Menba Kastamonu Üniversitesi Su Ürünleri Fakültesi Dergisi
Menba Journal of Fisheries Faculty
ISSN 2147-2254 | e-ISSN: 2667-8659

Menba Kastamonu Üniversitesi Su Ürünleri Fakültesi Dergisi 2021; 7(2): 77-89 Araştırma Makalesi/Research Article

Effectiveness and Impact of Artificial Reef Project in Tigbauan, Iloilo, Philippines: A case study

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Article Info

Received:
26/10/2021
Accepted:
16/12/2021

Keywords:
- Artificial reef
- Effectiveness
- İmpact
- Philippines

Abstract

Artificial reefs (ARs) are one of the most popular and important management approaches to enhance fishery production, especially in overfished areas. However, poor site selection and lack of monitoring to some AR projects are common to this matter. Hence, in this paper, a case study was conducted to determine the effectiveness and impact of the AR project in Tigbauan, Iloilo, Philippines, through a qualitative field survey research approach. ARs used in the study are jackstone-type designs made-up of concrete that were constructed by the local fishers. Findings revealed that while other fishers reported that AR improved longline catch, on the contrary, fishers who used gill nets did not experience any catch changes; rather, it sometimes entangled and damaged their nets. Despite initial monitoring showing the presence of benthic organisms like sponges and soft corals after 6 months of installation and gradually attracting fish to aggregate, lack of follow-ups to the present date brings the AR project impact imperative. While most respondents claimed that water quality in the installed site was maintained after 4 years, the targeted objective to increase fish species abundance was not achieved. Furthermore, some respondents reported that installed ARs were buried due to natural calamities. Thus, this study suggests that the AR project in the installed site did not meet the expected output due to a lack of monitoring and poor site selection.

Atıf bilgisi/Cite as: Toring-Farquerabao, M. L. B., Domingo. E. R. & Tahiluddin A. B. (2021). Effectiveness and impact of artificial reef project in Tigbauan, Iloilo, Philippines: A case study. Menba Journal of Fisheries Faculty, 7(2), 77-89.

INTRODUCTION

Artificial reefs (ARs) are well-known and have been used for a long time around the world and have served many purposes such as habitat restoration (Clark & Edwards 1994; Komyakova et al., 2019), fish stock enhancement (Pickering et al., 1999), aquaculture (Fabi & Fiorentini, 1996), tourism or recreation which serve as diving site (Tynyakov et al., 2017), fisheries management (Fabi et al. 2015; Becker et al. 2016; Florisson et al. 2018) and research areas (FAO, 2015). Thus, it became an important and popular resource enhancement technique (Bohnsack and Sutherland 1985) and can be considered as a management intervention (Munro and Balgos 1995) to recover and/or improve natural habitats, increase productivity, and concentrate or enhance populations of living marine resources (FAO, 2015) by concentrating fishes and by increasing the natural production of biological resources (Bohnsack & Sutherland, 1985). According to RA 8550, or the Philippine Fisheries Code of 1998, as amended by RA 10654, ARs are defined as any structure, natural or man-made materials, placed on a body of water below the sea surface (Lokesha, 2013) to mimic some functions of a natural reef (FAO, 2015; Wu et al., 2019) that affect the local biological community (Seaman & Jensen 2000; Svane & Petersen, 2001). It also has served as habitat replacement for destroyed corals (Waltemath & Schirm, 1995) that functions as part of the natural ecosystem with no destruction to the existing environment (FAO, 2015) or supplement existing natural reefs (Miller & Hobbs, 2007). Furthermore, ARs are also used to prevent any active fishing gear operations, such as bottom trawling (Komyakova et al., 2019) and dredging activities, especially in municipal waters. Thus, ARs' definition is broad and not limited to structures developed as reefs and intentionally submerged to benefit human activities (Tynyakov et al., 2017). Instead, the benefits are for the ecosystem as a whole.

A large number of ARs have been deployed in coastal regions worldwide over the past three decades (Yang et al., 2019). AR structures had been deployed in over 50 countries worldwide by 2011 (Fabi et al., 2011). This is done primarily in areas where fishery resources have been overexploited or are rebuilding (Pitcher & Seaman 2000; Brickhill et al., 2005). In the Philippines, together with other Asian countries like Indonesia, Malaysia, Cambodia, and Vietnam (FRA, 2010), ARs are widely used mainly for fishing and fisheries management (Waltemath & Schrim, 1995) to improve fishery resources (FRA, 2010)

because fishing is a major source of food, income, and export earnings in these areas (EEPSEA, 2017). It enables fishers to reduce fishing effort in terms of time and fuel by attracting a great abundance of fish. However, overfishing and degradation have been threatening the country's fishery sector for many years (EEPSEA, 2017), which leads to a debate as to what are the ARs' purpose should be. Mcmanus (1995) claimed that the coastal waters of the Philippines are generally overfished to the point of having higher fishing pressure than the maximum potential harvest. To address such issues and problems, the establishment of ARs was done as one of the fishery management tools (EEPSEA, 2017).

The municipality of Tigbauan in Iloilo, Philippines, specifically Barangay Baguingin, is one of the recipients to have ARs installed in the country. This is one of the coastal resource management projects of the municipality, which was established way back in 2015 (Pers. Comm with Municipal Fisheries Officer). Tigbauan is a second-class municipality located in the Southern part of the Province of Iloilo with 10 coastal barangays. These ten coastal communities considered fishing as one of the significant livelihoods for each household in the community. AR project was initiated and conceptualized by the Local Government Unit (LGU) of Tigbauan in consultation with the municipal fisherfolk of Barangay Baguingin and in coordination with the Bureau of Fisheries and Aquatic Resources (BFAR) Region VI and the Provincial Capitol of Iloilo. Parties responsible believed that implementing the AR Project along the coastal waters of Tigbauan would help minimize active fishing operations that would protect critical marine habitats and soft-bottom communities. Implementers concerned have willingly and jointly pledged to extend full support and cooperation in implementing the project in support of fisheries conservation and resource enhancement towards achieving food security and poverty alleviation program of the government. Target beneficiaries are the municipal fishermen in the area. The AR project was provided with a total amount of Php306, 820.00 (approximately US$6, 100) for the construction of 250 units of ARs. Obligations were divided among parties.

The management and operation of this AR project were the primary responsibility of the fisherfolk organization and LGU. Together with other local partners, the project implementers formulated a management plan for the proper management of the ARs. The management plan made was adapted by the LGU to become the official policy of the municipal government. Hence, municipal fisherfolks were completely aware of the project and responded positively with full support prior to implementation and installation. Furthermore, LGU, in cooperation with the Provincial Office and BFAR Region VI, successfully disseminated the importance and benefits of the AR to the target beneficiaries. The target number of ARs that should be deployed was 250 units. However, according to the survey, fishers in the area who were responsible for the management and operation of the ARs claimed that there were only an 100 units of ARs successfully deployed. The problem is that not all the materials provided by BFAR were utilized for the construction of ARs. This may be due to lack of funding for the labor from LGU. Another was the repair of the bridge at that time, which is situated near where the ARs were being constructed. There was no coordination with the contractor and fishermen regarding the start of the bridge repair; hence, ARs under the bridge were damaged and could no longer be used. ARs in the area had been deployed four years ago, and yet updates regarding its benefits to the target beneficiaries are quite vague up to this point of time.

Understanding how artificial reefs can be integrated into a more general marine resource management framework is a critical element in promoting the importance of ARs in the long run. However, the ability to evaluate the performance of ARs is quite challenging. AR projects have been criticized for lack of planning in the development of adequate monitoring programs that will provide fisheries scientists and managers with the information required to test their inherent purposes despite significant developments in construction and design (Claudet & Pelletierm 2004). ARs can potentially provide a wide range of benefits towards ecosystem as claimed by different authors. However, the extent to which they achieve their goals has received less attention. There are limited publications available as to which this management strategy is effective or not. Lack of monitoring and awareness towards community with regards to the project is quite common. Moreover, financial funds and effort from the government are being utilized; hence, a return to the community is necessary on this matter. Thus, this study aimed (1) to evaluate the level of awareness of the fishers in the community on the installed artificial reefs; (2) to assess the status and impact of installed ARs based on the fishers' perspective; (3) to determine the issues and concerns regarding the installed artificial reef; and (4) to assess also whether a four-year ago installation of ARs could have a felt impact to fishers' life.

MATERIALS AND METHODS

Study Site and Duration

The study was conducted to evaluate the effectiveness of the artificial reef installed at the municipality of Tigbauan, Iloilo, Philippines. Tigbauan is a second-class municipality located in the southern part of the province of Iloilo. This area is bounded by the Iloilo Strait to the south and the municipality of Leon to the northwest, Oton to the northeast, and Guimbal to the east. It is located 22.85 km from the city of Iloilo, and it lies at approximately 10.7283°N, 122.3788°E. Tigbauan has 52 component barangays, 10 of which are situated along the coast, with a coastline of 8 km. ARs are installed specifically in Barangay Baguingin (Figure 1), which is one of the coastal barangays of Tigbauan, Iloilo, Philippines. This study was done for a week towards the end of November 2019.

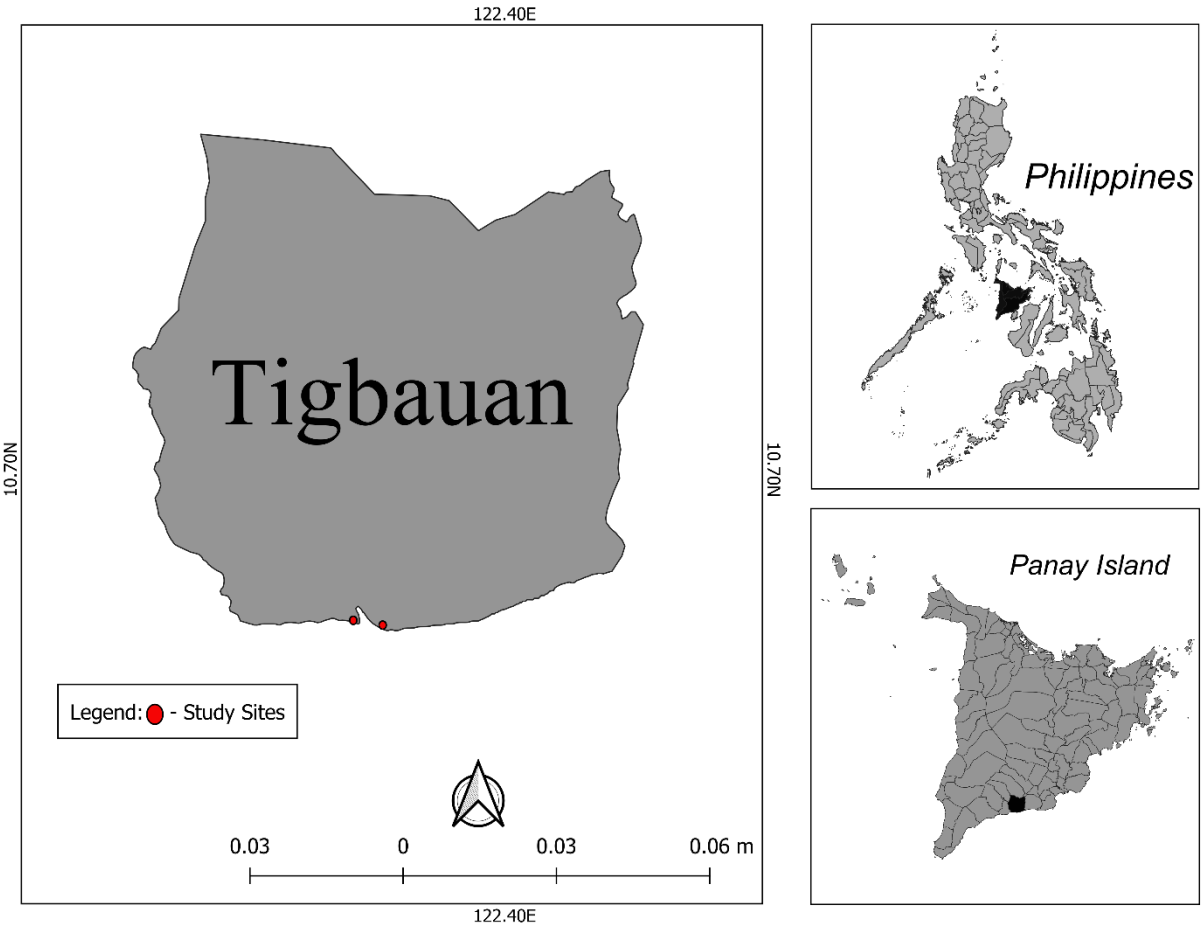

Figure 1. Map showing the study site.

Criteria for Site Selection

The criteria of site selection for ARs as provided by the Joint DENR-DA-DILG-DND Memorandum Order No. 1 Series of 2000 are as follows: (1) site where ARs are to be installed should not be less than 1 km away from existing natural reefs, if present, or 500 me away from existing ARs; (2) site should be near an alternative food sources (i.e. seagrass beds)' constructed on a flat, barren area of relatively good visibility and at depth protected from wave action but still accessible to members of the association for possible monitoring (i.e. 15-25 m away from the shoreline); (3) site should be outside designated navigational sea lanes and does not obstruct traditional navigational route of local fishers going to and from the fishing ground or pose a navigational hazard to ships and other sea crafts; (4) water current must be moderate so that plankton can stay in the vicinity; (5) site should have a rocky or sandy substrate with flat to gradually sloping bottom; (6) site should be free from pollution; and (7) site should have a water depth ranging from 6 to 12 fathoms.

The LGU was responsible for selecting the site as to where ARs are to be installed and Barangay Baguingin was chosen as the recipient. However, no prior scientific study was done on this. The only consideration was that the area chosen is adjacent to mangroves which are, for them, essential to be protected, which defeats the purpose of the mangrove in the coastal ecosystem as to help in reducing wave energy and protecting our coasts against natural hazards such as storms, tsunamis, and coastal erosions, limiting erosion and shielding coastal communities from the destructive forces of tropical storms (Spading et al., 2014). Another is the future plan of making the place a fish sanctuary or a marine protected area (MPA). According to the Aquaculturist of Iloilo Provincial Capitol, who was assigned for the pre-assessment at that time prior to ARs installation, the area has a sandy-muddy bottom with no coral reef present, making the place a good choice for the ARs to be built to help promote aggregation of fish and to help fishers gather more catch.

Design for ARs Used in the Municipality

The AR design chosen was of "jackstone-type" made up of concrete cement having a length of 1 m and a square dimension of 5x5 in (Figure 2). The decision regarding the choice of the design was accordingly originated from BFAR. This design is included in BFAR's package of technology. No concrete scientific explanation was presented. According to the consultations made with the concerned agencies, the design does not matter. All types of AR designs serve the same purposes (i.e., promote fish aggregation, spawning ground, etc.). This statement may be due to the sparse evaluation of artificial structure performance which was noticed by Becker et al. (2018). Implementers focused on proper deployment manner and desired depth instead.

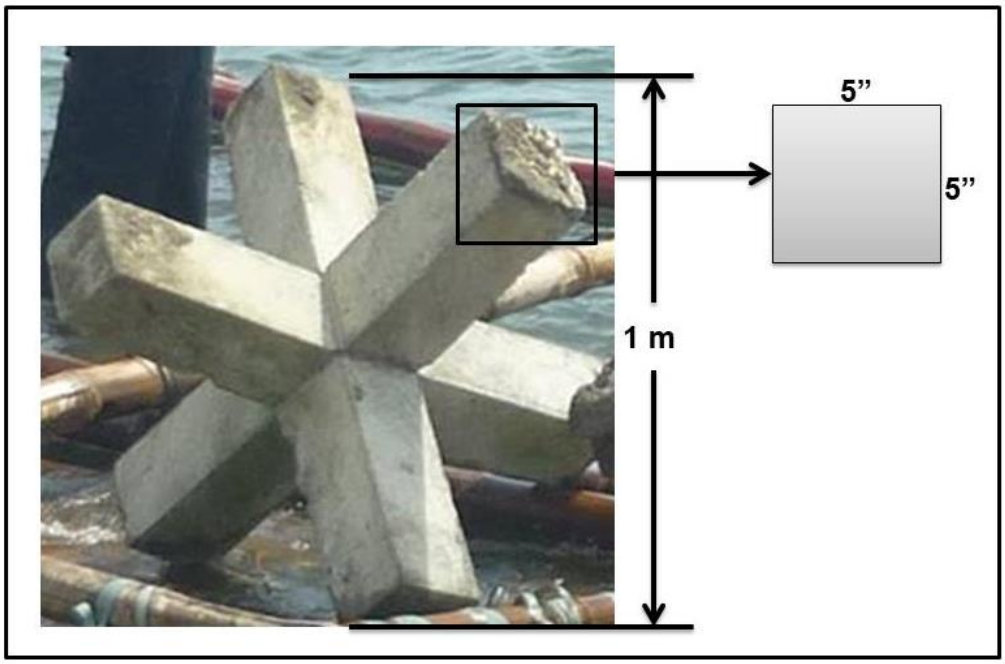

Figure 2. Specifications of AR deployed in Barangay Baguingin, Tigbauan, Iloilo, Philippines (Photo taken from Ariel S. Tentia, Tigbauan Municipal Bantay Dagat Member).

Deployment of AR units

Deployment of ARs in Barangay Baguingin was done in 3 days by the municipal fisherfolks in coordination with the LGU. ARs were carried by municipal fisherfolks to the shoreline and were loaded to the bamboo raft locally known as *balsa* for deployment. Upon arrival to the desired area, ARs were dropped down one by one from the raft to the water surface until it sunk to the bottom without the proper guidance of deployment by a diver due to the unavailability of a skilled person to do the task (Figure 3).

Figure 3. Deployment of ARs at Barangay Baguingin, Tigbauan, Iloilo, Philippines: (a) ARs were carried by municipal fisherfolks to the shoreline; (b) ARs were loaded to bamboo raft; (c) ARs were brought to the desired area of deployment; and (d) ARs were manually pushed to the water (Photo taken from Ariel S. Tentia, Tigbauan Municipal Bantay Dagat Member).

The target number of ARs that should be deployed was 250 units. However, according to the survey, fishers who were responsible in the area claimed that approximately 100 units were only successfully deployed. The problem is that not all the materials provided by BFAR were utilized for the construction of ARs. This may be due to a lack of funding for the labor from LGU. Another was the repair of the bridge at that time, which is situated near where the ARs were being constructed. There was no coordination with the contractor and fishermen regarding the start of the bridge repair; hence, ARs under the bridge were damaged and could no longer be used. ARs were deployed 200 meters away from the shoreline with a depth of 8 meters at low tide and 10 meters at high tide, which fits the site's criteria in terms of desired depths that could avoid obstruction of navigational paths for municipal fishers. As a result, fisherfolks in the barangay did not experience any hard time in their travel to their desired fishing ground.

Ideally, upon deployment, ARs should be guided by a diver to put it in the correct manner (Figure 4a) to have its best benefits as stated in the Joint DENR-DA-DILG-DND Memorandum Order No. 1 Series of 2000. However, this was not what had happened in Barangay Baguingin. Under the circumstances, there was no available diver to guide the ARs. Hence, municipal fishers tended to scatter the ARs (Figure 4b), defeating its purpose in the long run.

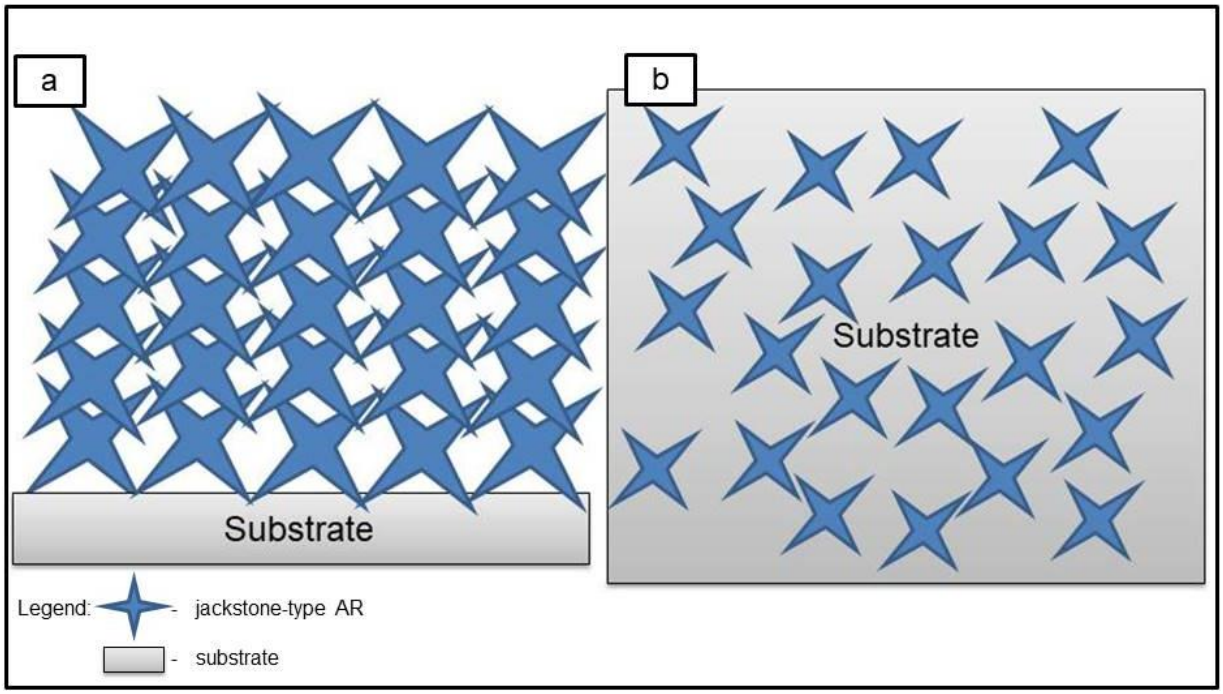

Figure 4. Manner of deployment of AR: (a) ideal and proper deployment of ARs; and (b) manner of deployment of AR done by municipal fisherfolks at Barangay Baguingin, Tigbauan, Iloilo, Philippines.

Data Gathering

This study employed a purely qualitative field survey research approach, where data were collected majorly through qualitative techniques during the fieldwork that took place in the study area.

Data sources had included both primary and secondary data. Primary data were gathered through interviews with the use of questionnaires. Key informant interview (KII) (see Appendix A for the questionnaire) with the Municipal Agriculture Officer of the Municipality of Tigbauan, President of the BFARMC and Barangay Captain in Barangay Baguingin, Training Specialist of Bureau of Fisheries and Aquatic Resources (BFAR) and Provincial Aquaculturist II of Iloilo Provincial Capitol was done to have an overview of the artificial reef installed in the area. The level of awareness of each fisher as to the implementation of the AR project and its effectiveness and impact were assessed through a household (HS) survey after KII. A list for the household survey respondents was based on the registered fisherfolks in the barangay and was acquired from the Municipal Agriculture Office. A semi-structured questionnaire (Appendix B) was used during the interview.

The secondary data collected and used in this study included reports and detailed plan of the project from Local Government Unit (LGU) of the municipality. In addition, local ordinances related to artificial reef installation were collated, analyzed, and used in this study. These secondary data contained the exact location and other important information with regards to the implementation of the said management strategy and have served as basis for the researcher to start the study.

Data Analysis

Qualitative data were analyzed using descriptive statistics, and mean scores were derived for all quantitative results using SPSS v. 20.

RESULTS

Effectiveness and Impact of Installed ARs

A total of 42 respondents were surveyed to assess the effectiveness and impacts of the AR Project established in Barangay Baguingin, Tigbauan Iloilo, Philippines, in 2015. Table 1 shows the profile of the respondents in Barangay Baguingin, Tigbauan, Iloilo. Majority of the respondents were males (88.1%) who were registered municipal fisherfolk of the recipient barangay. Females, 11.9% of the total respondents, interviewed were the wives of the fishers. This was due to the unavailability of their husbands during the field survey. Large number of fisher population in the area has more than 30 years of experience in fishing. However, the ages of fishers ranged from 22 to 59 years old. No formal education among municipal registered in the barangay is high, with a total percent composition of 88.1%. They all varied in the type of fishing gears used with gillnet (57.1%) followed by skimming net (16.7), longline (11.9%), crab pot (11.9%), and beach seine (2.4%).

Table 1. Respondent's profile in Barangay Baguingin, Tigbauan, Iloilo, Philippines.

Respondents (n=24)	Frequency	Percentage Composition (%)
Sex		
Male	37	88.1
Female	5	11.9
Total	42	100
Years of Residence (years)		
11 - 15	2	4.8
21 – 25	2	4.8
26 – 30	1	2.4
>30	37	88.1
Total	42	100
Religion		
Roman Catholic	42	100
Civil Status		
Single	2	4.8
Married	38	90.5
Widowed	2	4.8
Total	42	100
Educational Attainment		
Elementary level	4	9.5
Elementary graduate	2	4.8
High School level	7	16.7
High School graduate	24	57.1
College level	2	4.8
College graduate	2	4.8
Vocational course	1	2.4
Total	42	100
Respondent Type		
Fisher	37	88.1
Fisher's wife	5	11.9
Total	42	100
Fishing Gears Used		
Gillnet	24	57.1
Longline	5	11.9
Crab pot	5	11.9
Skimming net	7	16.7
Beach seine	1	2.4
Total	42	100

Respondents claimed that the area where ARs were installed was in good condition and still in good condition after these were installed (Table 2). There were no indications of improvement. They have noticed no progress or any changes in the area prior to the objectives which were set and aimed by the project. However, fishers who used the longline as their fishing gears experienced a good catch after 6 months of establishing ARs. Species caught increased in terms of quantity, and species present also improved. However, other fishing gears used in the area, such as the gill net, which is the major gear used in the barangay, did not experience such an increase in the catch. Fishers claimed that it sometimes damaged their nets when entangled accidentally in the installed ARs. This happened during the time when buoys (markers) installed were washed out by strong waves brought by typhoons that passed the area. On the other hand, this is in contradiction with the study of Santos & Monteiro (1997). They both identified that ARs contributed to an improved value of artisanal fishery based on a fishing survey by gill nets in the Algarve coast, the southernmost region of continental Portugal. The reason might be Barangay Baguingin installed the

ARs are too closed from the shoreline (i.e., 200 m away), and gillnetters mostly fished in farther areas to catch more target species.

Table 2. Respondent's perception of the condition of the area before and after the installation of ARs in Tigbauan, Iloilo, Philippines.

Condition	Respondent's Perception on the Site Condition Before AR Installation		Respondent's Perception on the Site Condition After AR Installation	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Poor	1	2.4	9	21.4
Not Good, Not Bad	14	33.3	0	0
Good	27	64.3	33	78.6
Total	42	100	42	100

Monitoring was done after 6 months of installation by the provincial aquaculturist through an underwater visual survey. It was noticed that there was already presence of sponges and soft corals that are starting to grow in the installed ARs. Fishes tend to aggregate slowly. However, this was the only monitoring that was done, and no follow-ups until the present date. Beneficiaries and concerned agencies do not have updates and/or ideas on the actual state of deployed ARs 4 years ago. Respondents claimed that ARs were buried after a year. Only less than half a meter remained due to the typhoons that have passed, and accordingly, the area is exposed to stronger waves during this period. The presence of the river nearby also contributed to the phenomena whenever heavy rainfall happens, and there are rapid run-offs coming from the upland.

After 4 years of AR installation, respondents claimed that the water quality of the place was maintained and there was no increase of contaminations (Table 3). One of the main objectives of the project, which is increasing the target species for the fishers to have more catch and more income, was not achieved. Majority (88.1%) claimed that the catches were still dependent on the seasonality of the species and not because of the establishment of the ARs. In the study of Bohnsack et al. (1994), they have gathered equivocal evidence that the increase in biomass was likely due to aggregation rather than increased production from studies around the world. It was pointed out that ARs can serve purely as an aggregation device without any increase in biomass. Therefore, the effectiveness of ARs still remains up for debate on attraction versus production (Lee et al., 2018). The ecological, social, and economic goals of this project were in a dilemma.

Table 3. Respondent's perception of the condition of the area after the installation of ARs in Tigbauan, Iloilo, Philippines.

Questions	Respondent's Perception After the Installation of AR		
	Yes	No	No Idea
1. Is water quality maintained?	100%	0%	0%
2. Is the structural integrity and stability of the AR infrastructure maintained over time?	73.80%	16.70%	9.50%
3. Is there an increase of contaminants in the water?	0%	100%	0%
4. Is the occurrence of target fish increases?	11.90%	88.10%	0%
5. Are the ecological, social and economic goals of AR achieved?	26.20%	73.80%	0%
6. Is navigational safety maintained?	100%	0%	0%

DISCUSSION

All the respondents were positive and supportive as the project was introduced by concerned agencies. However, the main objective that connects to the main problem or concern among fishers was not addressed directly by the project. Entangling of nets used by gillnetters in the barangay is a minor problem since the area where ARs were deployed was provided with buoys as a marker. Hence, fishermen could avoid setting gill nets near the ARs. They were also fully aware of the presence of AR structures in their place. Joint DENR-DA-DILG-DND Memorandum Order No. 2000- 01 stated that registered fisherfolks who use longline fishing gear were the only allowed fishing practice along with established ARs. Trawling, dredging and/or dragging are the main illegal activities that affect much the fishers. The ARs only cover approximately 100 m^2. The area available for illegal fishers is still much larger, leading to damage of the area and collecting all possible organisms on their way. Another is the nature of the bottom where the ARs were deployed. As mentioned earlier, the area has a sandy-muddy bottom is situated near the river mouth. Whenever heavy rainfall or typhoons happen, the sedimentation rate is high, leading to the ARs being borrowed. According to some of the respondents, less than half a meter of these deployed ARs was visible. Site selection should have been considered seriously so that the projected benefit could be achieved utmost. Although the LGUs set specific rules with regards to this matter, Lemoine et al. (2019) stated, on the hand, that deployment of ARs should be based on the predetermined objectives conceptualized by the managers or implementers. This would serve as their baseline in the implementation of the

project to avoid failure in the future. Moreover, the improper manner of deployment, which makes the project ineffective and inefficient.

Moreover, numerous studies (Scarratt, 1973; Spanier, 1991; Fabi, 1996; Jensen & Collins, 1996 cited from Lee et al., 2018) claimed that the effectiveness of ARs still remains up for debate in terms of increasing biomass because it depends on the design of AR structure, in particular, whether it meets specific habitat requirements of individual species and age groups.

AR project is beneficial to fishers if properly deployed. However, fished ARs have the potential to lead to overfishing if they increase the aggregation or attraction of existing stocks without increasing the overall size (Jebreen 1995; Bohnsack & Sutherland, 1985). Such an outcome would counter their inherent purposes. Moreover, the major issue they are currently facing is the rampant dragging activities in the fishing ground, which destroys the habitat, catches all species present, does not leave the small ones, and damages their fishing gears. For instance, crab pots were soaked for 24 hours prior to hauling. Dragging activities usually happen at night time. Whenever trawl or dredge passes by the deployed crab pots, these will be dragged and nowhere to be found, contributing to the loss of income of crabbers. Municipal fisherfolks suggested enforcing the existing ordinance strictly, i.e., bans of using trawl and active gears in municipal waters. AR project quite lessens the illegal activity; however, it covers only a small area which gives the illegal practices larger area to their illegal activities. Serious consultation with different stakeholders must be conducted to come up with a more effective management plan. CRM Plans in the municipality should address the fishers' main problems, or issues currently face to gain more positive results and supports.

The results of this case study will give baseline information that can provide ideas to the local government authorities on the current status of the installed artificial reef in Tigbauan, Iloilo, Philippines, and its impacts on the fishers. Information from the study can contribute to policymakers, and coastal resource managers in decision making as to AR projects are necessary to be implemented. Improved management measures can be formulated as well to lessen its failure in the future.

CONCLUSION AND RECOMMENDATIONS

Tigbauan, Iloilo, Philippines, specifically Barangay Baguingin, is one of the LGU recipients of the AR Projects conducted nationwide in the Philippines. Monitoring is scarce in the area, thus leading to limited knowledge about the status of the installed ARs underwater. Proper deployment manner and site selection of ARs are essential and necessary to focus on to avoid failure of the projects. Barangay Baguingin failed to follow such factors, and therefore expected benefits were not achieved. Although Baguingin fishers are fully supported and are optimistic about the AR Project to provide good services for them and the ecosystem, the AR structures ultimately did not meet the fishers' expectations.

This study strongly recommends that monitoring of the implemented projects must be done to have an update on the status of the project and if whether it is feasible in the area. Different stakeholders should be involved in the monitoring process so that realizations would be met and efforts invested were not be wasted if possible. Furthermore, prior to any projects that are planned to be implemented should have a scientific basis to avoid any disappointments in the long run.

COMPLIANCE WITH ETHICAL STANDARDS

Author contributions

All authors contributed equally to the writing of the manuscript.

Conflict of interest

Authors declare that they have no conflict of interest.

Animal welfare statement

No animals were used in this study. Human rights statement Official approval is not required for this type of study.

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Appendix A

Effectiveness and Impact of Artificial Reef Project in Tigbauan, Iloilo, Philippines: A Case Study

Key Informant Interview (KII) Survey Form

Date of Interview: _____

I. Respondent Informed Consent Statement

Research conducted by:
Maria Liza T. Farquerabao and Eddie R. Domingo
MS Fisheries Biology Students
University of the Philippines Visayas

As an informed participant in this research, I understand and acknowledge that:

I have been duly informed that my responses will be kept anonymous, and my personal details and those of any other people or organizations.

I have been properly informed that the details I provide will be used for the completion of the study entitled "Effectiveness and Impact of Artificial Reef Project in Tigbauan, Iloilo, Philippines: A Case Study" and may also be used as material for books or journal articles.

I have been duly informed that I may choose to end my participation at any time without consequence.

Any questions that I had about this research have been satisfactorily answered.

_____
Signature Over Printed Name

Name of Respondent: _____
First Name Middle Name Last Name

Position/Occupation: _____

II. Overview of Installed Artificial Reef

1. What type of artificial reef was installed? State the specifications of the design.
2. Why chose that design/type?
3. Who are the target beneficiaries of this project?
4. Are there ordinances related to the installation of an artificial reef in this municipality?
5. Why Barangay Baguingin was the only recipient among the coastal barangays in Tigbauan, Iloilo?
6. When was the installation done?
7. How many were installed? Specify the area covered.
8. Who are the responsible agencies initiated the project?
9. Why come up with the projects? Are there scientific studies prior to implementation? State the reasons for installing the artificial reef.
10. Was there a consultation meeting with the fishermen or community regarding the installation? Was any information drive done in the area?
11. What were the responses of the people prior to the implementation of the project?
12. Who are responsible for the construction of the artificial reef? Are the people in the community/fishermen involved?
13. How much is the total cost of the project?

III. Effectiveness of Artificial Reef Installed

1. Is there monitoring or assessment done after the artificial reef installation?
   ___ Yes ___ No
   If yes, answer the questions below.
   - How is monitoring done? Do you have tools and methods to follow?
   - Who are responsible?
   - How were the findings recorded and stored, i.e., data management?
   - What are the challenges encountered in monitoring and regulatory activities?

Questions	Yes	No	Comments/Remarks
a. Is water quality maintained?			
b. Did the structural integrity and stability of the reef infrastructure is maintained over time?			
c. Is there an increase of contaminants in the environment (water and sediments)?			
d. Is the occurrence of pests and/or other invasive species minimized?			
e. Are the ecological, social, and economic goals of the reef achieved?			
f. Is navigational safety maintained?			
g. Are the objectives of the projects being met at the least possible cost?			
h. Does the monetized value of the project's benefits exceed the project's costs?			

If no, answer the following questions.

a. Why no monitoring or assessment had been done after the installation?
b. Any updates regarding the status of the reef and its impact on the fishermen in the area?

IV. Issues/Concerns regarding the artificial reef installed

V. Any plans for the artificial reef installed?

VI. Any future CRM plans in the municipality?

Appendix B

Effectiveness and Impact of Artificial Reef Project in Tigbauan, Iloilo, Philippines: A Case Study

Household Survey Interview Form

Household Number: _____ **Date of Interview: _____**

I. Respondent Informed Consent Statement

Research conducted by:
Maria Liza T. Farquerabao and Eddie R. Domingo
MS Fisheries Biology Students
University of the Philippines Visayas

As an informed participant in this research, I understand and acknowledge that:

I have been duly informed that my responses will be kept anonymous, and my personal details and those of any other people or organizations.

I have been properly informed that the details I provide will be used for the completion of the study entitled "Effectiveness and Impact of Artificial Reef Project in Tigbauan, Iloilo: A Case Study" and may also be used as material for books or journal articles.

I have been duly informed that I may choose to end my participation at any time without consequence.

Any questions that I had about this research have been satisfactorily answered.

_____
Signature over Printed Name

II. Personal Background

1. Name of Respondent: _____
   First Name Middle Name Last Name
2. Age: _____ years old
3. Gender: _____ Male _____ Female
4. Years of residency in Tigbauan, Iloilo
   ___ <1 year ___ 1-5 years ___ 6-10 years ___ 11-15 years
   ___ 16-20 years ___ 25-30 years ___ >30 years
5. Highest Educational Attainment:
   ___ No formal schooling ___ Elementary level
   ___ Elementary graduate ___ High school level
   ___ High School graduate ___ College level
   ___ College graduate ___ Vocational Courses
6. Religion: ___ Roman Catholic ___ Other: _____
7. Civil Status: ___ Single ___ Married ___ Widowed ___ Separated
8. Number of Household Members: _____

9. Are you a fisherman? ___ Yes ___ No
   If yes, specific gear used: _____
10. Years of Engagement in Fishing: _____
11. Major Source of Income: _____
12. Other Source of Income: _____

III. Level of Awareness

1. Are you aware of the installation of the artificial reef in your area?
   ___ No Awareness ___ Limited Awareness
   ___ Moderate Awareness ___ Extensive Awareness
   ___ Complete Awareness

2. Did you remember when was it installed? ___ Yes ___ No
   If yes, what date? _____
   If no, why? _____

3. Was there an information drive done by LGU prior to the installation?
   Is it well explained? ___ Yes ___ No
   If yes, explain what information did he/she understand.
   _____

   If no, state reason/s why. _____
4. What was your reaction to the project?
5. What was your contribution as a fisherman?
6. Are there monitoring done by LGU or any other government agencies?
   _____ Yes _____ None
   If yes, did you participate during the monitoring? _____

IV. Effectiveness of Artificial Reef Installed

1. Rate the following conditions.

1 – Very Poor, 2 – Poor, 3- Not Good Not Bad, 4 – Good, and 5 – Excellent

Questions	Rating	Comments
1. How was the status of the area before the installation of the artificial reef?		
2. How is the status now, three years after the installation?		

2. Check the answer. Provide any perceptions of the fishermen in the comment box.

Questions	Yes	No	Comments
1. Is water quality maintained?			
2. Is the structural integrity and stability of the reef infrastructure maintained over time?			
3. Is there an increase of contaminants in the environment (water and sediments)?			
4. Is the occurrence of target fish increasing?			
5. Are the ecological, social, and economic goals of the reef achieved?			
6. Is navigational safety maintained?			

3. In your own perspective, was it necessary to install the reef in your area?
   ___ Yes ___ No. Why? _____
   _____
4. Did you already feel the impact in three-year time? ___ Yes ___ No
   If yes, how? _____
   _____
   If no, why is it so? _____
   _____
5. Any issues or problems encountered regarding the presence and installation of the artificial reef?
   _____
   _____
6. Do you have a suggestion for the concerned LGU to improve the project?
   _____
   _____
7. Any other concerns/issues in the area that needs to be addressed immediately regarding your coastal area?
   _____
   _____
8. If given a chance, what message do you want to tell the fishery managers to improve the fishery resources at the same time improving your status as a fisher?
   _____