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Coastal Community Empowerment: Recovery of cockle shell waste into eco-friendly artificial reefs in Mutiara Beach Trenggalek Indonesia

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ABSTRACT The community empowerment activity is conducted in the form of training of trainers (ToT) and mentoring for the community of Mutiara Beach, Trenggalek, East Java. Trenggalek Regency has regional dominance of mountains and hills is located in the southern part of East Java Province. The improvement of facilities at Mutiara Beach is increasingly being improved in line with one hundred tourist programs. The marine environment must be maintained to remain sustainable and can support tourism, one of which is by maintaining conservation of coral reefs. The existing condition of coral reef was stressed and needs to be restored. The problems to be solved, currently, community groups, Pokmakwas are only sinking the artificial reefs, while coral reef conservation is needed not only by the government but also by the community itself. This community also do not have the knowledge and experience making artificial reefs by utilizing the garbage around the beach. Cockle shells are still not managed optimally in the coastal. In contrast, cockle shells have the potential as filler material and material on the surface of artificial reefs. Artificial reefs can also be made of concrete mixed with cockle shells that have not been used so far. The concept of processing cockle shell waste emerged by reusing it as a mixture of material and as a roughage material for artificial reefs. The purpose of community empowerment is to give training for local community as a trainer for sustainability transfer knowledge. Method to achieve the goal using socialization, giving brief explanation and directly handson practice. Artificial reef has been manufactured from TOT, analyzed to compare with criteria design in order to decide the success of TOT has been achieved. TOT resulting trainers from Pokmaswas as a leader to produce artificial reef with local community. The trainers were success to manage local community with resulting seven artificial reefs with their creativity. Local community was able to identify alternative material in order to change cockle shell with coral flakes carried by tide sea. The result of the TOT activity was that one artificial reef produced that complied with the design criteria as described during the training. TOT participants, Pokmaswas, can invite communities around the coast to produce seven artificial reefs that are also in accordance with the design criteria and ready to be drowned. Pokmaswas can be agents of change to initiate and protect the coral reef ecosystem as well as manage cockle shells in Mutiara Beach.

INDEX TERMS Cockle, hands-on practice, reef, tide.

I. INTRODUCTION

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Seratus desa wisata (Sadewa), the Hundred Tourism Villages Program was officially launched by Trenggalek Regent Mochamad Nur Arifin on December 15, 2021, in the Regional Cultural Arts Degree event. Sadewa is one of the steps to accelerate economic recovery in Trenggalek to achieve the target of 2024, there are 100 tourist villages established according to the Rencana Pembangunan Jangka Menengah Daerah (RPJMD), Medium Term Infrastructure Program Plan target. The concept of Sadewa is based on local wisdom and carries nature tourism, local art, culture, and stories as excerpts of local history. A tourism village is an instrument that will be used by the district government in leveraging the regional economy during the pandemic Covid-19. In line with the Regent, in the art and cultural attraction "Senandung Ngerit" on December 21, 2021, the Head of the Tourism and Culture Office Sunyoto conveyed the need to build cooperation and facilitation of community arts, and artist development as well as arts and cultural organizations.

This attraction is the first step in the commitment to develop the potential of a tourist village. Besides developing the entire potential of the village, the community is also aware of the importance of protecting the environment.

At the same event, the Acting Regional Secretary, Anik Suwarni also encouraged village managers to seek to present a variety of village potential, ranging from art, local culture, and beautiful natural panorama.

Trenggalek Regency is located in the southern part of East Java Province which has regional dominance of mountains and hills in the coastal area of Java Island which is directly adjacent to the ocean Indonesia. Geographically, the coastal area of Trenggalek Regency has considerable potential significant to be developed from the fisheries, marine, and tourism sectors. This is stated in Medium Term Infrastructure Program Plan (RPIJM) in the field of copyright for 2016-2020. Mutiara beach is one of the beaches in Trenggalek, located in the village of Tasikmadu, Watulimo District.

As reported from the Trenggalek news online media on December 29, 2021, Tasikmadu Village is one of 35 villages that are included in 100 tourist villages in 2021. Based on the explanation of the Trenggalek Regent compiled in Republika.co.id on September 8, 2019, Mutiara beach is one of the beaches which is very suitable for running paddle sports and tourist activities. It needed to be efforts to keep the marine ecosystem at Mutiara Beach in balance by supporting healthy coral reef conditions.

Coral reef ecosystems have many roles, both ecologically and socially economy. From an ecological point of view, coral reefs are a habitat for many marine biotas is a source of biodiversity. In addition, coral reefs are spawning grounds, a place to find food, and shelter for fish. Healthy reef conditions can increase fishery productivity. Coral reefs produce various kinds of compounds that are important for supplements and medicines, especially from the associated benthos biota. Coral reefs protect the coast from the threat of abrasion. From a socio-economic perspective, the income of coastal

communities can increase both from fishery products and marine tourism. Given the enormous benefits it provides coral reefs should get better attention from the government, communities, NGOs, businessmen, and politicians [1]–[4].

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One of the efforts in preserving coral reefs is to create an area for conservation. The purpose of conservation areas is to protect, conserve and take advantage of the ecosystem function as a habitat for the life of aquatic biota at present and in the future. In addition, conservation areas also protect particular characteristics of coastal areas and small islands. Conservation areas can support sustainable regional management. In 2017, the total area of marine conservation areas in Indonesia was around 19 million hectares. The locations of water conservation areas are spread from the western, central to eastern regions to cover most of Indonesia's sea, including coral reefs. However, coral reefs may be due to degradation caused by global climate change, rising temperature, acidification, earthquake, and tsunami [4], [5]. Coral reefs are complex ecosystems consisting of limeproducing biota (mainly corals) along with another biota that lives on the bottom and in the water column. There is a process of attachment of coral biota to the bottom of substrates in the sea, limestone skeleton formation, segmentation, degradation, erosion, and accretion. The process occurred repeatedly over a while longer resulting in a coral reef. As a stable habitat, coral reefs inhabited by biota are associated with a network complex so there is a relationship between biotas and environmental factors [4]–[6].

Indonesia's corals are widespread from Sabang to the north of Jayapura, but their abundance is not evenly distributed. The highest number of coral genera was found in eastern Indonesia. However, coral diversity is starting to decrease from Kalimantan to Sumatra. The southern coast of Java is directly adjacent to the Indian Ocean and has low coral diversity. The Southern Coast of Java has extreme hydrodynamic conditions causing not all types of coral to be able to grow. Additionally, the many rivers which flow into the Indian Ocean caused a lot of sedimentation, and salinity is not stable [4].

The condition of coral reefs in Trenggalek is reported to be poor condition, this is determined based on the percentage of live coral cover of less than 25%. There are five site areas of coral reefs and all of these sites are in poor condition. According to data released on August 1, 2018, by www.coralreefwatch.noaa.gov, coral reefs in the southern coastal region of Java are on the watch level (monitoring). The watch level (monitoring) shows that there has been heated stress on coral reefs and there is a potential for coral bleaching.

This shows that reef conservation has experienced heat stress. Coral Bleaching is the occurrence of coral bleaching due to the loss of symbiosis with single-celled algae, zooxanthellae. The zooxanthellae algae photosynthesize and provide food for corals, and in symbiotic reciprocity receive the protection and nutrients needed for photosynthesis. Zooxanthellae are sensitive to stress or pressure including

temperature changes, and when they die or leave the corals, the bleached corals usually cannot meet their needs the energy. In some cases, the zooxanthellae return and the coral will survive. Coral death due to bleaching and disease due to increased heat and decreased calcification (coral) due to ocean acidification. Since 1980 coral bleaching has been increasing in all coral reefs in the world, 80% of the reefs in the Indian Ocean are turning white so that cause 20% of deaths. Currently, Mutiara Beach Trenggalek is in a state of stress and under monitoring status so that reef restoration does not decrease to levels warning to alert level 2 needs to be done through efforts to make artificial reefs [6], [7].

Mutiara Beach is one of the reef conservation areas in Trenggalek as a support area for marine ecosystem sustainability. According Central Bureau of Statistics, Mutiara Beach is part of the Watulimo District which has the biggest potential as a producer of marine fish, which reached 98.7% compared to the Munjungan and Panggul. It is necessary to preserve the marine ecosystem for supporting fishery potential can be developed to realize the sadewa program. Not only marine ecosystems but the environment on land must also be maintained.

Reef restoration to improve reef status in Trenggalek from bad to good will require a long time if relying on natural reef growth. Under normal conditions, corals can reach growth up to about 2 cm per year for corals massive and 10 cm for branching corals. It is necessary to approach using artificial reefs to accelerate the growth of coral reefs [8]. Artificial reefs can be constructed using adhesive/attachment materials such as cement portland, a mixture of sand and cement, marine epoxy, wire, and cable ties [9]-[11]. Artificial reefs have been used on coral reefs for ecological conservation, research, and socio-cultural purposes since the 1980s [12]. The artificial reef can be made from concrete. These concretes can have function as a container for the attachment of coral reefs and feeding ground, benthic organisms, become spawning ground, and nursery ground for reef fishes. Normal concrete and calm shells as material of artificial pyramid reef at Pasir Putih Beach, Situbondo, Indonesia [13]. Artificial reef from concrete has to consider material as a critical parameter in the design unit. To optimize the potential of concrete units as artificial reef to support and increase biodiversity composition has to meet the concrete requirement to detail about binder composition, aggregate type, and plasticizer on surface chemistry and early biofilm formation which influence subsequent colonization [14]. Concrete artificial reef in Pramuka island waters, Kepulauan Seribu, Jakarta, Indonesia already installed to conserve existing coral reefs. Concrete artificial reefs in Pramuka island can effectively use to create a new habitat for coral fishes, corals, and others biota, particularly in degraded coral reefs ecosystem [15].

A common problem in coastal areas is the lack of waste management from fishery products and tourism activities. The garbage from fishery processing such as cockle shells is still not managed well to increase the generation of waste in coastal areas. Cockle shell processing uses a recovery approach which is processing waste into materials that have benefits. Recovery of cockle shells as filling material for coral reefs can be done in addition to the roughness of artificial reefs made of concrete [16]–[18]. Coconut shells has potential to be used to address the degradation of coral reef [19]. Artificial coral

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According to an interview with the Pokmaswas head, the existing activities related to coral reef conservation only accept artificial coral reefs and sink them in the sea. So the Pokmaswas and the surrounding community have never known how to make artificial reefs by utilizing waste in the form of shells that have not been managed optimally. Waste management on the beach and reef conservation in the sea are expected to work together to support the sadewa program. Community empowerment in Mutiara Beach is carried out through training on making pyramid-shaped reefs with the cockle shell mixture. Training will be provided to Kelompok Masyarakat Pengawas (Pokmaswas)/supervisory community groups as training for trainers. Pokmaswas get training to be trainers for the local community in Mutiara Beach. The method used in community service is training of trainers (ToT). ToT is a strong predictor of sustainability because of its potential for up-skilling the workforce rapidly, exponentially by developing local educators and cheaply. The basic idea of ToT is to initiate a training point: knowledge and skills are taught to a small group of trainees who become trainers and go on to transfer those skills to others [20]. Pokmaswas as a leader hoped can deliver and teach how to construct artificial reefs using cockle shells mixture. Artificial reefs resulting from Pokmaswas based on the initial design will be sunk into the reef conservation area together with pokmaswas, environmental activists, Kelompok Masyarakat Sadar Pariwisata (Pokdarwis)/tourism-aware community groups, and the service tourism and culture as partners in community service.

This community empowering activity contributes to the preserve marine environment through the planting of artificial reefs from local community coastal work. Communities are expected to be able to independently produce artificial reefs using calm shells waste which is widely available in coastal areas. There is the harmonization between all levels of society and the district tourism and culture office is expected to each other to play a role in coral reef conservation activities. This activity also supports the implementation of the Merdeka Belajar Kampus Merdeka (MBKM)/ Freedom to Learn, Independent Campus by giving roles to students as members of the community empowering the team. Students from the study program of waste treatment have a subject for preservation of coral reef ecosystems through marine pollution control courses and industrial non-hazardous solid waste management using a recovery approach. The involvement of partners instead of as a participant of ToT, will also sink artificial reefs that are adapted to weather conditions for diver safety consideration. Partners also campaign manage beach waste to recover into artificial reef. Treating waste using recovery paradigm to produce new products that are eco friendly for marine environment dan to support sustainability in Mutiara Beach in order to achieve Sadewa Program.

The aim of this activity is to conducted ToT in Pokmaswas as an agent of change to protect existing coral reef in Pantai Mutiara Trenggalek dan to manage waste resulted by beach activity. This activity followed by utilized ToT to deliver the education about saving sea environment and how to manufacture artificial reefs by using cockle shell in surrounding beach. The participants of ToT have competencies resulting artificial reef and as a trainer for local community to produce artificial pyramid feef based on criteria design by using cockle shell waste.

II. METHOD

The challenge in training methods decision can be described by some reasons: (a) are sometimes difficult to define is used to refer to aids, tools, and the like; (b) given the relatively long history of training methods, providing a comprehensive list of types of training methods is

problematic, and (c) are rapidly changing to reflect the current technological advances, making it difficult to categorize definitively. Identification of 13 core methods: team training, stimulus-based training, simulation, role play, role-modeling, programmed instruction, mentoring and apprenticeship, lecture, job shadowing, job rotation, internship, games-based training and case study. Learning modality refers to the communication method by which training content is delivered to the learners. The three learning modalities are learning by doing, seeing, and hearing. When trying to create a meaningful grouping system for training methods, we have to consider the sensorial nature of each method, and we noticed a pattern. The training environment refers to the setting in which the training will be conducted. A natural environment refers to the real work. A contrived environment refers to particularly creation for the training and does not resemble the work environment, whereas a simulated environment is contrived but aims to simulate the natural work environment. Therefore, for the training environment criterion, we have three possibilities: contrived, natural, and simulated [21]. ToT approach has been widely used for capacity building in community settings. ToT have also been conducted to increase social service agency staff's interests in the implementation and dissemination research in health as well as in environment protection. The ToT method was utilized to enhance the performance and competence of social service staff from the participating community agencies, in designing, implementing, and evaluating the subsequent community-based interventions. ToT approach can be conducted by academics accommodate concerns that have been expressed about the dissemination of evidence-based practice and sustainability of interventions developed and implemented. The ToT promotes capacity building by passing on some simple skills and tools that are beneficial to developing and testing interventions but are new to community practitioners. Based on the principles

underlying of ToT (to deliver cost-effective and sustainable interventions), the training conducted with improvements and modifications, to enhance Pokmaswas staff's competence to conduct community-based intervention and evaluation [22]. ToT was hosted by the Shipbuilding Institute of Polytechnic Surabaya directly in Pantai Mutiara.

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The step of activity to empowering local community in Mutiara Beach following steps:

1) Preparation and samples

Carrying out training of trainers needs to identify who the training is given to. A survey of existing conditions is needed to determine who is suitable to be a trainer for the local community. All the member of Pokmaswas were invited to a briefing session about the importance to protect coral reef and to manage the cockle shell waste in Mutiara Beach. Pokmaswas staff from these organizations were assigned by their leader to participate in the ToT (free of charge).

2) Development of training program

Communicate with Pokmaswas to determine the day of implementation and who the training of trainer participants joining. Analyzing the fault that occurred after the trainer were given training. Conducting to solve the potential problems by activities together among academics and participant of training of trainer. FIGURE 1 shows ToT workshop and evaluation method has been conducted in community service in Mutiara Beach Trenggalek.

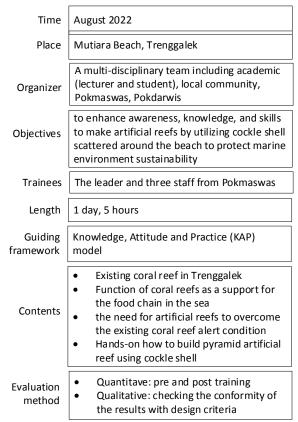


FIGURE 1. Training of Trainers workshop and evaluation

3) Content of training programs

The training content was designed by a multidisciplinary team including academics and community partners basing on the "Knowledge, Attitude and Practice (KAP)" model [23] and was organized into two sessions (2 - 3 h per session) delivered on the same day. The academics has a role as a leader for research and theoretical components of the training, and the community partners ensured the acceptability of the training contents and led the component of positive psychology training.

4) Evaluation

Evaluation conducted using two methods, quantitative (pretest and post-test) and qualitative (by checking pyramid artificial reef). Qualitative evaluation conducted by checking the artificial reef resulted compared to criteria design have been socialized and taught. Checking dimension and structure of artificial reef manufactured by participant training of trainers.

III. RESULT

A. EXISTING CONDITION SURVEY

Existing survey conducted by observational approach to identify field condition, initiate cooperation with local community, to discuss training type and the material needed.

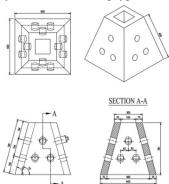


FIGURE 2. An engineering drawing of artificial reef.

B. ARTIFICIAL REEF MOLD MAKING

Artificial reef mold made from triplex based on design criteria reported in [18]. The mold equipped with three holes in each side to support ease of lifting for sinking process.

C. CONDUCTING TRAINING FOR TRAINER TO EMPOWERING COMMUNITY AND PRACTICE OF MAKING ARTIFICIAL REEF

Training conducted using artificial reef mold manufactured by student and technician of non-metal workshop in Politeknik Perkapalan Negeri Surabaya. Training developed by some of lecturer helped by student.

D. EVALUATING THE RESULT OF TRAINING

The effectiveness of training given by lecturer to some of participant needs to be evaluated the level of readiness in providing training to local community by checking the artificial reef produced. FIGURE 2 represents an engineering drawing of artificial reef manufacturing by adding cockle shell waste. It used as a guide to evaluating artificial reefs whether by following an initial design.

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E. IMPLEMENTATION MAKING ARTIFICIAL REEF BY LOCAL COMMUNITY

The trainers coordinate local coastal community to produce artificial reef refers to training experience using mold given in training activity.

IV. DISCUSSION

A. EXISTING CONDITION SURVEY

Based on survey and interview at Mutiara beach, it found that management of Mutiara Beach is operated by two community groups, namely supervisory community (Kelompok Masyarakat Pengawas/ Pokmaswas) and tourism-aware community groups (Kelompok Masyarakat Sadar Wisata/ Pokdarwis). Each group have responsibility and its authority. Pokmaswas have authority and duties in the marine area and Pokdarwis have to be responsible for the land area at Mutiara Beach. Refer to job description for each community groups, training for trainer was given to Pokmaswas.

B. ARTIFICIAL REEF MOLD

Involving students, technicians, and lecturers to make artificial reef mold conducted in PPNS non-metal workshop. Molding consists of two parts equipped with hooks in between to manufacture artificial reefs with three holes on each side. Started to mark and cut triplex, assembly the part of molding until finished become molding ready to use. This activity was conducted together between students and supervised by a lecturer and technician in a non-metal workshop. FIGURE 3 show a snippet of a series of steps for making a mold until the finishing mold is ready to be used during the training given to Pokmaswas.



FIGURE 3. A series of steps for making artificial reef mold in PPNS non-metal workshop.

C. CONDUCTING TRAINING FOR TRAINER TO EMPOWERING COMMUNITY AND PRACTICE OF MAKING ARTIFICIAL REEF

Training for trainers given to Mr. Kacuk as a leader Pokmaswas and some members started with socialization in the community surrounding Mutiara beach. Socialization as a beginning activity was attended by Pokmaswas, Pokdarwis and local community. FIGURE 4 shows socialization of how

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to make artificial reef by using additional material from cockle shell waste before hands-on practice. Next activity after brief explanation, conducted consolidation and preparation in hands-on practice to decide where training of trainer will be



held.

FIGURE 4. Socialization and brief explanation to the local community regarding the steps for making artificial reefs.

The result of consolidation decided hands-on practice conducted near Pokmaswas base camp in order to ease coordination and lifting of material. Continued with the preparation of tools and materials for molding in artificial reef molds as shown in FIGURE 5.



FIGURE 5. Preparation and consolidation before hands-on practice.

Training for trainer given to Pokmaswas begins with installing pipes as components to form holes on each side of the artificial reef. Artificial reefs are developed not to replace highproductivity natural coral reefs but as structures that can provide one of their functions. Hole on each side of artificial reef has critical function for provision hiding room from base building. Some species which interested depends on nature from room hideaway which provided. The artificial reef has potential to attract a group of organisms like crayfish, oyster, and grass sea as well as be used effectively to obstruct the operation of ships trawling. The artificial reef support increasing levels of diversity to natural reefs, species richness, biomass and fish density. Artificial reef can mimic natural coral reefs in order to fish biodiversity [8], [10], [11], [24]. FIGURE 6 represents an assembly of the pipe in a mold before it is cast to form a cavity in the artificial reef. A material was filled into the mold until reaching the top. It will become the bottom of the artificial reef after drying and remove from the mold. FIGURE 7-10 shows the steps to constructing an artificial reef. After all the material are put into mold, flatten on the top of the mold, then wait a few days for it to dry. The most common function of artificial reefs was to support

marine ecosystem restoration (18%), to create new sites for diving (41%) and to conduct exploration (22%). The most common structure of artificial reef was piles of concrete construction blocks (11%), reef balls (13%) and ship wrecks (44%). The most common structure of artificial reef was made by metal and concrete [11].



FIGURE 6. Assembly twelve pipes in artificial reef molding for making.



FIGURE 7. Deliver how to prepare material using weight scale



FIGURE 8. The practice of mixing artificial reef materials



FIGURE 9. Put the material that has been mixed gradually into the mold

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FIGURE 10. Fill out all the material includes cockle shell waste in the mold.

D. EVALUATING THE RESULT OF TRAINING

The effectiveness of training has been given to Pokmaswas as trainers for the local community needs to be evaluated. This evaluation conducted using artificial reef resulted from training for trainer. Checking the accuracy of artificial reef compared to criteria design have been created before manufacturing. Artificial reef produced from training in accordance with the initial design drawing shown in FIGURE 11. The artificial reef produced from the training for trainer activities is checked for their conformity with FIGURE 2 as a technical guideline to determine the conformance with the criteria design. This work was conducted to represent a quantitative method evaluation.



FIGURE 11. Artificial reefs manufacturing from training activity

E. IMPLEMENTATION MAKING ARTIFICIAL REEF BY LOCAL COMMUNITY

Manufacturing artificial reefs by local community in Mutiara beach lead by the head of Pokmaswas. This activity used mold from PPNS, following the experience during attend training of trainer, the leader coordinates the making of artificial reefs. Starting from mix the material including crushed cockle shell waste, put in mold until reach the top and wait until dry in order to remove from mold. Finishing stage is attaching the uncrushed cockle shell waste to outside of artificial reef using the mixing of glue for walls and white cement.

The finishing stage is attaching cockle shell waste to the outside of the artificial coral with the help of glue for walls and white cement. Starting from applying a mixture of glue and white cement to the outer wall of the artificial reef, shown in FIGURE 12. FIGURE 13 shows next step, attachment of cockle shell waste one by one to the outside of artificial reef

after being smeared with a mixture of glue and white cement. The attachment of seashell waste to the outer part of the artificial reef provides a rough surface shape that can accelerate the sticking of marine biota (biofouling). Previous studies reported that biofouling occurs more rapidly on the rough surface of the artificial reef than on the smooth surface. The increasing attachment of marine biota using diversity index indicators can reach 20% on artificial reefs using cockle shell waste material compared to pure concrete materials [25]–[27].

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FIGURE 12. Smearing glue and white cement on the outside artificial reef



FIGURE 13. Cockle shell attachment on the outer side of artificial reef



FIGURE 14. Production of pyramid artificial coral reef by local community

The local community conducted artificial reef production on Mutiara beach supervised by the head of Pokmaswas. Seven artificial reefs could produce during three weeks. FIGURE 14 shows an artificial reef created by a coastal community in head

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of Pokmaswas supervision. The finishing touch for pyramid artificial reef by attachment of cockle shell shown in FIGURE 15.



FIGURE 15. Finishing touch by local community in pyramid artificial reef

Seven pyramid artificial reefs have been produced by the local community in Mutiara Beach within three weeks, with head of Pokmaswas supervision and coordination. FIGURE 16 shows an artificial reef created by a coastal community that has been appropriate to the initial design criteria.



FIGURE 16. Seven artificial reefs produced by local community in Mutiara beach.

The closing event of community service in Mutiara Beach is captured by a memorable moment in FIGURE 17. In closing event, it was also stated that the evaluation of community service activities through this ToT achieved the success of increasing KAP.



FIGURE 17. Closing of community servicel event.



FIGURE 18. The result of pre-TOT and Post-TOT

Qualitative methods are used to analyze success in conveying knowledge, attitudes, and practice. Qualitative methods are carried out through pre and post training of trainers. FIGURE 18 shows result of pre-ToT and post-ToT score. Knowledge, Attitude and Practice (KAP) of ToT participant increase by an average 43%. The average pre-ToT score was 43,75 while the average post-ToT score was 87,5. There was a significant increase in the KAP of the Pokmaswas team.

Training for trainers reported successful to initiate representative from local community as a trainer for its community. Training of trainers is more sustainable and effective method because its exponentially by developing local educators, cheaply, and potential for up-skilling the workforce rapidly [28]–[32].

The factors that support the success are local people were open to knowledge, awareness, and skills enhancing; have the awareness to protect the environment around the coast and the sea, match with the field of interest as staff of Pokmakwas; and the training is carried out directly in practice in the field then supported by the availability of all materials and carried out with no more than five participants so that they can focus on delivering the material and practical.

The weaknesses of activities include: the process of implementing the training cannot be carried out optimally, because of the health protocol. Geographically, the location of Mutiara Beach passes through the highlands with rudimentary road conditions and erratic weather conditions. This ToT has also been carried out according to the Pokmakwas schedule. Recommendations that can be given for the implementation of community service in this site, must consider the effectiveness of travel routes and suitable schedules. In comparison with previous activities in Situbondo [18] which were held by training with more than five people, this activity relatively could produce more than pyramid artificial reefs with particular finishing by attachment of cockle shell to surface.

IV. CONCLUSION

The objective of community service in Mutiara Beach are to enhance the knowledge, awareness and skill to make artificial reefs by utilizing cockle shell scattered around the beach to protect marine environment sustainability.

Training of trainer activity have proven to be very beneficial for initial approach to local community, including: 1) trainers from Pokmaswas having experience that be able to deliver their knowledge and skill to local community 2) having a environment awareness team in local community 3) increase the knowledge about waste treatment using recycle paradigm 4) having an initial booster to encourage the local community's creativity 5) emerging idea from the local community to provide an alternative to replace cockle shells with coral flakes carried by sea at high tide.

The next work plan is to submerge the artificial reefs and for sustainability, it is necessary to monitor whether the pyramid artificial reefs can be overgrown by natural corals.

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