argawana fishing community.

Monitoring and Evaluation

Field monitoring was conducted during the initial period of using the marine monitoring device that had been installed together with the Komunitas Nelayan Argawana fishers. The monitoring aimed to assess the extent to which the technology was used in daily practice and to understand changes in the fishers decision-making patterns after acquiring the ability to read scientific data. The results showed that fishers began integrating weather and wave monitoring data into their activities, although intensive assistance from the internal data management team was still required during the early stages of use. Overall, the monitoring indicated that the technology was not only understood conceptually but was gradually becoming part of the community's daily work routine.

How the fishers used the data generated by the device demonstrated positive development. Before the intervention, most fishers determined their departure time based on inherited practices such as observing cloud direction, water color, and wind felt directly in the field. After entering the post installation phase, they began checking wind speed, wave height, and current conditions before deciding to depart. The data management team, consisting of five trained fishers, played an important role in helping their peers access and interpret daily data. They routinely downloaded, recorded, and displayed key information on the group information board. This helped fishers who were less familiar with digital tools to still understand the actual sea conditions. Data use among fishers became more consistent in the following weeks, especially when weather conditions were unstable.

The effectiveness of the device in supporting fishing decisions was evident from the decline in sudden trip cancellations due to weather changes. Based on the monitoring, fishers who previously returned early because of high waves became more selective in choosing departure times. When the data indicated increased wind speed or a potential rise in wave height, fishers opted to delay departure or shift to a safer route. They reported that data-based decisions helped reduce fuel losses and provided a greater sense of safety. In addition, field tests showed that the data displayed by the device were reasonably accurate and aligned with the actual conditions they encountered at sea. This effectiveness was also reflected in the increased internal discussions among fishers about current patterns, wind direction, and daily weather conditions, topics that were rarely discussed systematically before the intervention.

Monitoring also identified several technical challenges during the initial utilization period. The main challenge was connectivity disruptions during bad weather, which caused slower data access. In addition, some fishers had difficulty reading the current pattern graphs during the early stages. During monitoring sessions, the academic team provided improved visual guides to facilitate easier data interpretation. The partners responded positively to these challenges, promptly reporting issues and willingly participating in technical adjustments. The data management group played an active role as the communication bridge between the fishers and the academic team, allowing issues to be resolved quickly.

Key lessons from the mentoring process show that the successful use of technology relies heavily on the active involvement of fishers in understanding, managing, and utilizing the data. This process strengthened the co creation model, as fishers were not only end users but also managers of information relevant to their safety at sea. Monitoring revealed that empowering the data management team was essential for ensuring the sustainability of device use. Furthermore, fishers acknowledged that scientific data did not replace their local wisdom but rather complemented and enhanced their decision-making at sea. This integration became a key lesson, demonstrating that strengthening scientific literacy can be effective when combined with the ecological knowledge long possessed by coastal communities.

Discussion

The results of the community engagement program in Argawana Village show that the co creation approach played a highly influential role in the success of efforts to strengthen scientific literacy and promote the use of marine monitoring technology among fishers. Co creation enabled a collaborative working relationship between the academic team, village authorities, and the “Komunitas Nelayan Argawana” fisher community. As a result, every stage of the program, from planning to evaluation, reflected local knowledge, actual needs, and the technical capacities of the direct beneficiaries. This approach did not create a one-way transfer of knowledge but involved fishers as actors with rich ecological experience and as equal partners in the learning process.

Findings from the coordination stage indicate that co creation fostered a sense of shared ownership of the program. Fishers were involved from the beginning in identifying technological needs, understanding the benefits of the intervention, and providing input on the structure of activities. This is in line with the principles of community empowerment, which emphasize that participation from the stage of identifying problems to the stage of implementation has a direct impact on program success. The formation of the internal data management team within the community shows that co creation did not stop at conceptual discussions but was translated into an operational structure that strengthened community self-reliance.

The results of the FGD show how co creation transformed fishers from passive users into producers of knowledge. Fishers not only shared feedback on the desired features of the marine monitoring device but also contributed empirical experiences related to currents, weather signs, and fishing risks. These experiences became the basis for designing the technology that was used. Their input enriched the device design, so it became relevant to local conditions and easy to understand. This process illustrates that technological innovation becomes more effective when it is built through the integration of scientific knowledge and local experience rather than through a top-down approach.

The implementation of technical training shows that co creation effectively improved the fishers' technical skills. Hands-on practice allowed fishers to learn how to read weather indicators, interpret wave and current data, and use this information for decision-making at sea. The increase in post test scores from 42 percent to 87 percent shows that the learning method used was effective in increasing knowledge. This also demonstrates that technology does not replace local knowledge but strengthens it by providing a more consistent scientific foundation for decision-making.

During the installation and testing phase, the involvement of fishers shows how co creation supported deeper technology transfer. Fishers took part in technical processes such as installation, connection checks, and data verification. This involvement increased their technical understanding and built confidence in their ability to operate the device and interpret data independently. This approach helps prevent dependency on external actors and supports long term sustainability of the technology.

Field monitoring shows that fishers have begun to integrate weather and wave data into their fishing activities. These findings support the program impacts, particularly the first impact which is the growing familiarity and use of scientific tools in daily fishing activities. The use of scientific data before departure shows that the internalization of technology is progressing. Fishers are no longer relying solely on intuition but are combining it with more accurate scientific information. This shift indicates a transformation of knowledge within the community. The second impact, which is the improved ability to determine safer and more accurate departure times, can be seen from the decrease in sudden trip cancellations and the increase in internal discussions among fishers about daily weather conditions. Real time data helps reduce the risk of encountering sudden high waves and allows for more measured departure decisions. Fishers also report feeling safer because their decisions are now based on data instead of relying only on natural signs.

The third impact relates to the reduced risk of failed catches and improved fuel efficiency. Information on currents and wind speed allows fishers to choose the right departure time and avoid unnecessary detours. This efficiency directly reduces operational costs and increases the effectiveness of fishing trips. The fourth impact relates to the enhanced role of fishers as citizen scientists, which is visible in the work of the data management team that operates the device, records daily data, and interprets the information for collective use. They serve as knowledge centers within the community and as connectors between scientific data and local experience. This transformation shows that co creation is not only improving technical skills but also building new knowledge structures within the community. The fifth impact relates to the strengthening of the collective capacity of the "Komunitas Nelayan Argawana" community. The entire process shows that the program does not only improve individual abilities but also reinforces social cohesion through collaboration in data interpretation, discussions on fishing risks, and shared decision-making. Stronger collective capacity becomes an important form of social capital that supports the sustainability of the program.

CONCLUSION AND RECOMMENDATION

The community engagement program in Argawana Village demonstrates that the co creation approach is effective in improving scientific literacy, technical capability, and the practical use of marine monitoring technology among the “Komunitas Nelayan Argawana” fisher community. Through stages of coordination, FGD, technical training, equipment installation, and monitoring, the program successfully built an equal and collaborative partnership between the academic team, village authorities, and fishers, resulting in solutions that align with local needs. The pretest and post test results indicate a significant increase in participants’ understanding, while field monitoring shows that fishers have begun integrating scientific data into their decisions regarding fishing time and route selection in a safer and more efficient manner. The early impacts of the program include an increased ability to utilize scientific tools, reduced risk of failed catches, improved fuel efficiency, and the emergence of fishers as citizen scientists who can independently manage and interpret marine data. Overall, the program enhances not only individual capacity but also the collective capacity of the fisher community, supporting the self-reliance of coastal groups in responding to environmental dynamics and fishing risks.

The success of this program indicates the need for ongoing mentoring to ensure that the use of marine monitoring technology remains consistent and adaptable to changing coastal conditions. It is therefore recommended that the fisher data management team receive further training in weather data analysis, device maintenance, and the development of a more structured recording system to strengthen their technical capacity. The village government and related institutions are also encouraged to support this initiative by providing necessary facilities, integrating marine data into village planning, and establishing partnerships with oceanographic and meteorological agencies. In addition, the program should be expanded to other fisher groups in the Puloampel area so that its positive impacts can be more widely felt and contribute to strengthening coastal economic resilience based on science and technology. With multi stakeholder support and continuous learning, the use of co creation-based technology can serve as a sustainable empowerment model for coastal communities.

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