SIGAP: Seaweed Harvesting Tool Innovation to Increase Harvest Efficiency in Pa'Jukukang Village, Regency of Bantaeng

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ABSTRACT

The location of Pa'jukukang Village, Bantaeng Regency, is a coastal region where many of its residents rely on seaweed cultivation and harvesting for their livelihoods. Preliminary findings suggest that the harvesting procedure is still primarily manual; particularly when removing the seaweed from the ropes. Additionally, the presence of shells attached to the ropes is an additional barrier that could delay the harvesting procedure and add to the resident's workload. This Community Service project intends to provide the residents with SIGAP (Innovative Solutions for Harvesting Tools), a tool developed to help facilitate the removal of seaweed and cleaning of shells from the ropes. On September 12, 2026, the activity took place utilizing a Service-Learning method through the phases of observation, tool development and design, demonstration, practical application and evaluation. Results indicate that SIGAP may serve as an alternate means to harvest seaweed which was formerly completed manually. Residents indicated positive feedback concerning the utilization of SIGAP since it was perceived to improve the efficiency of removing seaweed and lessen direct skin contact with the rope containing shells. Residents provided comments on the size or shape of the tool as part of the evaluation process for improving the design.

Therefore, SIGAP has the capability of being refined into a simplistic technology innovation that supports a more convenient seaweed harvesting process that is suitable for use in the field.

1. Introduction

Seaweed is a very popular commodity to grow in coastal regions. It has an important economic impact on communities that depend on aquaculture as a source of income (Oratmangun et al., 2026). Growing seaweed is a multi-step process. First there is the growing and maintaining stage, then comes the harvesting stage. Harvesting is one of the most important stages because this is where the seaweed is collected so that it can be processed into a usable form. Harvesting is typically a long and tedious process. Specifically, when removing the seaweed from the cultivation lines. Because of how long and hard it is to harvest, it would help if there were ways to make the harvesting process easier and faster for people who are growing seaweed. Making the harvesting process easier will allow people to complete their daily tasks quicker and better fit the needs of what is actually happening in the field (Syafriadi et al., 2026).

Pa'jukukang Village, a coastal community located in Bantaeng Regency, has many natural resources available to its residents. Many of these resources are being developed for use in the local economy. One of the ways that residents are developing these resources is through seaweed farming. Seaweed farming provides an important source of income for coastal residents. Seaweed farming not only provides an important source of income for residents, but it also has the potential to provide even greater opportunities for residents through better and more environmentally sustainable forms of business operations (Adnan & Riza, 2023). Seaweed farming is divided into three main stages. Harvesting is one of those stages. Harvesting is the most important stage because it will determine the amount of seaweed that is produced. Harvesting also determines how much labor is needed to produce the seaweed. Finally, harvesting determines the type of economic activity that takes place among the people who are involved in the farming of the seaweed.

The harvesting phase in seaweed cultivation includes the actual gathering of the cultivated produce as well as removing the seaweed from the ropes utilized during the cultivation phase. According to initial findings made by students involved in the KKN 79 program at UIN Alauddin Makassar while conducting field research in Pa'jukukang Village, manual harvesting remains a predominant method for harvesting seaweed; this relies heavily on manual labor. Based upon the student's preliminary findings, it appears that the local community does not currently utilize any specialized machinery to assist in the harvesting process. Manual harvesting methods have been developed as part of the local community's cultivation practices, however, the removal of the seaweed from the cultivation ropes can be extremely labor intensive and require a great deal of time, especially with larger harvests.

The second major problem with manual harvesting is related to the attachment of shellfish and other organisms to the cultivation lines. Because these organisms remain attached to the cultivation lines while manual harvesting is taking place, they cannot be removed (cleaned) at

the same time as the harvest is collected. Therefore, the community must carry out a separate, manual cleaning operationcan extra step in addition to the harvesting operation which increases the amount of labor needed and the length of time needed to complete the harvest. A clear example of why there is a need to create a simple device that will allow for simultaneous removal of the cultivation line and cleaning of the cultivation line of any attached organisms, so that the harvesting operation will become more productive and efficient.

Based upon the problems found in the harvesting phase, the KKN 79 student group of UIN Alauddin Makassar created an innovative solution based on the local condition and needs of the community. SIGAP (Solutif Inovatif Guna Alat Panen/Innovative, Solution-Oriented Harvesting Tool) was developed to aid in the harvesting of seaweed; it reduces the dependence of manual labor. SIGAP has two main purposes, which are: to separate the seaweed from the cultivation line and to remove the organisms that attach to the cultivation line. Since both purposes can be achieved through SIGAP, the number of manual labor steps will decrease, allowing for a more efficient and convenient harvesting process. SIGAP is an example of the use of a simple, need-driven innovation to help support seaweed cultivation efforts in coastal regions.

In developing technology for use by communities, we should be aware of how the attributes of the technology match up with what people are looking for. We want to develop technology which can easily be used and which will last over time. When we think of developing technology to empower communities, it is not just about bringing in new machines. It is about bringing solutions to the everyday problems that communities have in their day-to-day lives (Zuhairi, 2025). Therefore, the development of SIGAP (Innovative Solution Using Practical Harvesting Tools) aims at developing technology which is simple, yet useful, and fits into the context of the user. The innovation of SIGAP was developed specifically for the seaweed farmers of Pa'jukukang Village. SIGAP was developed to help farmers harvest and clean their cultivation lines. By doing so, SIGAP would provide direct benefit to the actual situation on the ground.

What makes this program unique is that we have developed a simple harvest tool that does more than just help detach seaweed; it also helps clean the lines used for cultivating seaweed by removing shellfish that are attached to them - both tasks can be completed in one simple step. In addition to creating the physical tool, we use a participatory model to demonstrate how the tool works and allow seaweed farmers to try using it during hands-on training workshops. We believe that involving the community in both the introduction and use of the tool will increase their understanding of the tool's function and use, as well as lead to long term adoption and use of the tool as part of their day-to-day seaweed cultivation practices.

The community service project implemented via the SIGAP program will be implemented to create and introduce a novel seaweed harvesting tool. The seaweed harvesting tool has been developed to enable both the removal of harvested seaweed and the cleaning of the seaweed growing line from mollusks. The utilization of the seaweed harvesting tool is anticipated to assist the community of Pa’jukukang Village in simplifying their harvesting operations, allowing for less manual labor during harvesting, and enabling them to carry out the harvesting operation in a more efficient and effective manner. In addition, the SIGAP program

is a product of the KKN 79 cohort of UIN Alauddin Makassar students and represents a way for these students to utilize simple, needs-driven technology as well as establish a continued use of the technology beyond the end of the KKN program.

2. Method

A community service project has been implemented under the SIGAP (Solutive and Innovative Approaches for Harvesting Tools) program. On September 12th, 2026, the project was carried out in Pa'jukukang Village, Bantaeng Regency, South Sulawesi Province. The project focused on providing support to community members who are involved with seaweed cultivation and harvesting. The project was carried out by students of the 79th cohort of the Community Service Program (KKN) of UIN Alauddin Makassar. This community service program is designed to allow the students to use their knowledge and skills to provide services to the communities based upon what they identify as being needed.

The activity uses a service-learning model that combines the student learning experience with directly working on community problems (Sasmitasari et al., 2026). The model allows students to identify problems first hand and then use their knowledge and skills to create solutions that meet the specific requirements of the community (Khasanah et al., 2025). The model has been implemented in the SIGAP program through a series of stages: problem identification, tool design/development, tool implementation/practice in collaboration with the community, and evaluation of the results of using the tools.

The implementation of the SIGAP program has been conducted through several phases. The first phase consisted of conducting a direct observational study of the daily activities of the community members when they were involved in harvesting seaweed. The purpose of this study was to obtain a realistic picture of the condition of seaweed harvesting practices and to identify the problems that the community members experienced in the field. From the observations, it was determined that the process of removing seaweed from the growing line is still done manually using their hands. In addition, it was observed that shellfish often attach themselves to the growing line, thereby making the harvesting process more difficult and increasing the amount of work required of the community members. It is based on these findings that we can determine what type of harvesting equipment would be most appropriate for the community members in Pa'jukukang Village, as long as such equipment is simple, easy to use, and compatible with the characteristics and working conditions of the community members.

The next step is to plan and develop SIGAP, using what we learned about the problems in the previous phase. In this step, the students created a product that will help take off seaweed from the growing lines and remove any shell fish that may be growing on the ropes. Students developed the product so that it has a very simple form and operation so that the people who use the product can do it themselves. Students have also taken into consideration how easy it is to use the product, as well as whether or not the product is appropriate for the types of conditions and needs of those harvesting in the fields. After students finished creating the product, they prepared to introduce, test, and implement SIGAP directly with the community.

The subsequent phase of the program included the orientation, demonstration, and hands-on usage of SIGAP by the people of Pa'jukukang Village. In addition to providing information

about SIGAP's functions and advantages in assisting the process of seaweed harvesting, the students also demonstrated the operation of SIGAP on the growing lines. Community members then had the chance to physically interact with SIGAP while being guided by the students. The purpose of this activity was to educate the community about SIGAP and give them direct experience in using the device. As part of their role, the students monitored each user's experience and the reactions of the community, and these data will form the basis for evaluating the successfulness of SIGAP in actual use.

The last part of the process will be assessing how the program has been implemented, and what can be done to ensure its longevity. The assessment will provide us with feedback about the community's reaction to the functionality, benefits, and ease of use of the SIGAP tool. It will also help us determine if there are areas where we need to make modifications to the design of the tool. Data for the assessment will come from observations, interviews, and documentation collected while the tool is being used in practice. Feedback from the community especially about the physical characteristics of the tool will help us refine the tool so that it is more suitable for use in the environment in which it will be used.

The long-term sustainability of this project is to allow the use of SIGAP to take place independently after the KKN has ended. At that point, the community will have to maintain and repair the equipment themselves, based on their use of the equipment in the field. Design improvements may occur over time through a process of incremental design based upon what works best for users, while also meeting the needs of the community; thus enabling the application of SIGAP to grow as the users' situation changes.

3. Results and Discussion

Initial observations in Pa'jukukang Village showed that the majority of seaweed harvesting was being done manually. The community was removing the seaweed from the cultivation lines with their hands. These findings suggest that before SIGAP was introduced, there were no specialized equipment for harvesting seaweed. While manual harvesting can require a lot of energy and time if it is done many times over especially if the harvest being worked on is large, it is possible to use manual harvesting as well.



Figure 1. Harvesting Process and SIGAP Initial Stage

In addition to the difficulties associated with removing the seaweed from the cultivation lines, early findings indicated there were problems with shellfish attaching themselves to the lines. Shellfish are often present on lines that have been used for a long time. This adds another layer of complexity to harvesting, as farmers will have to remove both the seaweed and any

attached shellfish from the cultivation lines. Since the entire operation remains manual, it will be more complicated and require more man power and time to finish.

In addition to being confirmed through interviews with local residents, these results indicate that the presence of shellfish growing on the cultivation lines makes the seaweed harvesting process more difficult. The residents stated that when the cultivation lines have been in use for approximately two months, there will be a larger quantity of shellfish on the ropes, making it harder to harvest. Because of this, a tool such as SIGAP may help make the residents' work easier. Therefore, the resident interview results also support the finding that the observations made in the field correlate with the experiences of those who participate in the seaweed harvesting activity.

Prior to the use of SIGAP, residents of Pa'jukukang Village reported that the entire process of harvesting seaweed was completed manually. However, after the implementation of SIGAP, the community has found a new way to complete their harvesting activities. In particular, residents can now use SIGAP to detach seaweed from the cultivation lines. As a result, residents are less reliant on manual labor to perform their harvesting activities. Therefore, SIGAP has made the harvesting process more efficient and effective than it was when residents were required to complete all harvesting activities manually.

The problems observed in the observation stage were used to create SIGAP, a device developed to assist with harvesting seaweed. SIGAP was designed to meet the requirements of harvesting operations and the working environment at Pa'jukukang Village. SIGAP has a simple structure, with a handle on one end and a special shape on the other that makes it easy to separate seaweed from the growing line. The special shape includes a U-shaped opening that allows the user to pull and release seaweed attached to the growing line. In addition, the design of SIGAP allows users to use the same tool to remove shellfish that are attached to the growing line, enabling them to complete both harvesting functions using only one piece of equipment.

The development process for SIGAP is based on systematically combining each component of the device, ultimately creating a finished product that can be utilized to harvest seaweed. The device's physical design both its shape and size have been created so as to make it easier to operate; additionally, the design has been modified according to the current characteristics of the cultivation lines (Ropes) used within the local community. After all of the components have been combined together, every single component of the device will then be examined to determine whether or not it functions properly and whether or not all components are working together as they were designed to do so. This examination stage will serve as the last preparatory step prior to utilizing the device for actual harvesting operations.

SIGAP was created after both the design and development phases. SIGAP is a harvesting tool that has two main uses; first, it can help take off seaweeds from the cultivation line, second, it can remove the shellfishes that are growing on the cultivation line. This combination of the two functions is one of the most innovative features of SIGAP. The reason for this innovation is because SIGAP is intended to assist users during the different phases of the harvesting operation with only one simple and easy-to-use device. Therefore, the use of SIGAP should help the community perform the harvesting operations in a more efficient manner, based upon each user's individual requirements and the actual situation at the site.

The implementation of SIGAP included three main components: (1) introduction to SIGAP; (2) demonstration of using SIGAP; (3) hands-on practice in utilizing SIGAP. First, the activity started with the explanation of the functions, operation mechanisms, and procedures for using SIGAP. Then, the students demonstrated how to use the tool in a tensioned line as if they would do it during the harvest. Next, the community members had the opportunity to practice using SIGAP themselves under the guidance of the students. The objective of the hands-on practice component was to allow the community members to know more about the operation mechanisms of SIGAP, and provide them with firsthand experience of operating SIGAP, as well as collect feedback from their experience of operating SIGAP for seaweed harvesting.

The findings of the implementation demonstrate that SIGAP is a novel approach to addressing the needs of the community in Pa'jukukang Village. Before the development of SIGAP, the process of removing seaweed from cultivation lines involved manual labor using one's hands. SIGAP provides another option for harvesting, through providing a means to facilitate the removal of seaweed and assist with the removal of shellfish which are attached to the cultivation lines. Therefore, SIGAP was developed as a direct response to the problems and requirements of the community related to their seaweed harvesting practices.

Local people have given SIGAP a positive reaction in Pa'jukukang Village. According to residents of Pa'jukukang, SIGAP makes the harvesting process easier; specifically by reducing the need for hand contact with the rope that holds the shellfish. This is seen as a major advantage, since direct hand contact with shellfish during the harvesting process can result in injuries to the hands. Therefore, the use of SIGAP provides another option for removing seaweed from the ropes while also reducing hand contact with the parts of the rope that contain shellfish.

Beyond reducing direct manual contact, the community is also aware that using SIGAP may reduce the amount of labor required for harvesting. One resident stated that manually harvesting requires four to five individuals while using SIGAP only requires one person to pull the machine through the water. The findings show that the community views SIGAP as a way to make work easier and require less manual labor in harvesting seaweed. The feedback received from the community shows how well SIGAP meets the requirements and problems associated with the collection of seaweed. This evaluation has been made, both as to the physical properties of the tool and as to what was observed in the community while using it. The results of the evaluation indicate that the initial adoption of SIGAP reflects an attitude in the community to accept simple technologies developed according to their specific needs particularly, to help with the process of collecting seaweed.

The community responded positively to using SIGAP; however, they also provided feedback about how well it is designed and how easy it is to use. From the comments made by residents in the area, there are some improvements that can be made to SIGAP to make it more appropriate for actual operating conditions. Residents suggested that the top of SIGAP should be widened and the bottom modified so that it will not get damaged if people step on it when using it. Residents also recommended that the openings in SIGAP should be made larger so that users would have more space to move around while they were using it, which would help improve their level of comfort while using SIGAP.

The feedback provided by the community on the implementation of SIGAP indicates that SIGAP is not simply a matter of introducing the tool and having people use it; rather, it is also a matter of evaluating the implementation of the tool through user experiences. In addition to being used as a way to identify areas of the tool which could be improved upon, the community's experiences with using and observing the tool will serve as a basis for further refinements to SIGAP. As such, the development of SIGAP can be directed toward meeting the needs of the community and the real-world situations they face when engaged in seaweed harvesting activities, through their involvement in the evaluation process.

Community assessment indicates that when we introduce basic technology, we need some time to adapt to our users' situation and how they work. To perform its intended job of addressing specific issues, a tool must also be easy to use, provide comfort for the user, and fit into the user's field condition. Therefore, feedback from the community will play an important role in developing SIGAP, so that the characteristics of SIGAP are developed to meet the requirements of the community.



Figure 2. Community Service Program Documentation

The uniqueness of SIGAP comes from the combination of two different purposes in one easy to use device; it helps users remove seaweed from cultivation lines and simultaneously removes shellfish that may be growing on these lines. This new technology was created as a result of the identification of problems that occur in real-life situations where people are trying to harvest products such as seaweed and shellfish. Therefore, the purpose of SIGAP is to help users address their needs when they are harvesting. In addition to creating the device, the use of SIGAP involves the participation of the user community in a variety of ways including demonstrating how to use the device, giving users opportunities to physically operate the device, and allowing users to be involved in the process of introducing the new technology to them.

The result of the application showed that Sigap provides alternatives to communities in conducting seaweed harvest activity. Positive responses from the community, as well as multiple types of feedback received from them, will be used as a source for evaluating the product during the next development stage. Adjustments to the design based upon user

feedback and need are necessary to bring Sigap closer to the realities of the workplace so that it can function more efficiently and effectively.

The continued use of SIGAP after the completion of the service project will ensure that this program is sustainable. Maintenance of equipment and repairs to damaged parts should occur regularly as needed as a result of both equipment condition and the practical experience gained in the field. Design improvements should focus on meet-ing user needs that have been identified throughout the implementation process. Finally, additional testing with indicators such as harvesting time, required labor force, and ease of operations is required to provide empirical data supporting the effectiveness and value of SIGAP in assisting seaweed harvesters.

4. Conclusion

The "Solutive and Innovative Seaweed Harvesting Tool" (SIGAP) was created by the community of Pa'jukukang Village, Bantaeng Regency, as an alternative way to harvest seaweed. The tool was developed as a result of the difficulties the local fishermen faced while working on their boats. The SIGAP tool is designed as a single tool that can be used for two different purposes; one is to assist in the removal of seaweed from the growing lines and the other is to remove any shellfish that may have grown on the lines. When using SIGAP, there is a multi-step process that includes introducing the tool to the community, demonstrating how it works, and allowing the community members to operate it themselves so they will be able to both understand and apply the knowledge they have gained through using the tool.

The results of this study show that SIGAP is a good alternative to manual methods of harvesting. The community's response to the tool has been positive, especially since the tool makes it easier to remove the seaweed from the ropes and also reduces direct contact with ropes which may contain shellfish. Community comments about the size, shape, and opening dimensions of the tool provide feedback to help evaluate how well the tool fits in the environment where it will be used.

The program's sustainability is focused on allowing communities to independently utilize and develop SIGAP. Regular updates to the design and maintenance of the equipment will need to occur, based upon experiences of users and their requirements. In addition to these updates, more tests using quantifiable measures like harvest times, labor requirements, and how easy it is to operate the equipment should take place to gather more objective data supporting the efficacy of SIGAP in assisting with seaweed harvesting.

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