Supporting Report-6

Public Consultation in Phase-1

11. Public Consultation

11.1 Overview

Figure 11.1.1 shows the schedule of the public consultation, including workshops with stakeholders and the Project Coordination Committee (PCC), with the Tuvaluan government, stakeholders, and relative organizations. In this chapter, details of the workshops and PCC are presented in Sections 11.3 and 11.4, respectively.

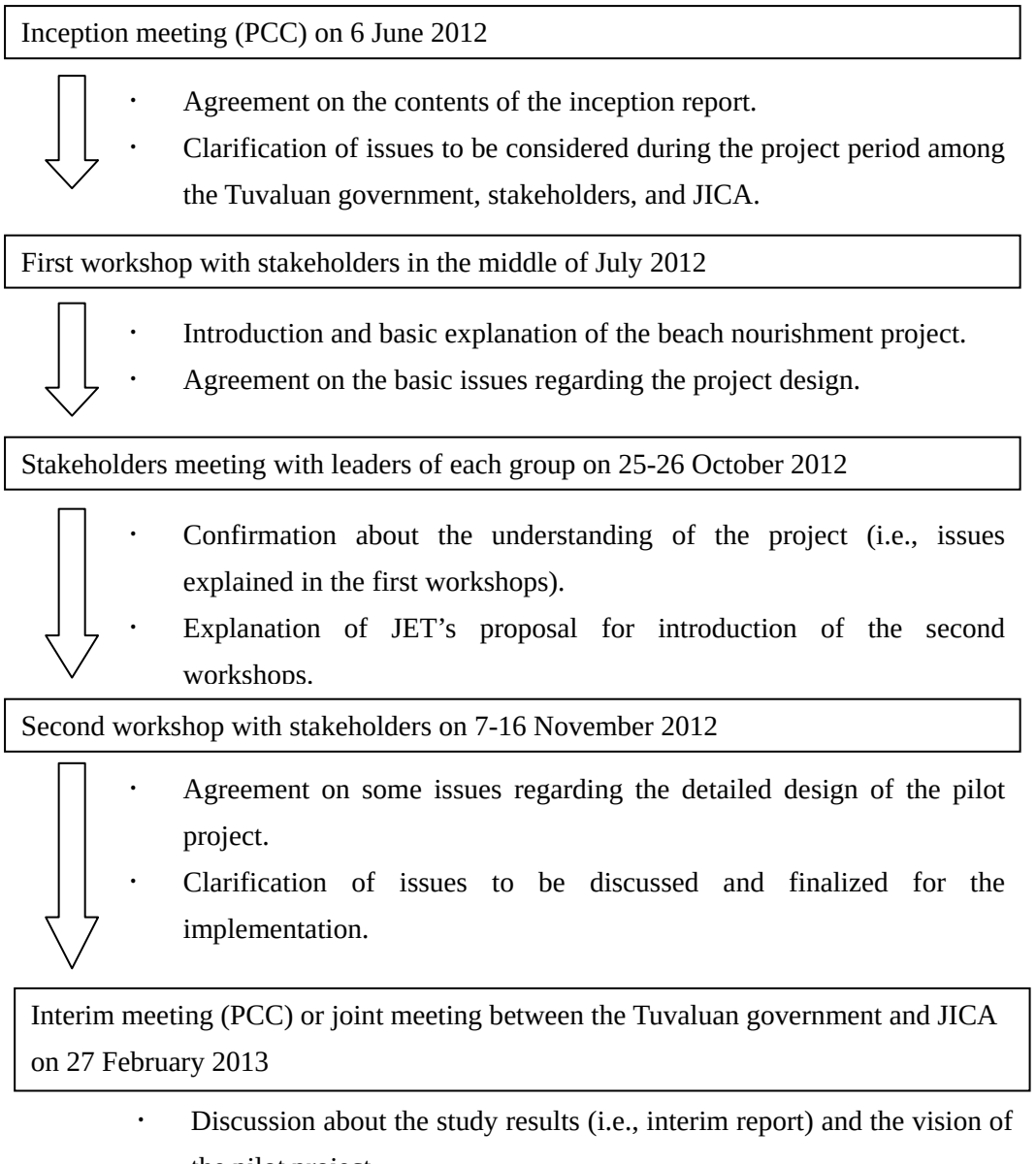


Figure 11.1.1 Schedule of the Public Consultation

(Source: JICA Study Team)

11.2 Approach to Public Consultation

(1) Characteristics of the Community

Figure 11.2.1 shows the governance system in Tuvalu. In the figure, the area enclosed with the red line shows the target for PCC, while the area enclosed with the blue line shows the target for the workshops with stakeholders. One entity in the governance system in Tuvalu is represented by the Fale Kaupule. The Fale Kaupule is a traditional assembly present in each island of Tuvalu and was created in accordance with customs and tradition. The Fale Kaupule is conferred with greater control over the affairs and activities of the islands by vesting in them powers and functions once vested in the island councils. Basically, the Fale Kaupule is the supreme decision making body of all matters in the community that are of public interest or political importance, with the Kaupule as the executive arm within the community. Therefore, it is important that any public consultation has to be conducted with permission from the Fale Kaupule, and any decision from the community will be made by them.

The community originally from Funafuti mainly consists of the following four communities: the Funafuti Fale Kaupule, Funafuti Women, the Funafuti Fisherman, and the Funafuti Masaua community. For reference, “Masaua” in the Tuvaluan language means “the young”. There is also another community consisting of residents from other islands. All the communities have to be involved in the public consultations. However, it seems that some communities have less voice when they are involved in other communities. Therefore, it was noted that the workshops should be conducted considering such traditional situations of the communities.

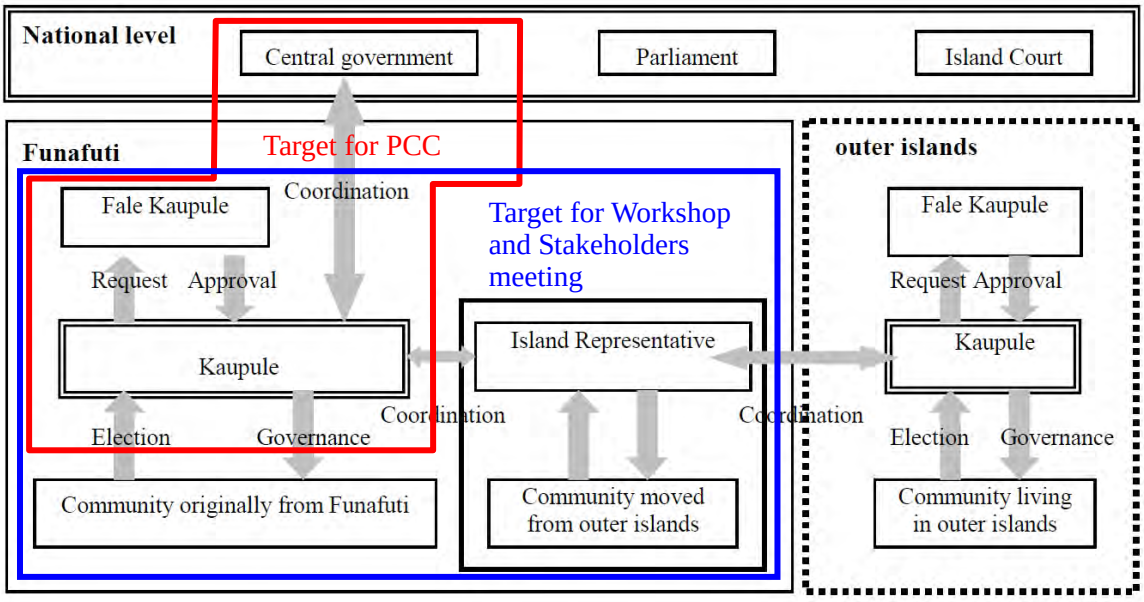


Figure 11.2.1 Governance System in Tuvalu

(Source: Completed JICA Development Study (2011))

(2) Plan for Public Consultation

Through the considerations on the characteristics of the Funafuti community above, the basic procedures for the workshops are planned as follows:

- The contents of the workshop are going to be explained to the Fale Kaupule before conducting other workshops with other communities;
- After the first workshop with communities, the second workshop with the Fale Kaupule will be conducted to obtain consensus on the issues discussed with all communities; and
- Basically, the workshop is going to be held independently with each community. Especially, for the women's community, they seem to have less voice than other communities; therefore, the workshop with the women's community should be conducted independently.

In addition, considering that the beach nourishment is not so familiar to the Funafuti communities, the following methods are adopted to improve understanding through the workshops;

- The stakeholders meetings with leaders from each community were conducted to confirm their understanding about the project before conducting the second workshop;
- One of the main objectives of the workshop is to build a consensus with stakeholders. However, there are some issues which are not directly related to a particular community. For example, the issue of boat landing is not directly related to the women's community because there is no fisherman in that community. Considering such situations, the workshop should be held starting with clarifications on the issues to be agreed upon between the community and others; and
- The presentation materials are prepared in Tuvaluan language in order to promote participants' understanding during the presentation. On the other hand, members of the JICA Study Team made presentations and answered their questions in English to avoid misunderstanding on technical matters. In case of necessity, the secretary of the JICA Study Team translates English to the Tuvaluan language for the participants' understanding.

11.3 Workshops and Stakeholders Meeting

(1) First Workshop with Stakeholders

The first workshop was held during the middle of July 2012 to give an overview of the project and to have some basic agreements with the stakeholders. Table 11.3.1 shows the summary of the issues agreed on in the first workshop, and the issues to be discussed in the second workshop. The presentation materials are shown in Appendix 11.3.1.

Table 11.3.1 Summary of the First Workshop

Main Issues	Agreements (Conclusion)	To be Discussed in the Second Workshop
Gravel nourishment for beach protection	Reasonable with scientific basis	Image of cross section of beach nourishment
Candidate gravel and sand borrow sites	-	The JICA Study Team will present the candidate gravel and sand borrow sites along with their impacts to the environment
Construction of groins as sand stoppers	Reasonable with scientific basis	Explanation on the importance of sand stoppers
Material used for the boundary between the public and private areas	The parapet, a continuous concrete structure, was not preferred because it would prevent rainfall discharge from the residential area to the lagoon.	The JICA Study Team will propose other suitable materials for the boundary.
Beach management after the nourishment	Since the beach is a public area, private constructions, such as boat landing slopes, are not allowed.	Explanation on the importance of beach management
Boat landing	・ Boat landing slope is not allowed to be constructed in the project area (i.e., the beach nourishment area) ・ There is a possibility to construct public boat landing slope at the edge of the project area	・ Confirmation of the necessity of boat landing slope since some fisherman mentioned disadvantages of constructing a boat landing slope
Necessity of the Prince William Ramp and the Amatuku Jetty	Both existing structures are not needed and they could be removed.	Possibility of removal and reuse of both structures
Beach use during construction	(No discussion)	Restrictions during the construction period

(Source: JICA Study Team)

(2) Stakeholders Meetings with Leaders of Each Community

The stakeholders meetings were conducted on 25-26 October 2012 with leaders and key persons of each group: the Funafuti Fale Kaupule (FFK), the Fisherman Group (FG), the Masaua Group (MG), and the Women Group (WG). The details of the meetings are summarized in Table 11.3.2. The presentation materials used in the stakeholders meetings are shown in Appendix 11.3.2.

Table 11.3.2 Summary of Stakeholders Meetings with Leaders of Each Community

Objective	1) Confirmation of understanding of the project (i.e., first workshop) 2) Discussion of the proposals made by the JICA Study Team
Date	25-26 October 2012
Venue	Funafuti Town Council
Participants (Stakeholders)	Key persons from FFK, FG, MG, and WG (recommended by Mr. Pasefika, President of Kaupule) *Meeting was conducted for each group
JICA Study Team	Messrs. Endo, Ichikawa (social considerations), and Onaka
Photos taken during the stakeholders meeting with leaders/key persons	 

(Source: JICA Study Team)

1) Confirmation of Understanding of the Project (i.e., first stakeholders meeting)

To confirm the understanding of the project, a hearing with stakeholders was held without giving any information about the project. The stakeholders answered several basic questions without looking at the base map of the project site. The results are shown in Table 11.3.3.

Table 11.3.3 Results on the Understanding of the Project by Stakeholders

Group of Stakeholders	Fale Kaupule (FFK)	Fisherman Group (FG)	Masaua Group (MG)	Women Group (WG)
Leaders / Key persons	Mr Suka Mr Obrien Mr Elisala	Mr Tapumanaia Mr F. Naseli Mr P. Naseli	Mr Siaosi Mr Penileta	Mrs Simeona Mrs Katarake
Purpose of the project	・Protection against wave and erosion ・To keep the beach in beautiful conditions	・To bring back the beach width to previous width	・To maintain the natural sandy beach	・Protection against waves
Material for beach nourishment	Sand	Gravel	Gravel	Sand
Project area	Between the no sand area and the Prince William Ramp/Amatuku Jetty	Up to around the Prince William Ramp/Amatuku Jetty including the community center	Up to around the Prince William Ramp/Amatuku Jetty including the community center	Up to the Amatuku Jetty including the community center
Boat landing	To construct the boat landing slope at the north end of the project area	To construct the boat landing slope at the north end of the project area	To construct the boat landing slope at the north end of the project area	To construct the boat landing slope at the south end of the project area

(Source: JICA Study Team)

Table 11.3.4 Evaluation of the Stakeholders' Understanding of the Project

Confirmation	Evaluation of Stakeholders' Understanding
Objective of the project	Each group well understood the basic objective of the project, which is for "beach protection".
Materials for Beach Nourishment	Each group well understood that the beach would be widened through the beach nourishment project. Some groups, however, misunderstood what the materials would be used for nourishment.
Project Area	Each group well understood that the north end of the project area would be around the Prince William Ramp/Amatuku Jetty. However, only FFK correctly understood where the south end of the project area would be. The south end would be at the area without sand.
Boat Landing	Their understanding was that the boat landing slope would be constructed at the end of the project area.

(Source: JICA Study Team)

2) Discussion of the Proposals Made by the JICA Study Team

The following shows the stakeholder's opinions on the proposals made by the JICA Study Team.

a. Project Area

(Explanation by the JICA Study Team)

- There is a deep water area in front of the Amatuku Jetty. Suppose the beach nourishment is conducted until the Amatuku Jetty, the deep area may trap the sand from the project area.
- Since the project is a pilot project, it would be desirable for the project to become successful as much as possible in order to target a full-scale project in the future.
- Therefore, the project area is preferred to be from the Prince William Ramp until the Amatuku Jetty, although the final decision on this should be discussed with the government.

(Opinions from the Stakeholders)

- (FFK, FG, and WG) They agreed to the proposals considering the risks of outflow of sand.
- (WG) They agreed to the proposals because of the scientific basis and the Fale Kaupule's approval.

b. Materials for Beach Nourishment

(Explanation by the JICA Study Team)

- In the first workshop, gravel was presented as the material to be used for the beach nourishment.
- However, it was proposed in the meeting that the combination of gravel and sand would be desirable because of the following reasons:
  1) To restore the natural beach conditions in Tuvalu; and
  2) Improvement for beach utilization, especially for boat landing.
- The vision of the beach after beach nourishment would be similar to the sandy beach located next to the project area, although the final decision on this should be discussed with the government.
- This matter should be discussed with the government for finalization.

(Opinions from the Stakeholders)

- (FFK, and WG) They have considered that it is important to restore the natural beach conditions. Furthermore, the sandy beach would be more convenient for daily use not just for them but for everyone who uses the beach.
- (FG, and MG) They agreed with the proposal for the improvement of boat landing.

c. Boat Landing

(Explanation by the JICA Study Team)

- In the first workshop, it was explained that the boat landing slope may be needed at the edge of the project area because structures are not allowed in the beach nourishment area.
- The reasons why private boat landing slopes were constructed at the beach could be the following:
  1) The present beach consists of concrete blocks and angular gravels. The bodies of boats could be damaged during boat landing.
  2) Boat owners have to bring their boats to their houses for repair works.
- The construction of one boat lading slope has the following disadvantages:
  1) The boat landing slope would be crowded due to concentration of access.
  2) Boat owners have to transport their boat from the boat landing slope to their houses. Some machines such as cars would be needed for the transportation. In addition, the residential area does not seem to have enough space or roads for the transportation.
- On the other hand, the beach with gravel and sand (i.e. the JICA Study Team's proposal) would make boat landing possible because the beach profile is similar to where boat landing is conducted daily.

(Opinions from the Stakeholders)

- (FFK) Considering that the beach itself can be used as a boat landing slope, the last proposal was preferred (i.e. first workshop).
- (FG, and MG) Considering the necessity of transportation, they realized that one boat landing slope would be inconvenient. Since they can conduct boat landing on the present sandy beach with some support materials, they agreed to the proposed cross section.
- (WG) They preferred the proposal that would be convenient for boat landing and restoring the natural beach.

d. Beach Management

(Explanation by the JICA Study Team)

- Issues related to beach management had not been explained in the first workshop. However, this is one of the most important matters because it needs understanding and cooperation by stakeholders.
- Explanation on the necessity of beach management and types of maintenance methods (technical and nontechnical) was conducted by the JICA Study Team.
- For beach management, the awareness of each resident or beach user should be enhanced.
- In the first workshop, a continuous concrete wall (i.e. parapet) was considered the boundary material between the public and private areas. However, the parapet was not preferable because it could prevent rainfall discharge from the residential area to the lagoon.
- Instead of the parapet, natural stones and trees were proposed as the boundary materials. Installation intervals are going to be set considering boat landing space. Such space will contribute to the improvement of rainfall discharge.

(Opinions from the Stakeholders)

- (All groups) They well understood the types and prohibited matter regarding beach management.
- (FFK) As for maintenance, they are willing to have leadership to enhance the awareness of the residents. Holding a seminar on beach management could be effective for further understanding.
- (FG) Some intervals would be needed for the installation of boundary materials considering boat landing.
  (FFK) The site visit will be necessary to set the appropriate installation intervals.

(3) Second Workshops with Stakeholders

The second workshop with stakeholders was held with the schedule as shown in Table 11.3.5. The objectives of the workshop were to improve the understanding of stakeholders through explanation about basic planning and to agree on some issues before proceeding with the detailed design. During the meeting, the issues were mainly divided into three categories: agreement, confirmation, and understanding matters.

An issue considered directly related to the community is categorized as agreement matter for the corresponding community. An issue considered not directly related with the community is categorized as confirmation matter. Lastly, an issue considered not needing any agreement during the workshop but could be important as basic information for the project is categorized as understanding matter. These categorizations are shown in Table 11.3.6 along with the outline of the contents of the workshop and agreement matters for each group. The presentation materials used in the workshop are shown in Appendix 11.3.3.

Table 11.3.5 Schedule of the Second Workshop with the Stakeholders

Date		Place	Time	Description
11/7	Wed.	Community Hall	10:00-12:00	Workshop with FFK
11/9	Fri.	Community Hall	10:00-12:00	Workshop with WG
11/12	Mon.	Bingo Hall	10:00-12:00	Workshop with FG
11/13	Tue.	Bingo Hall	10:00-12:00	Workshop with residents and MG
11/16	Fri.	Community Hall	10:00-12:00	Workshop with FFK (second) (Confirmation of the agreements)

(Source: JICA Study Team)

Table 11.3.6 Outline of the Contents of the Workshop and Agreement Matters for Each Group

Planning and Design Matters for the Project	**FFK**	**FMG**	**WG**	**RMG**
a. Concept of the project area	C	C	C	C
b. Concept of typical cross section	A	A	A	A
c. Necessity of groins as sand stoppers	A	A	A	A
d. Concept of boat landing	A	A	C	A
Construction Matters for the Project	**FFK**	**FMG**	**WG**	**RMG**
e. Limitation of beach use during construction period	A	A	A	A
f. Removal and reuse of existing structures and blocks in the project area	A	A	A	A
g. Removal and reuse of materials of the Catalina Ramp	A	A	C	C
h. Candidate borrow site for gravel	C	C	C	C
i. Candidate borrow sites for sand	A	A	C	C
Beach Management Matters for the Project	**FFK**	**FMG**	**WG**	**RMG**
j. Purpose of beach control	U	U	U	U
k. Basic role of beach control (beach utilization matter)	U	U	U	U
l. Identification of boundary	A	A	A	A
m. Introduction of kind of beach management and control	U	U	U	U

FFK: Fale Kaupule
FMG: Fisherman and Masaua Group
WG: Women Group
RMG: Residents from other islands in the project area and Masaua Group

A: Agreement matter
C: Confirmation matter
U: Understanding matter

(Source: JICA Study Team)

Figure 11.3.1 Presentation in the Workshop (Left: FFK, Right: WG)

(Source: JICA Study Team)

From the results of the workshop, Figure 11.3.2 shows the issues which had been agreed upon in the workshops and had to be discussed/finalized before the implementation. Some other important comments from stakeholders, which have to be considered into the detailed design, are listed below.

< Important opinions by stakeholders noted in the workshop >

- FFK requested that a back wall would be needed to prevent wave inundation or soil outflow from land during extreme weather conditions.
- FFK requested that the gap between the back wall would be needed for the boat landing. If the gap is just an open space, waves or soils can easily go through toward the land area. Therefore, they requested to make humps on the gaps to reduce wave inundation or soil outflow.
- A member of WG, who is the owner of a private seawall, disagreed with the removal of the seawall because the existing seawall has worked well to prevent waves so far. If after the implementation the member sees that the beach nourishment has the same function of preventing wave inundation as the seawall, the member would agree with its removal.

1. Issues which were agreed by stakeholders at workshops

1) Concept of typical cross section of beach nourishment

Typical cross section is designed as combination of gravel and sand to:

- Reproduce the original natural beach at lagoon side.
- Improve beach utilization, especially for boat landing.

2) Necessity of the groins (sand stoppers)

Groins needs to be constructed at both ends of the project area to minimize the outflow of sand

3) Concept of boat landing

After beach nourishment, beach (combination of sand and gravel) itself can be used for boat landing. Therefore, no boat landing slope (i.e. structure) will be constructed.

4) Removal of Catalina ramp and reuse of the material for the project (if needed)

If the construction materials were not enough, a part of Catalina Ramp would be removed for the construction materials

2. Issues which have some concerns to be discussed at next workshops

1) Removal of seawall

- FFK mentioned that the owner of seawall does not want to remove it.
- A member of FWG, who is the owner of seawall, opposed against removing the sea wall considering the wave overtopping during the extreme weather conditions. She wanted filling the gravel / sand without removal or conducting the project outside of seawall area.
- FFG asked whether compensation is guaranteed for the owner of seawall if it's removed.

2) Reuse of concrete blocks at project site

- FFK mentioned that they would like to use removed concrete blocks for protecting other coastal area against wave overtopping.
- WG suggested that removed concrete blocks would be used for filling the deep area to reduce the outflow of sand.

3) Candidate borrow site for sand

- FMG and NRG basically agreed that sand borrow area was chosen to minimize the environmental impact. However, they also concerned about what happened in Kiribati (i.e. small island around new causeway was diminished)
- FWG had similar opinions as above.

4) Identification of boundary between public and private

- FFK mentioned that the identification of boundary would be preferred to reduce soil erosion (i.e. outflow of soil to lagoon side) as well as wave overtopping during extreme weather conditions. (e.g. parapet)

Figure 11.3.2 Issues that were Agreed Upon and to be Discussed Further

(Source: JICA Study Team)

(4) Issues that Need Consensus Before the Pilot Construction

As described in the previous section, there are some remaining issues that need consensus from stakeholders before the pilot construction. Such issues are discussed below along with corresponding drawings taken from the detailed design of this study.

- North and south boundaries of the project area

  The project area in the detailed design proposed that the Amatuku Jetty would be the north boundary and the existing seawall would be the south boundary. The distance between the boundaries is 186 m. The north boundary was set at the Amatuku Jetty to cover the community hall in the project area, considering the request from the Fale Kaupule. The south boundary was set up at the existing private seawall in order to avoid intrusion or removal of the seawall because its owner rejected to remove it as told during the workshop. It was noted that the owner would likely agree to remove the seawall if the beach protection effect is well examined after the implementation of the pilot project.

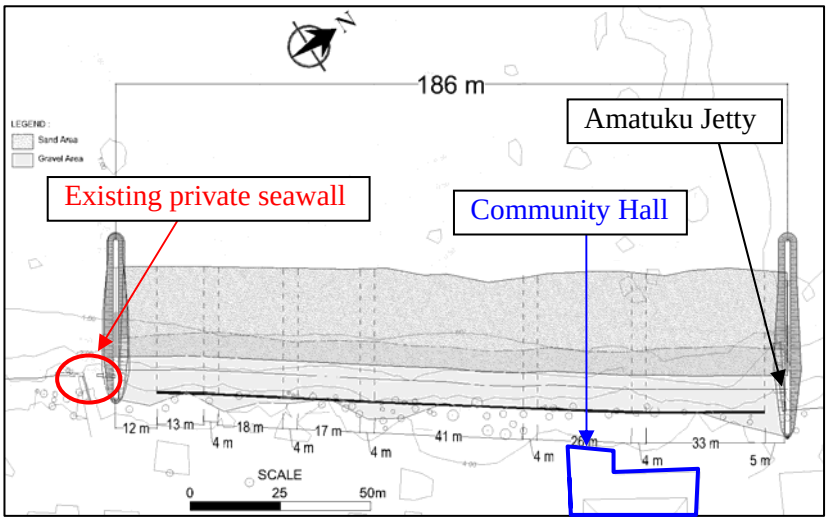


Figure 11.3.3 Project Area as Basis for the Decision

(Source: JICA Study Team)

- Concrete plan for the reuse of existing concrete blocks

  Some stakeholders requested to use the existing concrete blocks outside the project area. Therefore, it is important to explain the necessity of using the existing concrete blocks inside the project area to stakeholders based on the concrete plan.

- Impacts caused by sand extraction

  Stakeholders anticipated the worst situations that may occur due to sand extraction (e.g., erosion caused in Kiribati). It is important to explain the differences of the mechanism of sediment transport between the project area and Kiribati.

- Identification of the boundaries between the public and private areas

  The backshore wall was proposed, as shown in Figure 11.3.4, as identification of the boundaries, and as prevention for wave inundation and soil outflow during extreme weather conditions. The backshore wall was designed based on the stakeholders' opinions; however, the detailed design need to obtain consensus with them.

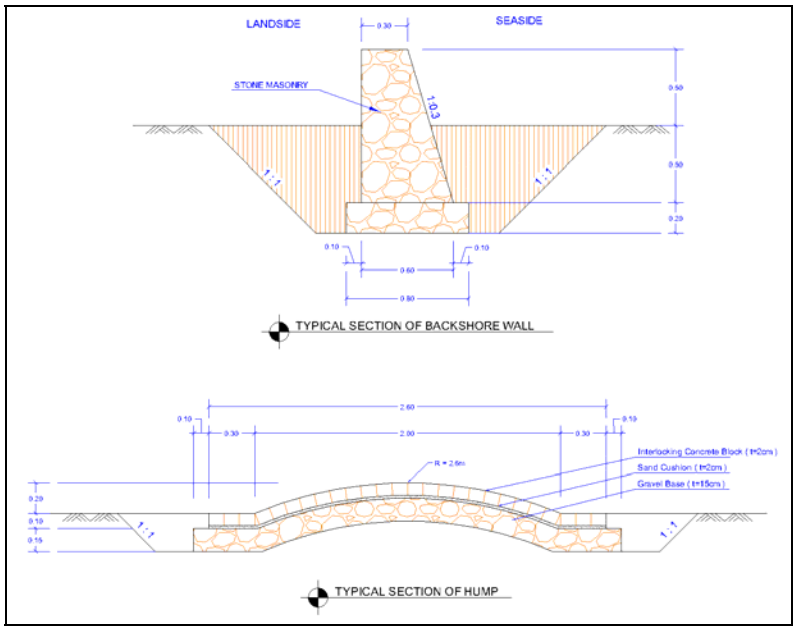


Figure 11.3.4 Typical Cross Section of Backshore Wall and Hump

(Source: JICA Study Team)

- Limitation of beach use during the construction period

  Before the pilot construction, the limitation of beach use during the construction period has to be explained to the stakeholders based on the concrete implementation schedule. During the implementation, some areas cannot be used for boat landing; therefore, alternative spaces have to be considered for such.

- Dimensions of sand stopper

  In the workshop, the necessity of sand stoppers was agreed upon; however, their detailed design and dimensions have not been explained to the stakeholders. Thus, it is important to explain the detailed design to the stakeholders before the pilot construction.

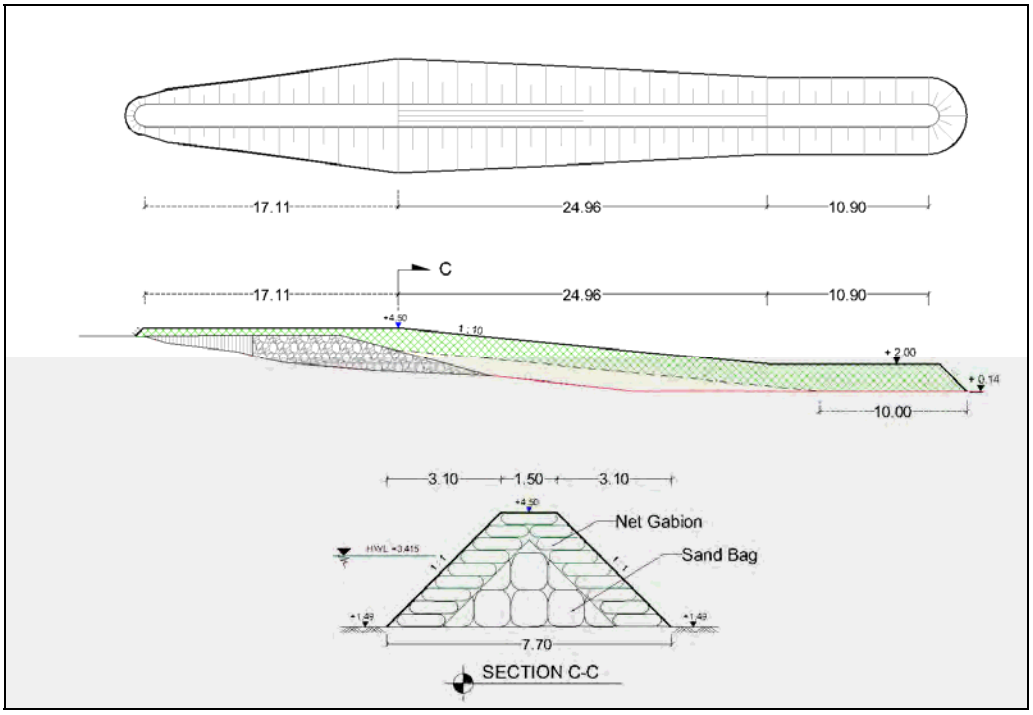


Figure 11.3.5 Typical Plane View and Cross Section of the Sand Stoppers

(Source: JICA Study Team)

11.4 PCC

PCC(Project Coordination Committee) was held in both the inception and interim meetings. It was attended by the Tuvaluan government, leaders of the Fale Kaupule, donors such as NAPA and JICA, and the JICA Study Team. The contents of the inception and interim meetings are summarized in the following sections.

(1) Inception Meeting

The inception meeting was held on 6 June 2012 in order to discuss the contents of the inception report, which consists of the overview and objectives of the pilot project. It was attended by members of the Ministry of Foreign Affairs, stakeholders, JICA and JET. In the meeting, the issues below were discussed and consequently were identified by all the participants. The details of the inception meeting are shown in Appendix 11.4.1.

< Issues identified in the inception meeting>

- Gravel nourishment as a public shore protection facility
- Necessity of management of gravel nourishment
- The process of selecting the gravel borrow sites
- Cooperation with the government and the stakeholders for coordination and arrangement of the project
- Tentative schedule for the implementation of pilot project
- The vision for full-scale implementation

Figure 11.4.1 Presentation During the Inception Meeting

(Source: JICA Study Team)

(2) Interim Meeting

The interim meeting was held on 27 February 2013 as the "Joint Meeting between the Tuvaluan Government and JICA regarding the project for Pilot Gravel Beach Nourishment against Coastal Disaster on Fongafale Island in Tuvalu". The objectives of this meeting was to discuss the contents of the interim report, which included the study results until the date of the meeting. The meeting was attended by members of the Ministry of Foreign Affairs, the stakeholders, donors such as NAPA and JICA, and the JICA Study Team. In the meeting, the following issues were discussed. The details of the interim meeting are shown in Appendix 11.4.2.

< Issues discussed in the interim meeting >

- Impacts on the environment as caused by the extraction of gravel from Funamanu Island
- Locations of the sand borrow sites and impacts of sand extraction
- Slope of the beach nourishment
- Wash-up of gravels during high wave conditions
- Impacts on areas outside the project area
- Rehabilitation plan
- Wastes from construction works

Figure 11.4.2 Presentation During the Interim Meeting

(Source: JICA Study Team)

Supporting Report-7

Bidding Process

8. Support for Bidding

8.1 Overview

Prior to the implementation of the pilot project, the capability and availability of the Contractor for the project have been studied from both technical and financial view points in the previous study. As the results, it has been judged that the Contractors should be selected from Fiji since no competent Contractor has existed in Tuvalu. In consideration of those situations, the following points should be taken into account when Bidding Documents would be prepared.

- Particularity of the project: Pilot project with limited budget, scale and construction period,
- Particularity of the works: Gravel nourishment with sand nourishment covering layer,
- Particularity of the procurement conditions in Tuvalu: No material and equipment being able to be supplied in Tuvalu,
- Particularity of the employment situation in Tuvalu: Unskilled workers should be employed in Tuvalu as much as possible.

Furthermore, Bidding Process, from Notice of Bids to Contract Awards, should be completed approximately within two months, and the supporting for Bidding should be mainly done in Fiji.

8.2 Preparation of Bidding Documents

8.2.1 Basic Concept of Bid and Bidding Documents

Prior to preparation of the Bidding Documents for this project, the following basic concept has been applied based on the series of discussion with the Global Environmental Department and Procurement Department in the JICA headquarters.

- Reference of bidding documents: Small Works and Grant Aids of JICA's Standard Bidding Documents.
- Pre-qualification: Not required.
- Type of Bid: Single envelope bid, nominated competitive Bid.
- Type of Contract: Lump-sum contract.

8.2.2 Contents of Bidding Documents

A series of discussions with above departments of the JICA headquarters and JICA Fiji office have been held timely and intensively to finalize the Bidding Documents.

The contents of the Bidding Documents are summarized below.

8.2.3 Outline of Bidding Documents

Each content was carefully and precisely specified complying with the particular features of this project in order to execute Bidding Procedure successfully and select the most eligible Bidder for this project. Outline of the Bidding Documents are described hereunder.

Table 8.2.1 Outline of Bidding Documents

For BID		
1. Name of the Works	ITB1.1 (BDS)	Pilot Gravel Beach Nourishment Against Coastal Disaster
2. Closing of Bid Submission	ITB22.1 (BDS)	Date: May 26, 2015, Time: 13:30 Fiji Standard Time
3. Bid Opening	ITB25.1 (BDS)	Date: May 26, 2015, Time: 13:45 Fiji Standard Time
4. Bid Submission & Opening Venue	ITB22.1, ITB25.1 (BDS)	Japan International Cooperation Agency(JICA) FIJI Office Attention: Mr. Hiroyuki Sawada Street Address: BSP Suva Central Building, Corner of Pratt Street & Renwick Road Floor/Room number: Level8 City: Suva ZIP Code: JICA Private Mail Bag, Suva, Fiji Country: Fiji Telephone: +679-330-2522 Facsimile number: +679-330-2452 Electronic mail address: Sawada.Hiroyuki@jica.go.jp Bids must be brought with the Contractor at address above and no later than the date and time mentioned above.
5. Currency & language	ITB15.1 ITB10.1 (BDS)	Currency of Bid: Fiji Dollar Language of Bid: English

6. Bid Validity Period	ITB18.1 (BDS)	60 days from Bid Opening date
7. Bid Security	ITB19.1 (BDS)	Not required
8. Answers & Questions	ITB7.1 (BDS)	1) Deadline for questions: 21 days before the closing of Bid Submission (May 6, 2015), 2) Submission of questions: ***To be sent by e-mail*** to the address mentioned below: JICA : Sawada.Hiroyuki@jica.go.jp Consultant (N.K) as C.C.: onaka-ss@n-koei.jp 3) Date for Answers: anytime before the final date of issuance of Addendum (refer to 4) below), 4) Date for final date of Issuance of Addendum: May 13, 2015
9. Type of Bid	-	Nominated Competitive Bid Single Envelope Bid (1 original, 4 copies)
10. Evaluation Procedure	ITB29.1	Preliminary Examination of Bids The Employer shall examine the Bid to confirm that all documents and information requested in ITB 11.1 have been provided, and to determine the completeness of each document submitted.
	ITB29.2	If any of these documents or information is missing, the Bid shall be rejected.
	ITB30.1	Qualification of the Bidder The Employer shall determine to its satisfaction whether Bidders meet the qualifying criteria specified in Section III, Evaluation and Qualification Criteria, during the evaluation of Bids.
	ITB30.3	A negative determination shall result in disqualification of the Bid
	ITB31.1	Determination of Responsiveness The Employer's determination of a Bid's responsiveness is to be based on the contents of the Bid itself, as defined in ITB 11.
	ITB31.3	The Employer shall examine the technical aspects of the Bid submitted in accordance with ITB 16, Technical Proposal, in particular, to confirm that all requirements of Section VI, Works Requirements, have been met without any material deviation, reservation or omission.
	ITB31.4	If a Bid is not substantially responsive to the requirements of the Bidding Documents, it shall be rejected by the Employer.
	ITB33.1	Correction of Arithmetical Errors Provided that the Bid is substantially responsive, the Employer shall correct arithmetical errors.
	ITB33.2	Bidders shall be requested to accept correction of arithmetical errors. Failure to accept the correction in accordance with ITB 33.1, shall result in the rejection of the Bid.
	ITB37.1	Comparison of Bids The Employer shall compare the evaluated prices of all substantially responsive Bids established in accordance with ITB 36.2 "Evaluation of Bids" to determine the lowest evaluated Bid.
	ITB39.1	Award Criteria The Employer shall award the Contract to the Bidder whose offer has been determined to be the lowest evaluated Bid and is substantially responsive to the Bidding Documents, provided further that the Bidder is

		determined to be qualified to perform the Contract satisfactorily.
11. Bid Documents to be submitted by Bidders	ITB 9	Bid documents to be submitted by Bidders are: (a) Letter of Bid (b) Completed schedule incl. Activity Schedule (c) Written confirmation authorizing the signatory of the Bid to commit the Bidder (d) Documentary evidences as requested in Bidding Document (e) Technical Proposal as requested in Bidding Documents (f) Other documents as requested in Bidding Documents
For CONTRACT		
12. Prospected Award & Contract Date	-	Date：Date: June 12, 2105
13. Type of Contract	-	Lump sum Contract
14. Advance Payment	GC 48.1 (PC)	10 % of the Accepted Contract Amount
15. Advance Payment Bond	GC 48.1	Required (same amount as above)
16. Performance Security	GC49.1 (PC)	10 % of the Accepted Contract Amount
17. Retention Money	GC 45.1 (PC)	5 % of the Accepted Contract Amount
18. Contract Documents	GC 2.3 (PC)	Contract documents consist of: (a) Contract Agreement (b) Latter of Acceptance (c) Letter of Bid (d) Addendum to Bid Documents (e) Particular Conditions of Contract (f) General Conditions of Contract (g) Specifications (h) Drawings (i) Completed schedule incl. Activity Schedule
19. Language & Law	GC 3.1 (PC)	Language of Contract: English The law that applies to the Contract: Japanese Law
20. Insurance	GC 13.1 (PC)	Required as stated in Bidding Documents
For CONTRUCTION		
21. Prospected Commencement of the Works	G.C.1.1(dd) (PC)	Date: June 15, 2105
22. Prospected Completion Date	GC1.1(t) (PC)	Date: December 23, 2105
23. The Defects Liability Period	GC33.1 (PC)	180 days (D.L.P. applies to Groin only)
24. Liquidated Damage	GC46.1 (PC)	0.3 % of the Accepted Contract Amount per day (max. 10 %)
25. Price Adjustment	GC44.1 (PC)	Not applicable
26. Scope of Works	GS 2	The main items to be executed under the Project is, as follows;
		1. General Requirement - Mob/demobilization - Preparatory Works

		2. Gravel Mining & Transportation - Gravel Mining - Gravel Transportation 3. Groin - Unloading for Armor Stones - Core Gravel Placing & Leveling - Armor Rock Placing & Leveling 4. Gravel Nourishment - Site Clean-up - Gravel Filling & Leveling 5. Sand Nourishment - Sand Transportation - Sand Filling & Leveling 6. Backshore Stone - Stone Installation 7. Facility Procurement - Boat Trailer - Rubbish Bin
27. Care of Materials ➢ Sand & Gravel Materials	GS 9	Both sand and gravel materials shall be obtained from the designated quarry as well as areas respectively which are shown in the Contract documents and/or instructed by the Project Manager. The Contractor shall make his own arrangement, obtain necessary permit from authorized concerned organizations/owners and pay all fees as may be required.
➢ Imported Rock Materials	GS 10	Armor rock, which is delivered from Fiji island, shall be fumigated as per the requirement of Bio-security Authority Tuvalu (BAT) prior to mobilization to the Project site. The following certificates shall be submitted. 1. Fumigation Certificate (issued by the fumigation company in Fiji) 2. Phytosanitary Certificates (issued by Bio-security Authority Fiji, BAF)
28. Environmental Management	TS 107	The Contractor shall comply with the requirements stipulated in the environmental approval of this project issued by the Tuvalu government, applicable environmental laws/regulations of Tuvalu, and "JICA Guidelines for Environmental and social Considerations (2010)".
➢ Floating Craft	GS 5	On the reef flat where the Works are to be executed, coral and other fragile marine biologics inhabit. Every precaution shall be taken by the Contractor to avoid any damage to their biologics by execution of the works.
➢ Boat Grounding Zone	GS 16	No floating craft shall be permitted to touch the reef flat except for in the designated boat-grounding zone as practically instructed by the Project Manager at site.
➢ Access to the Beach	GS 17	The temporary roads to the beaches shall be made by suitable material which is approved by the Project Manager. Upon completion of the Works the haul roads shall be demolished as soon as possible.

➢ Water Pollution Control	GS 32	During carrying out onshore and on-the-reef activities, the Contractor should keep ambient water of working area from contamination, especially from silt or another fine-grained sediment, which may be highly detrimental to corals and other beach and offshore benthic invertebrates.
29. Safety and Security Plan	TS 103	The Contractor shall comply with all applicable safety regulations, take care for the safety of all persons entitled to be on the Site, and use responsible efforts to keep the Site and Works clear of unnecessary obstruction so as to avoid danger to theses persons. The Contractor shall also comply with the accepted Safety and Security Plan being included in the Contract documents, and refer any time to "The Guideline for the Management of Safety for Construction Works in Japanese ODA Projects (2014)"
30. Construction Program	GS 35	Thirty (30) days after receiving the "Letter of Acceptance", the Contractor shall submit to the Project Manager a Construction Schedule for the whole of the Works and Temporary Works to be carried out under the Contract as stated in the Contract documents.
31. Reports	GS 38	The Contractor shall prepare and furnish the Project Manager three (3) copies of the following reports without cost to the Employer/Project Manager as stated in the Contract documents: ➢ Monthly Progress Report ➢ Daily Report and Schedule ➢ Record in Photographs
32. Contractor's Employee	GC9.3 (PC)	In case the Contractor intends to hire his employees up in the Tuvalu, the Contractor shall make well coordination with "Kauple(or island council of Tuvalu).

(Source: JICA Expert Team)

8.3 Support on Bidding Process

8.3.1 Bidding Process

Bidding process mainly comprises of the following procedures until the Contract would be reached between the JICA Fiji office and the most eligible Bidder.

① Invitation for Bidders (April 17, 2015)
② Distribution of Bidding Documents (April 22,23, 2015)
③ Site Visit and Pre-Bid Meeting (April 28,29, 2015)
④ Closing Date of Questions from the Bidders (May 6, 2015)
⑤ Closing and Opening of Bids (May 26, 2015)
⑥ Bid Evaluation (May 27 - June 9, 2015)
⑦ Contract Confirmation (June 12, 2015)

⑧ Contract Awards (June 12, 2015)

Bidding process has been well monitored by the Activity Check-list .

8.3.2 Invitation for Bidders

Invitation letters have been sent to the nominated Bidders on April 17, 2015 as listed below.

- Pacific Marine & Civil Solutions
- Frame Tree Development Ltd.
- Construction Equipment Hire Ltd.
- Cruz Holdings Ltd.

8.3.3 Site Visit and Pre-Bid Meeting

A Site visit and Pre-Bid Meeting has been carried out as per the schedule mentioned below. Two of the nominated Bidders, Pacific Marine & Civil Solutions and Cruz Holdings Ltd. have attended at this event.

1st day:(28th April, 2015) - Project Site in Fongafale -

11:20 Arrived at Tuvalu (FJ281)
14:00 Meet at Vaiaku Lagi Hotel Front
14:10 Arrived at Project Site (hi-tide of
Explanation from Consultant
--- Contents ---
- Outline of the Project
- Site condition (natural and social)
- Considerations on construction work
- Others

15:30 Finish

2nd day:(29th April, 2015) - Project Site in Fongafale and Gravel mining Area in Funamanu and Papaellse –

8:30 Meet at Vaiaku Lagi Hotel Front
8:40 Arrived at Project Site (check in low tide condition)
9:10 Finish
9:20 Arrived at Vaiaku Lagi Warf
- Move to Funamanu by fisherman's boat

9:50 Arrived at gravel mining area at west tip of Funamanu
Explanation from Consultant
--- Contents ---
- Outline of gravel mining
- Considerations on construction work
- Others

10:30 Finish and shift to east tip of Funamanu (by boat)
11:00 Finish and shift to west tip of Papaellse (by boat)
12:00 Finish
12:30 Come back to Vaiaku Lagi Wharf

8.3.4 Closing of Submission and Opening of Bids

Submission of Bids was closed on May 26, 2015 at 13:30 Fiji standard time. Two Bidders below submitted their bids before the designated submission deadline.

- Pacific Marine & Civil Solutions
- Cruz Holdings Ltd.

Other two bidders expressed no intension to bid the project. Then, those bids were opened in presence of the two Bidders representatives on the same date as per the procedure mentioned below.

1. Start of Bid Opening
2. Opening Remarks by the Employer (JICA Fiji Office)
3. Introduction of the attendants (Employer, Consultant and Bidders)
4. Explanation of Bid Opening Procedure by the Consultant
5. Confirmation of the Bids
6. Bid Opening
7. Confirmatio of the ceiling price
8. Results of the Bid Opening
9. Explanation about Schedule of Bid Evaluation and Award of Contract
7. Closing of the Bid Opening by the Employer (JICA Fiji Office)

As a result of the bid opening, Pacific Marine & Civil Solutions was the lowest bidder and their bid price was within the ceiling price and therefore, the bid opening was successful.

8.3.5 Bid Evaluation

Bid evaluation was carefully carried out upon the following procedures in order to determine the most eligible Bidder for this project.

i. Preliminary Examination of Bids
ii. Qualification of the Bidders
iii. Determination of Responsiveness of Bids
iv. Correction of Arithmetical Errors (if necessary)
v. Comparison of Bids

Clarification was made in accordance with the Instructions to Bidders in the Bidding Documents two times for Pacific Marine & Civil Solutions in order to clarify their proposed methodology and to ask for additional information/materials. In the course of the bid evaluation, Pacific Marine & Civil Solutions turned down his offer and as a result, the bid submitted by Cruz Holdings Ltd. needs to be evaluated (as of June 5th 2015).

8.3.6 Award of Contract

After bid evaluation, the Employer will award the Contract to the Bidder whose offer has been determined to be the lowest evaluated Bid and is substantially responsive to the Bidding Documents, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily.

Supporting Report-8

Inspection on the Pilot Construction

The Project for Pilot Gravel Beach Nourishment Against Coastal Disaster On Fongafale Island

Completion Report of the Inspection

23rd December 2015

NIPPON KOEI CO., LTD.

FUTABA CONSULTING SERVICE CO., LTD.

Inspections related to the Pilot construction of gravel beach had been conducted and completed as shown in the Table-1.

Photos of each inspection item are shown in Photo-1 and the inspection sheets are attached as following.

Table-1 Inspection Items and Implementation Date

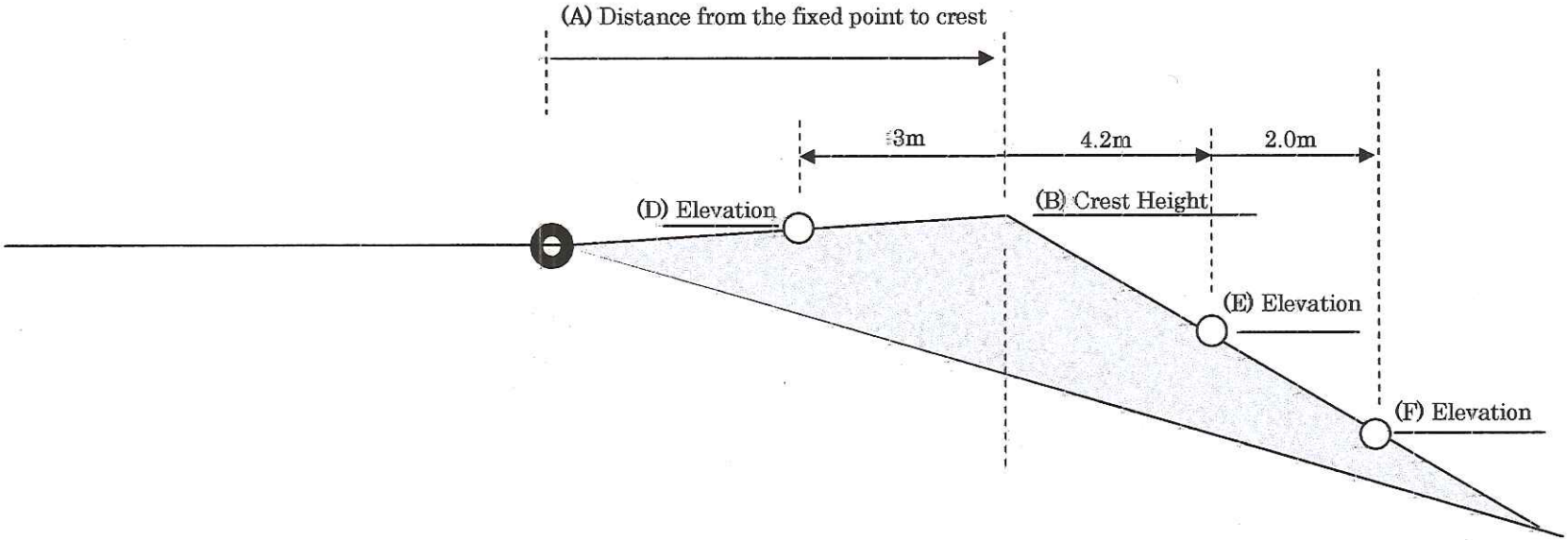
Inspection Items	Implementation Date
Gravel Beach Profile	1st Dec, 11th Dec., 2015
South Groin	8th Dec., 2015
North Groin	16th Dec., 2015
Gravel and Sand Profile	10th Dec., 12th Dec., 19th Dec., 2015
Backshore stone	22nd Dec., 2015
Facility(Boat Trailer)	22nd Dec., 2015
Facility(Rubbish bin)	22nd Dec., 2015

Gravel Beach Profile	South Groin
	
North Groin	Gravel and Sand Profile
	
Backshore Stone	Facility(Boat Trailer)
	
Facility(Rubbish Bin)	
	

Photo-1 Inspection Item Photos

Inspection Sheet for Gravel Beach Profile (Gravel Part Only)

Start Date	1st Dec. 2015	Complete Date	11th Dec 2015
Contractor's Person in charge	Mr. Dhirendra Singh Sign:	Consultant Inspector	Mr. Shingo Ichikawa Sign:

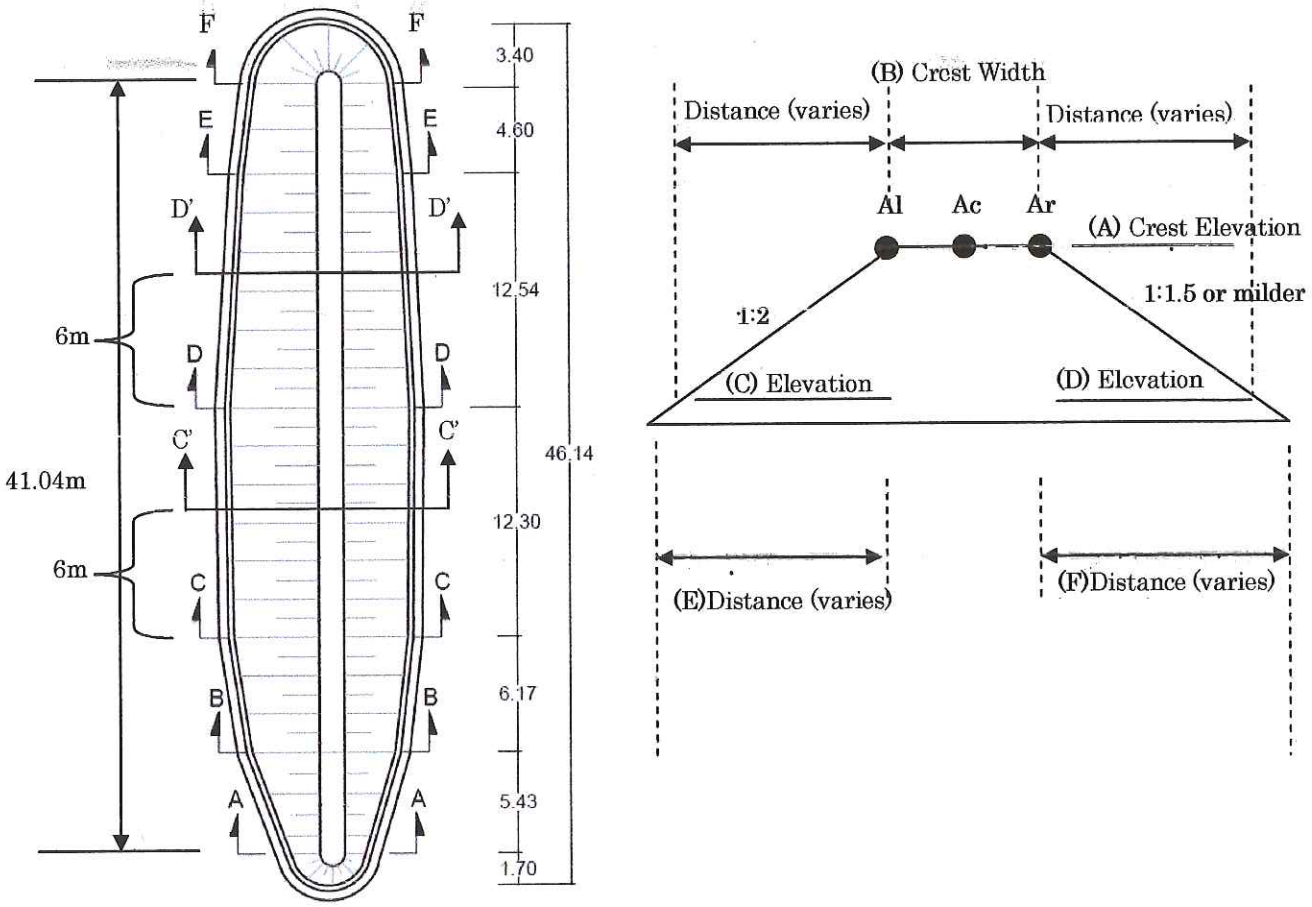


Line	Date	A (m)		B (m)		D (m)		E(m)		F(m)		Remark
		Design	Actual	Design	Actual	Design	Actual	Design	Actual	Design	Actual	
LC-08	N/A	12.55	-		-		-		-		-	
LC-09	11th Dec	6.00	6.75		4.298		4.129		3.010		2.413	
LC-10	11th Dec	6.00	7.3		4.263		4.073		3.008		2.408	
LC-11	11th Dec	6.00	7.7		4.203		4.147		3.010		2.433	
LC-12	11th Dec	6.00	8.0		4.200		4.027		3.002		2.401	
LC-13	11th Dec	6.00	7.3		4.215		4.042		3.002		2.410	
LC-14	11th Dec	6.00	6.9		4.203		4.017		3.017		2.406	
LC-15	1st Dec	6.00	7.3		4.207		3.972		3.000		2.411	
LC-16	1st Dec	8.59	10.0		4.234		4.020		3.021		2.401	
LC-17	1st Dec	6.77	8.0	+4.2m	4.201	+3.9m	3.972	+3.0m	3.022	+2.4m	2.403	
LC-18	1st Dec	6.00	8.4		4.257		3.992		3.101		2.403	
LC-19	1st Dec	12.12	13.2		4.216		3.968		3.100		2.408	
LC-20	1st Dec	6.00	7.0		4.212		3.989		3.065		2.400	
LC-21	1st Dec	8.46	9.8		4.213		3.990		3.027		2.400	
LC-22	1st Dec	9.42	9.7		4.239		3.994		3.012		2.400	
LC-23	1st Dec	6.00	6.8		4.201		3.995		3.040		2.401	
LC-24	1st Dec	6.00	8.7		4.200		4.090		3.000		2.407	
LC-25	1st Dec	8.52	12.7		4.200		4.142		3.034		2.408	
LC-26	N/A	—	—									

*Refer to the drawing "General Layout Gravel Beach Nourishment (Drawing No. 003)" in the Bidding Documents for LC No.

Inspection Sheet for South Groin

Start Date	8th Dec 2015	Complete Date	8th Dec 2015
Contractor's Person in charge	Mr. Dhirendra Singh Sign:	Consultant Inspector	Mr. Shingo Ichikawa Sign:



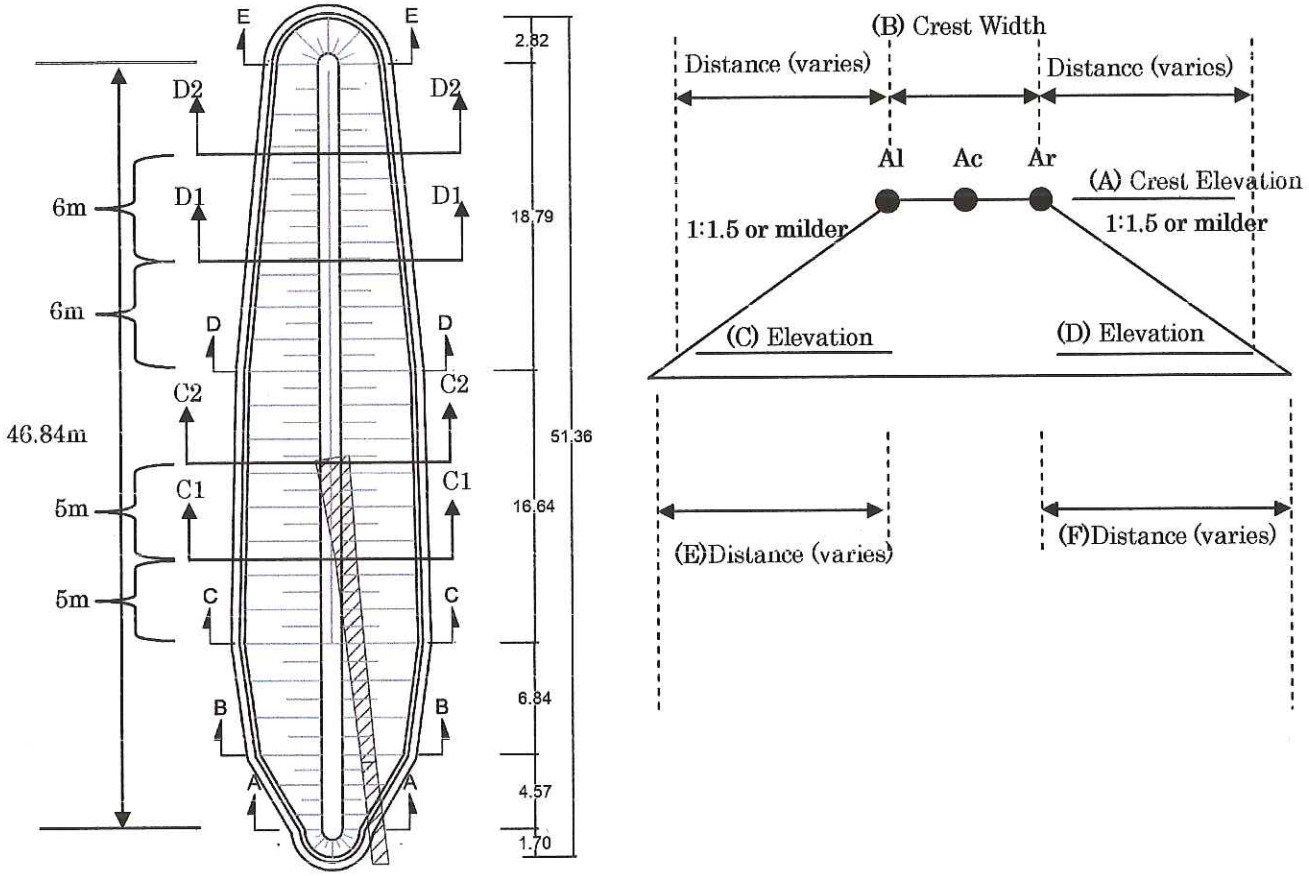
Section	A (m)				B (m)		C(m)			D(m)		
	Design	Actual			Design	Actual	Dist.	Design	Actual	Dist.	Design	Actual
		Al	Ac	Ar								
A-A	4.20	4.201	4.259	4.200	1.3	1.3	0.92	3.74	3.75	0.6	3.91	3.92
B-B	4.20	4.200	4.200	4.210		1.3	1.0	3.70	3.80	0.60	3.80	3.984
C-C	4.20	4.205	4.254	4.205		1.3	4.0	2.2	2.35	1.23	3.38	3.84
C'-C'	3.73	3.733	3.750	3.740		1.3	3.3	2.08	2.114	1.3	2.86	2.90
D-D	3.26	3.266	3.274	3.282		1.3	2.0	2.26	2.30	1.8	2.06	2.34
D'-D'	2.805	2.809	2.810	2.820		1.3	1.64	1.985	1.989	1.52	1.79	2.029
E-E	2.35	2.350	2.351	2.390		1.3	1.47	1.615	1.680	2.0	1.02	1.479
F-F	1.64	—	1.73	—		1.3	—	—	—	—	—	—

Section	E (m)		F(m)		Remark
	Design	Actual	Design	Actual	
A-A	1.44	0.92	1.06	0.6	Item E and F are checked just for reference because these values mostly differ from the design value due to bottom condition and adjacent beach profile.
B-B	3.23	1.0	2.42	0.6	
C-C	4.17	4.0	3.12	3.36	
C'-C'	4.25	3.97	3.18	1.3	

D-D	4.33	2.9	3.24	2.3	
D'-D'	3.94	3.91	2.95	2.28	
E-E	3.55	3.27	2.66	2.8	
F-F	2.89	4.0	2.16	4.0	

Inspection Sheet for North Groin

Start Date	16th Dec 2015	Complete Date	16th Dec 2015
Contractor's Person in charge	Mr. Dhirendra Singh Sign:	Consultant Inspector	Mr. Shingo Ichikawa Sign:



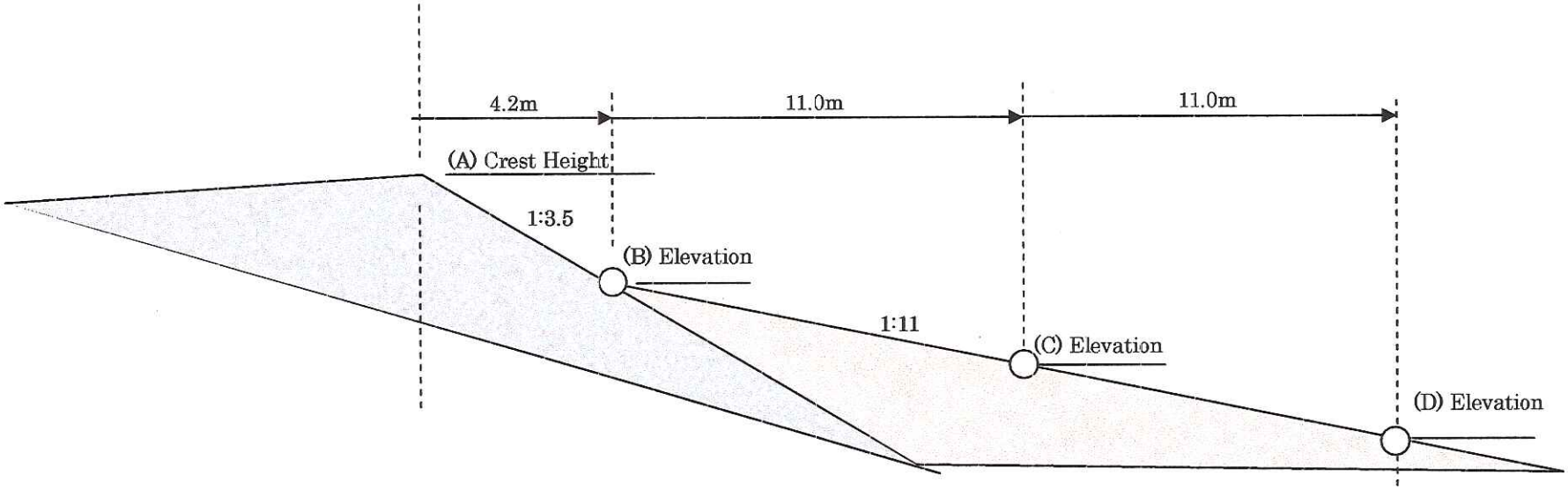
Section	A (m)				B (m)		C(m)			D(m)		
	Design	Actual			Design	Actual	Dist.	Design	Actual	Dist.	Design	Actual
		Al	Ac	Ar								
A-A	4.20	-	4.287	-		1.3	-	-	-	-	-	-
B-B	4.20	4.227	4.267	4.197		1.3	0.83	3.65	4.03	3.0	2.20	2.847
C-C	4.20	4.200	4.201	4.127		1.3	3.73	1.71	2.347	3.4	1.93	2.267
C1-C1	3.80	3.880	3.802	3.800		1.3	4.10	1.07	1.407	3.91	1.19	1.597
C2-C2	3.40	3.410	3.400	3.405	1.3	1.3	3.8	0.87	1.240	3.2	1.27	1.28
D-D	2.86	2.802	2.863	2.801		1.3	2.4	1.26	1.617	2.8	0.99	1.507
D1-D1	2.43	2.433	2.463	2.436		1.3	2.28	0.91	1.227	2.6	0.70	0.897
D2-D2	1.99	1.99	2.01	2.10		1.3	2.5	0.32	1.097	2.5	0.32	0.677
E-E	1.50	—	1.764	—		1.3	-	-	-	-	-	-

Section	E (m)		F(m)		Remark
	Design	Actual	Design	Actual	
A-A	-	-	-	-	Item E and F are checked just for reference because these values mostly differ from the design value due to bottom condition and adjacent beach profile.
B-B	3.44	0.83	3.44	3.95	
C-C	4.36	3.73	4.36	4.33	

C1-C1	4.24	4.1	4.24	3.9	
C2-C2	4.13	4.1	4.13	4.6	
D-D	3.99	4.3	3.99	3.7	
D1-D1	3.40	3.65	3.40	2.6	
D2-D2	2.80	3.3	2.80	2.5	
E-E	2.13	-	2.13	-	

Inspection Sheet for Gravel Beach Profile (Gravel and Sand Part)

Start Date	10th Dec. 2015	Complete Date	19th Dec 2015
Contractor's Person in charge	Mr. Dhirendra Singh Sign:	Consultant Inspector	Mr. Shingo Ichikawa Sign:

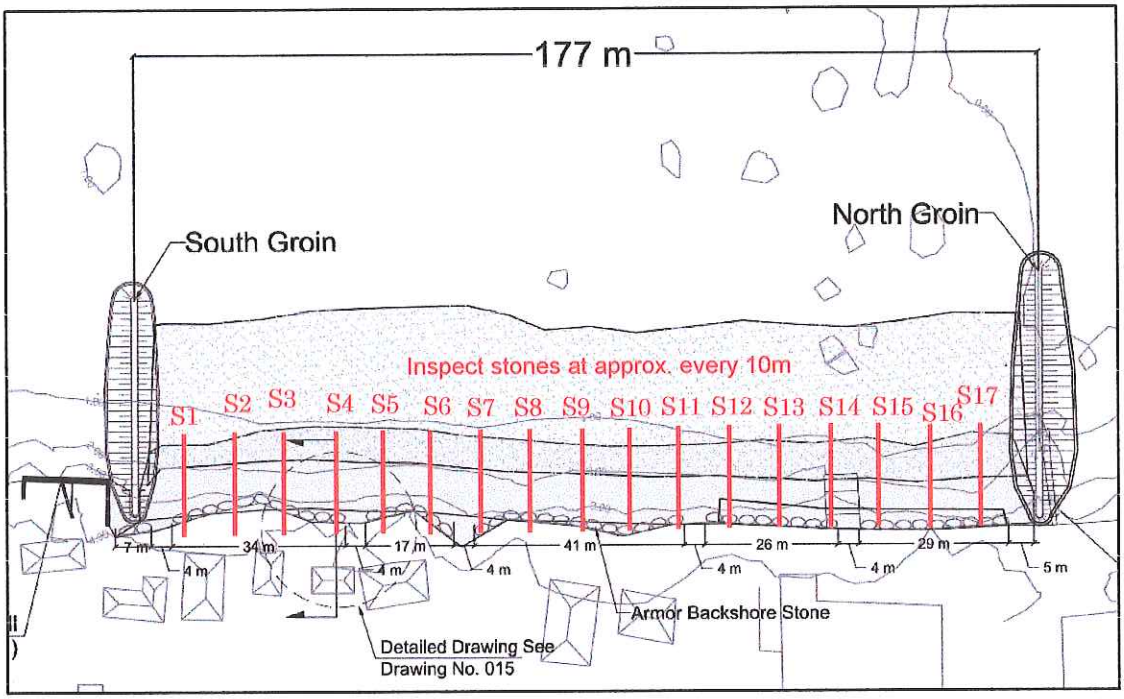


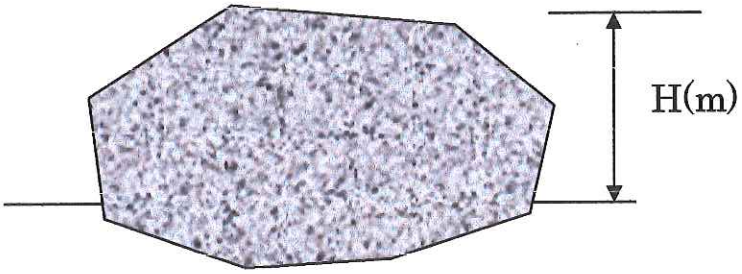
Line	Date	A (m)		B (m)		C (m)		D (m)		Remark
		Design	Actual	Design	Actual	Design	Actual	Design	Actual	
LC-08	N/A		-		-		-		-	
LC-09	19th Dec		4.201		3.032		2.002		0.412	Item D was surveyed just as reference. According to the letter "CHD-JV/Tuvalu/afk/29" and "GBNP-2015-033", underwater area approx. +1.0m～+1.5m was not leveled due to its difficulty. Volume of sand nourishment was checked by the transportation records.
LC-10	19th Dec		4.202		3.007		2.012		0.362	
LC-11	19th Dec		4.204		3.050		2.032		0.452	
LC-12	19th Dec		4.262		3.015		2.052		0.392	
LC-13	19th Dec		4.208		3.018		2.052		0.402	
LC-14	19th Dec		4.211		2.982		2.010		0.532	
LC-15	19th Dec		4.247		3.052		2.002		0.740	
LC-16	12th Dec		4.204		3.071		2.000		0.649	
LC-17	12th Dec	+4.2m	4.234	+3.0m	3.010	+2.0m	2.000	+1.0m	0.701	
LC-18	12th Dec		4.284		3.019		2.010		0.700	
LC-19	12th Dec		4.209		3.012		2.110		0.849	
LC-20	12th Dec		4.233		3.022		2.070		0.949	
LC-21	10th Dec		4.200		3.034		2.002		1.069	
LC-22	10th Dec		4.212		3.080		2.070		1.279	
LC-23	10th Dec		4.200		3.067		2.030		1.262	
LC-24	10th Dec		4.200		3.132		2.109		1.282	
LC-25	10th Dec		4.205		3.094		2.072		1.292	
LC-26	N/A									

*Refer to the drawing "General Layout Gravel Beach Nourishment (Drawing No. 003)" in the Bidding Documents for LC No.

Inspection Sheet for Backshore Stone

Start Date	22nd Dec 2015	Complete Date	22nd Dec 2015
Contractor's Person in charge	Mr. Dhirendra Singh Sign:	Consultant Inspector	Mr. Shingo Ichikawa Sign:





Section	H (m)		Remark	Section	H (m)		Remark
	Design	Actual			Design	Actual	
S1	0.5	0.45	Tolerance with ± 15cm	S10	0.5	0.4	Tolerance with ± 15cm
S2		0.55		S11		0.4	
S3		0.50		S12		0.45	
S4		0.55		S13		0.50	
S5		0.50		S14		0.60	
S6		0.50		S15		0.55	
S7		0.62		S16		0.42	
S8		0.55		S17		0.50	
S9		0.60					

Inspection Sheet for Facility (Boat Trailer)

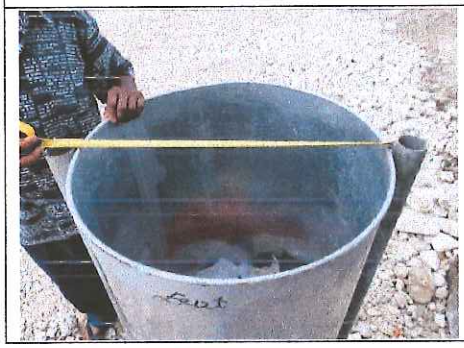
Start Date	22nd Dec 2015	Complete Date	22nd Dec 2015
Contractor's Person in charge	Mr. Dhirendra Singh Sign:	Consultant Inspector	Mr. Shingo Ichikawa Sign:

Front View	Back View
	
Tires	
	

Items	Design(as reference)	Actual
Length	6.0m	6.0m
Width	2.5m	2.5m
Frame material	Galvanized Steel	Galvanized Steel
Tire	2Nos	4Nos
Boat supporting tire	8 sets	10 sets

Inspection Sheet for facility (Rubbish Bin)

Start Date	22nd Dec 2015	Complete Date	22nd Dec 2015
Contractor's Person in charge	Mr. Dhirendra Singh Sign:	Consultant Inspector	Mr. Shingo Ichikawa Sign:

Diameter(0.6m)	Height of bin(0.9m)	Height from ground(1.15m)
		

No.1	No.2	No.3
		
No.4	**No.5**	
		

Items	Design	Actual
No.1	0.6m(Diameter)×0.9m(Height)	0.6m(Diameter)×0.9m(Height)
No.2	0.6m(Diameter)×0.9m(Height)	0.6m(Diameter)×0.9m(Height)
No.3	0.6m(Diameter)×0.9m(Height)	0.6m(Diameter)×0.9m(Height)
No.4	0.6m(Diameter)×0.9m(Height)	0.6m(Diameter)×0.9m(Height)
No.5	0.6m(Diameter)×0.9m(Height)	0.6m(Diameter)×0.9m(Height)

Supporting Report-9

Marine Environmental Monitoring Report (No.1-3)

Department of Environment

Project for Pilot Gravel Beach Nourishment against Coastal Disaster of Fongafale Island

Environmental Monitoring Report No.1

October 2015

JICA Expert Team

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1. Introduction

Since the commencement of the preparation and construction works of the gravel beach nourishment, the JICA Expert Team has been conducting environmental monitoring in accordance to the Environmental Monitoring Plan proposed under the project's Preliminary Environmental Assessment Report (PEAR). Table 1.1 provides an outline of the Environmental Monitoring Plan.

Table 1.1 Outline of the Environmental Monitoring Plan

	Item	Location	Frequency
1	Water quality (turbidity)	Shoreline around the Project site	Daily during sand-dumping works
2	Corals	Gravel collection sites (south Papaelise, north and south of Funamanu)	・Once a month during gravel collection works ・Once every 6 months in post-construction phase until end of 2016
3	Marine life	Reef area in front of the Project site	Once each in pre-construction and post-construction stages
4	Shoreline topography	・Project site and adjacent shoreline ・Gravel collection sites (south Papaelise, north and south of Funamanu) and adjacent shoreline	Four times in post-construction stage until end of 2016

Source: JICA Expert Team

This report summarizes the monitoring results obtained during the period from August to October 2015 namely for 1) water quality, 2) corals and 3) marine life. The results of the shoreline topography monitoring will be reported in the ensuing reports.

2. Implemented construction works

Table 2.1 shows the main construction works implemented during the monitoring period from August-October 2015.

Table 2.1 Main construction works implemented during August-October 2015

Month	Construction works
August	・Material transportation ・Site establishment
September	・Gravel mining and transportation from Papaelise ・Placement of gravels ・Construction of south groin
October (until 2nd week of October)	・Gravel mining and transportation from Papaelise ・Placement of gravels ・Construction of south groin

Source: JICA Expert Team

3. Methods and results of monitoring

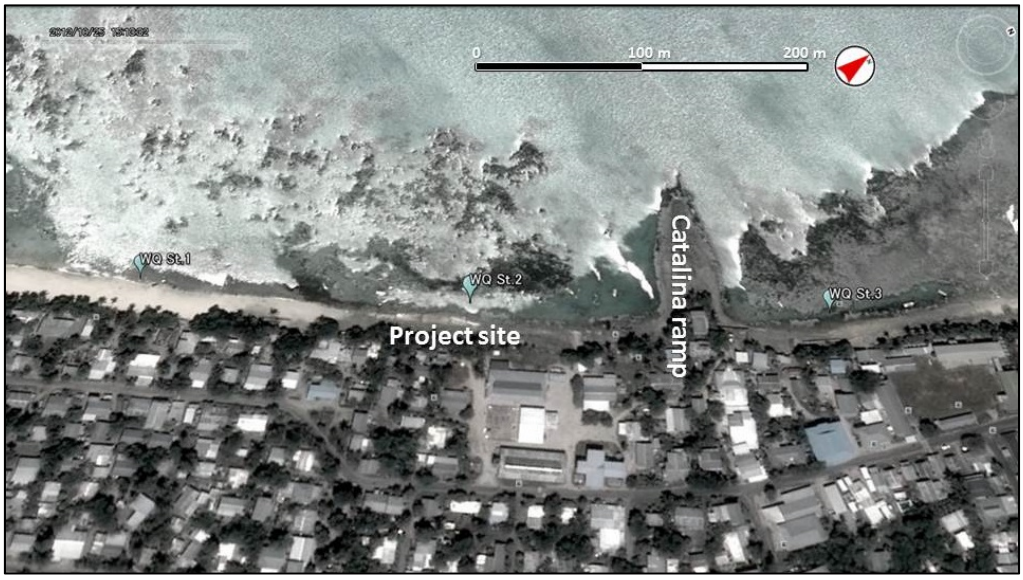
3.1. Monitoring of water quality

(1) Aim

To monitor the impacts of sand-dumping works on water quality (turbidity).

(2) Method

Since sand-dumping works were not yet implemented, baseline turbidity data were collected at three monitoring sites set along the shore using portable turbidity meter (DKK-TOA TB-31). Figure 3.1 shows the location of the turbidity monitoring sites.



Source: Prepared by JICA Expert Team using Google Earth

Figure 3.1 Location of the turbidity monitoring sites

(3) Results

Table 3.1 provides the results of the turbidity monitoring.

Table 3.1 Results of the turbidity monitoring

Date/time	Wind	Turbidity (NTU)		
		St.1	St.2	St.3
2015/08/06 14:00	Light easterly	4.3	4.7	3.5
2015/08/07 13:50	Light northerly	9.4	1.9	2.4
2015/08/08 16:40	Light westerly	6.2	2.6	2.5
2015/08/09 16:00	Light westerly	3.6	0.0	0.6
2015/08/10 16:00	Moderate southwesterly	14.5	11.9	2.0
2015/08/20 17:00	Light westerly	1.6	0.4	1.9
2015/08/24 15:10	Light southwesterly	2.3	1.0	1.1
2015/08/27 15:40	Moderate southwesterly	13.9	1.2	0.5
2015/09/25 16:30	Light westerly	3.9	0.7	2.1
2015/09/28 16:30	Light southwesterly	4.3	21.7	2.0
2015/10/16 16:00	Moderate westerly	7.8	3.5	8.9
2015/10/19 17:00	Light easterly	5.6	0.6	1.1
Average		**6.5**	**4.2**	**2.4**

Source: JICA Expert Team

Main findings of the monitoring are as follows:

- Turbidity levels were generally higher at St.1 (average value was around 6.5 NTU) compared to the other sites (average values at St.2 and St.3 were around 4.2 NTU and 2.4 NTU respectively). This is probably because St.1 is a sandy beach area, where the bottom sediment is easily disturbed by wind and wave.
- Highest turbidity was recorded on September 28th at St.2 (21.7 NTU). This was probably mainly due to gravel deposition activities. However, the turbidity generated from these activities appears to have not spread to the other sites as evidenced by the relatively low values at St.1 and St.3.

Turbidity levels will be monitored daily during sand-dumping works and necessary actions taken if it constantly (e.g. 1 week) exceeds 15 NTU at St.1 or St.3 as stated in the PEAR.

3.2. Monitoring of corals

(1) Aim

To monitor the impacts of gravel collection works on the corals adjacent to the gravel collection sites (Papaelise and Funamanu).

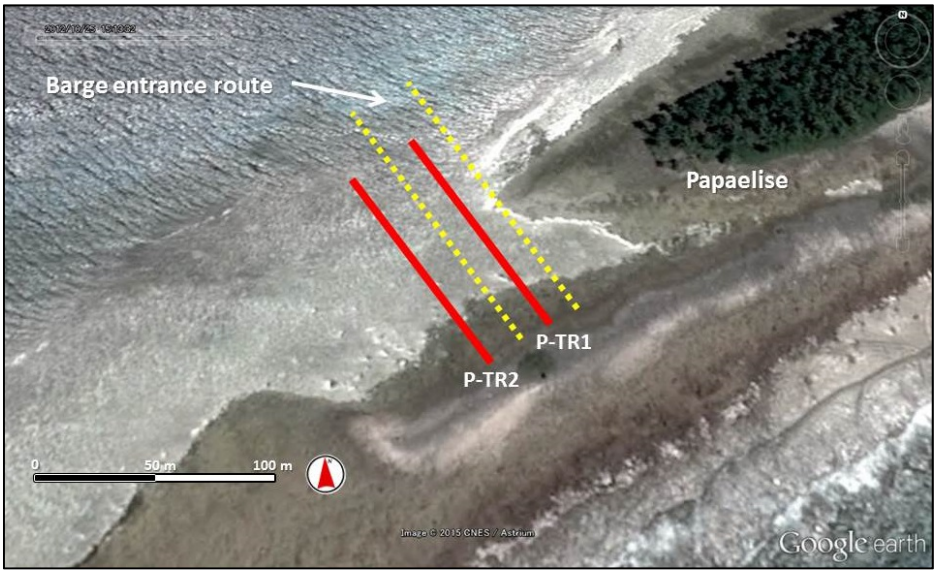
(2) Method

The coral monitoring method was slightly modified from the one proposed in PEAR. The main reason of the modification was to focus more on the potential impacts of the barge used for coral transportation from the gravel collection sites (e.g coral may be damaged by the bottom hull of the barge during entrance and exit of reef flat). The modified monitoring method is outlined below:

- Two monitoring transects of approximately 100 m length were set in the reef flat area vertical to the gravel collection sites. One transect was set inside the barge entrance

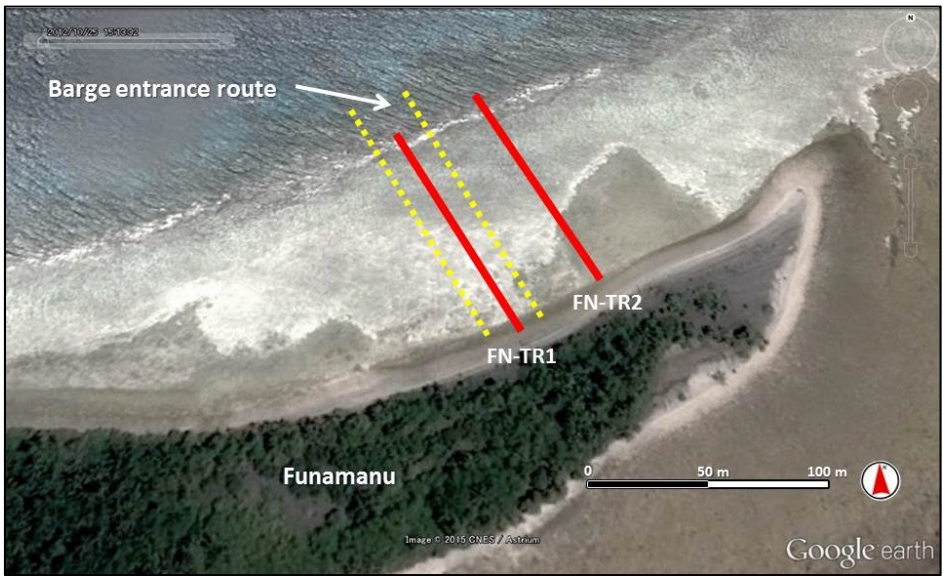
channel. The other was set outside of the barge entrance channel for reference purpose. Figures 3.2 and 3.3 show the location of the coral monitoring transects at Papaelise and Funamanu north respectively. Funamanu south was not monitored as it is unlikely that gravels will be collected from there.

- Information such as live coral distribution and coverage were recorded along each transect at 10 m interval. Any signs of coral damage due to the barge were also investigated.
- Monitoring was conducted on October 17th and 20th.



Source: Prepared by JICA Expert Team using Google Earth

Figure 3.2 Location of the coral monitoring transect (Papaelise)



Source: Prepared by JICA Expert Team using Google Earth

Figure 3.3 Location of the coral monitoring transect (Funamanu north)

(3) Results

1) Papaelise

Live coral distribution and coverage

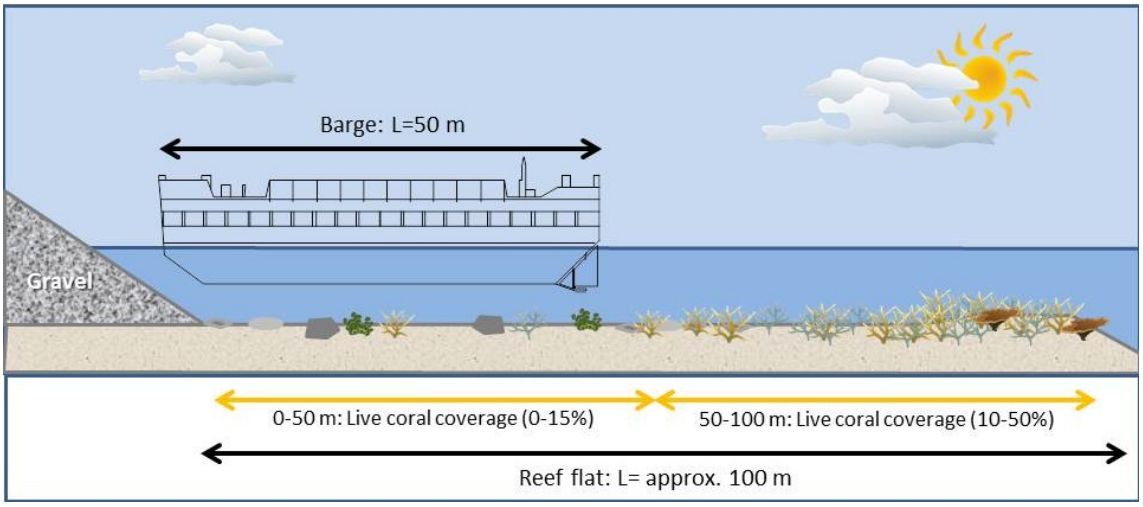
In Papaelise, live corals were mainly found between the outer reef flat and reef slope (i.e. around between 50-100 m from the shore). Live coral coverage ranged between 10-50% in this area. Patches of dead corals were found in some areas (e.g. 60-70 m from the shore at transect P-TR2). These are not caused by the barge as they appeared to be dead for a long time.

Live corals in the inner reef flat (i.e. around between 0-50 m from the shore) were scarce ranging between 0-15% coverage. Substrate in this area was mainly comprised of algae, rocks, rubbles and sand. Table 3.2 shows the live coral coverage observed along the two monitoring transects. Figure 3.4 is a cross-section image of coral distribution along the monitoring transect.

Table 3.2 Live coral coverage observed along Papaelise monitoring transects

Distance from shore (m)	Live coral coverage (%)	
	P-TR1 (barge entrance route)	P-TR2 (reference)
0-10	No live corals	Approx. 5%
10-20	Approx. 5%	Approx. 5%
20-30	Approx. 5%	Approx. 15%
30-40	Approx. 5%	Approx. 5%
40-50	Approx. 5%	Approx. 10%
50-60	Approx. 50%	Approx. 20%
60-70	Approx. 45%	No live corals
70-80	Approx. 30%	Approx. 15%
80-90	Approx. 40%	Approx. 45%
90-100	Approx. 50%	Approx. 50%

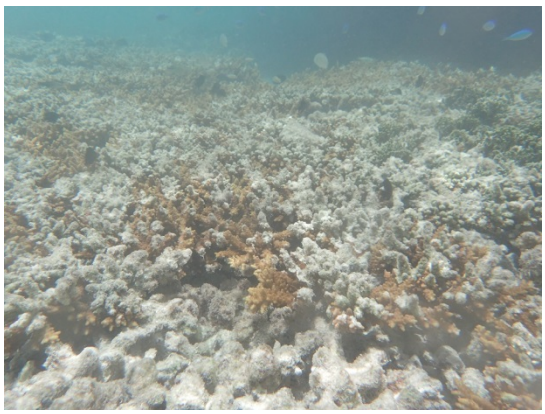
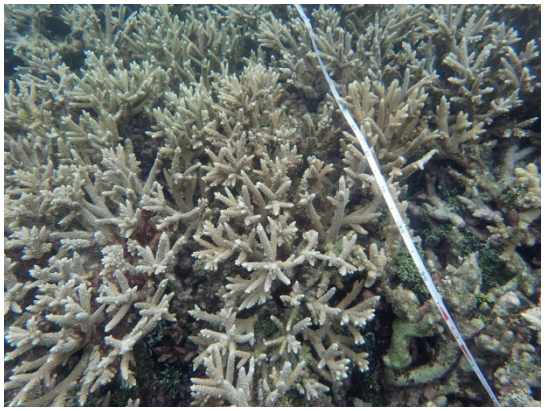
Note: Survey conducted on October 17th, 2015.
Source: JICA Expert Team



Source: Prepared by JICA Expert Team using IAN Symbols Libraries (http://ian.umces.edu/symbols/)

Figure 3.4 Cross-section image of coral distribution along Papaelise monitoring transect

Figure 3.5 shows typical substrate feature along the inner and outer reef flat of Papaelise monitoring transects.

Inner reef flat (0-50 m)	Outer reef flat (50-100 m)
	
No coral area (rubble, sand)	Dead patches of *Acropora* coral
	
Small patch of live Acropora coral among dead corals	High coverage of live *Acropora* coral

Note: Photo taken on October 17th, 2015
Source: JICA Expert Team

Figure 3.5 Typical substrate feature along the inner and outer reef flat of Papaelise monitoring transects

Coral damage

The status of coral damage was investigated along the route of the barge entrance channel. At the time of the survey, the barge was anchored to the shore loading gravels. The barge had already made around 7 trips prior to this survey starting from September 23rd, 2015. The main findings of the survey are as follows:

- No signs of notable coral damage by the barge (e.g. large bands of newly broken corals) were observed in the outer reef flat area where coral coverage is highest. This implies that the barge had been entering the reef flat area when there is sufficient depth (i.e. high tide).
- Few broken corals were found around the rear end of the anchored barge where there

is a patchy distribution of live corals. These corals were probably broken by the barge during anchoring. Figure 3.6 shows the live corals around the barge and examples of broken corals found around the barge. However, this is considered to be of minor significance for the following reasons:

- ✓ The extent of coral damage is limited to a small area
- ✓ The damaged coral species (branching *Acroprora*) are abundant in the area

Note: Photo taken on October 17th, 2015
Source: JICA Expert Team

Figure 3.6 Live corals around the rear-end of the barge (left) and examples of broken corals found around the barge (right)

2) Funamanu north

Live coral distribution and coverage

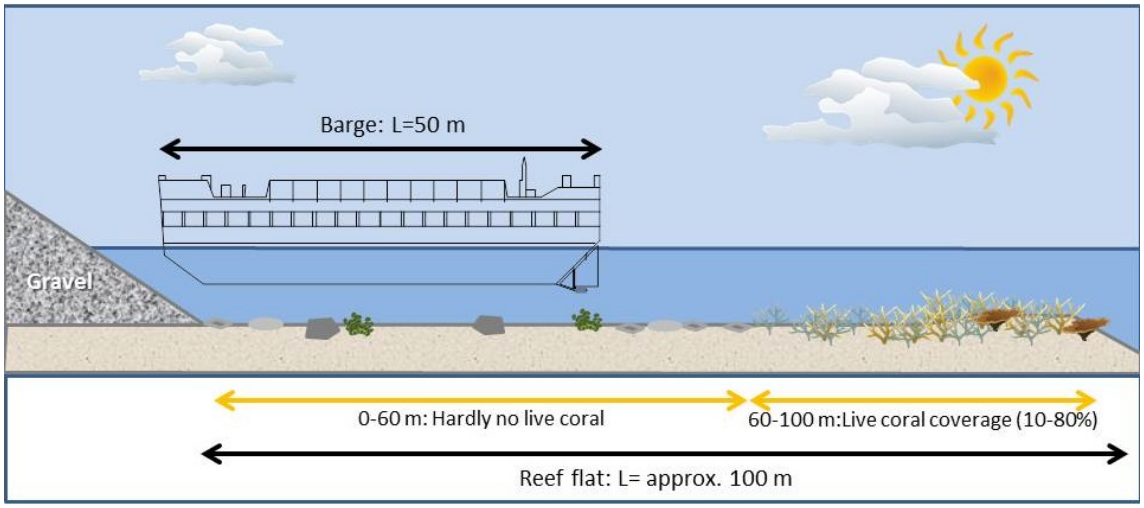
In Funamanu north, live corals were mainly found between the outer reef flat and reef slope (i.e. around between 60-100 m from the shore). Live coral coverage ranged around 10-80% in this area. Patches of dead corals were found in some areas (e.g. 70-80 m from the shore at transect FN-TR1). These are not caused by the barge as they appeared to be dead for a long time.

Hardly any live corals were found in the inner reef flat area (i.e. around between 0-60 m from the shore), hence there is no risk of coral damage from barge anchoring as in Papaelise. Substrate in this area was mainly covered by rocks, rubbles, sand and algae. Table 3.4 shows the live coral coverage observed along the two monitoring transects. Figure 3.7 is a cross-section image of coral distribution along the monitoring transect.

Table 3.3 Live coral coverage observed along Funamanu north monitoring transects

Distance from shore (m)	Live coral coverage (%)	
	FN-TR1 (barge entrance route)	FN-TR2 (reference)
0-10	No live corals	No live corals
10-20	No live corals	No live corals
20-30	No live corals	No live corals
30-40	No live corals	No live corals
40-50	No live corals	No live corals
50-60	Approx. 5%	No live corals
60-70	Approx. 15%	Approx. 10%
70-80	No live corals	Approx. 40%
80-90	Approx. 55%	Approx. 55%
90-100	Approx. 60%	Approx. 80%

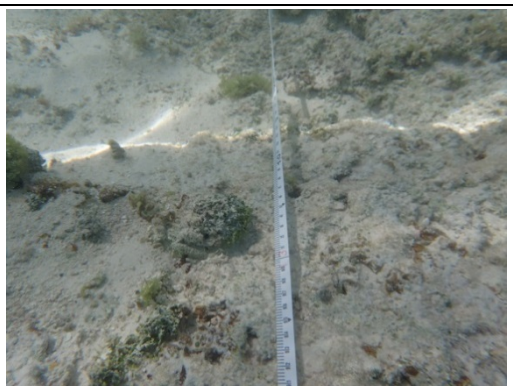
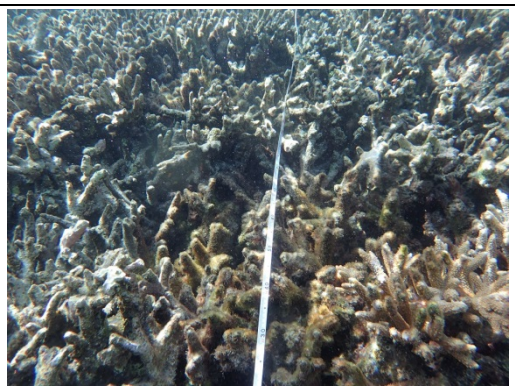
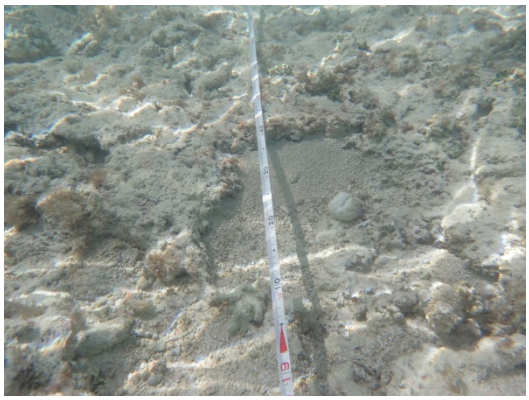
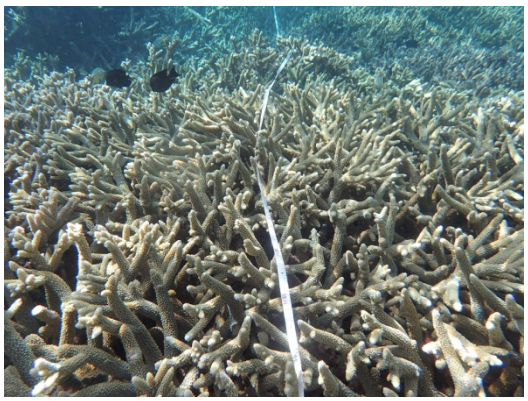
Note: Survey conducted on October 17th, 2015.
Source: JICA Expert Team



Source: Prepared by JICA Expert Team using IAN Symbols Libraries (http://ian.umces.edu/symbols/)

Figure 3.7 Cross-section image of coral distribution along Funamanu north monitoring transect

Figure 3.8 shows typical substrate feature along the inner and outer reef flat of Funamanu north monitoring transects.

Inner reef flat (0-60 m)	Outer reef flat (60-100 m)
	
No coral area (algae, sand, rubble)	Dead patches of *Acropora* coral
	
No coral area (rubble, sand)	High coverage of live *Acropora* coral

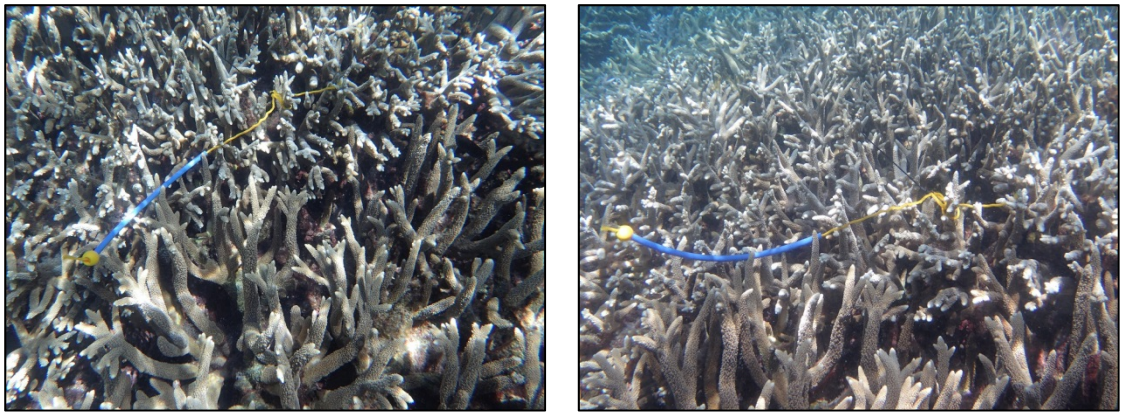
Note: Photo taken on October 17th, 2015
Source: JICA Expert Team

Figure 3.8 Typical substrate feature along the inner and outer reef flat of Funamanu north monitoring transects

Coral damage

Coral damage was investigated along the route of the barge entrance channel, focusing on the outer reef flat area where coral coverage is highest (there are no live corals in the inner reef flat area) and water depth shallowest. The survey was set a time when the barge was entering the reef flat area at high tide (around 10:30 AM on October 20th, 2015). This was the first time the barge entered Funamanu north. A live coral growing in the shallowest outer reef flat area along the entrance channel was tagged to see whether any damage occurred after barge passing. The main findings of the survey are as follows:

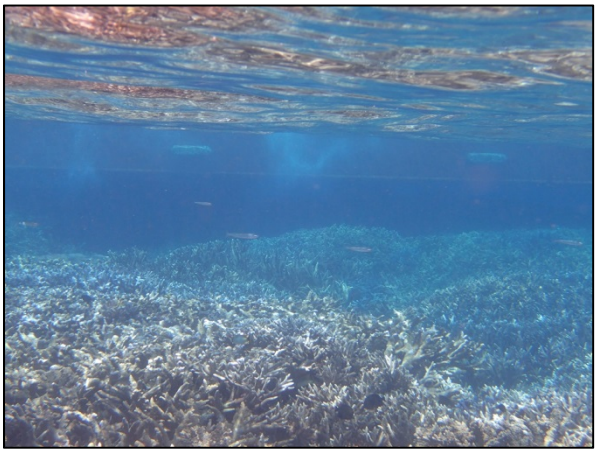
- No signs of notable coral damage by the barge (e.g. large bands of newly broken corals) were observed after the barge passed the outer reef flat area. Figure 3.9 shows the corals around the tagged area before and after passing of the barge. Note that there are no signs of damage.



Note: Photo taken on October 20th, 2015
Source: JICA Expert Team

Figure 3.9 Corals around the tagged area before (left) and after (right) passing of the barge

- According to underwater observation, there was about 40-50 cm clearance between the barge bottom and corals (barge draft was about 60 cm) when the barge passed through the shallow outer reef flat area (see Figure 3.10). Note that corals may be damaged if the gravel-loaded barge exits the reef flat area at the same water depth as the barge will have deeper draft. Therefore, the barge draft and water depth must be carefully considered when exiting. It is recommended that a clearance of at least 50 cm should be maintained between the barge and corals during barge entrance and exit.



Source: JICA Expert Team

Figure 3.10 Barge passing though the outer reef flat

3.3. Monitoring of marine life

(1) Aim

To monitor the impacts of the gravel nourishment works on the marine life adjacent to the project site.

(2) Method

Three 50 m transects were set adjacent to the Project site. The marine life (benthic fauna and fish species) observed along the transects were recorded, including their abundance were possible. The survey was conducted on August 1st, 2015. Figure 3.11 shows the location of the survey transects.

Source: JICA Expert Team

Figure 3.11 Location of the monitoring transects of marine life monitoring

(3) Results

The substrate of the surveyed area was primarily composed of sand with mixture of rocks and rubbles. Extensive distribution of Sargassum seaweeds were observed mixed with *Padina* species and *Halimeda* species. Figure 3.12 shows typical substrate feature along the surveyed area.

Typical substrate (mixture of sand, rock, rubble and seaweeds)

Sargassum sp.

Halimeda sp.

Padina sp.

Note: Photo taken on August 1st, 2015

Source: JICA Expert Team

Figure 3.12 Typical substrate features along the surveyed area

Table 3.4 shows the observed fauna species and their abundance along the surveyed transects. Species diversity was very low as only one benthic species (*Holothuria atra*) and three fish species were observed. None of the observed species are classified as threatened under the IUCN Red List. Abundance of *Holothuria atra* was quite high with 130 individuals counted at transect T3. Figure 3.13 is a photograph of *Holothuria atra*.

Table 3.4 Observed fauna species and their abundance within the surveyed transects

Transect	Distance from start point (m)	Scientific name	Common name	Abundance
T1	0-10	*Holothuria atra*	Black sea cucumber	3
		Dascyllus flavicaudus	Yellowtail dascyllus	4
	10-20	*Holothuria atra*	Black sea cucumber	7
		Chrysiptera biocellata	Twinspot damselfish	1
	20-30	*Holothuria atra*	Black sea cucumber	3
		Chaetodon auriga	Threadfin butterflyfish	1
	30-40	*Holothuria atra*	Black sea cucumber	10
	40-50	*Holothuria atra*	Black sea cucumber	4
T2	0-10	*Holothuria atra*	Black sea cucumber	15
		Chrysiptera biocellata	Twinspot damselfish	4
	10-20	*Holothuria atra*	Black sea cucumber	10
		Dascyllus flavicaudus	Yellowtail dascyllus	1
	20-30	*Holothuria atra*	Black sea cucumber	16
	30-40	*Holothuria atra*	Black sea cucumber	25
		Dascyllus flavicaudus	Yellowtail dascyllus	1
	40-50	*Holothuria atra*	Black sea cucumber	11
		Chaetodon auriga	Threadfin butterflyfish	-
T3	0-10	*Holothuria atra*	Black sea cucumber	28
	10-20	*Holothuria atra*	Black sea cucumber	30
		Dascyllus flavicaudus	Yellowtail dascyllus	1
	20-30	*Holothuria atra*	Black sea cucumber	17
		Chaetodon auriga	Threadfin butterflyfish	1
	30-40	*Holothuria atra*	Black sea cucumber	27
	40-50	*Holothuria atra*	Black sea cucumber	28

Source: JICA Expert Team

Note: Photo taken on August 1st, 2015

Source: JICA Expert Team

Figure 3.13 Photograph of *Holothuria atra*

Main findings of the survey are as follows:

- The results showed no major change in the benthic community structure from the survey conducted during PEAR preparation.
- There was no endangered species or any corals.

- The next monitoring survey will be conducted after the construction is completed. The results will be compared with this baseline survey and evaluate if there was any major impacts from the construction works.

4. Conclusion

During this monitoring period (August-October 2015), the main concern was possible coral damage by the gravel transporting barge. The risk of coral damage also increased as use of a large barge became necessary mainly due to time constraints in the construction schedule (initially small barges were intended for gravel collection). However, according to the monitoring survey, no notable coral damage was observed in the area except for some minor damage which is considered as insignificant due to its limited area and the abundance of same corals in the area. Although gravel collection works will continue for another few weeks, any significant coral damage is unlikely to occur providing that the barge enters and exit the reef flat area strictly only during high tide. The JICA expert team will continue to monitor the corals as well as supervise the Contractor to ensure that the barge enter and exit the reef flat area only when there is sufficient water depth taking into account the barge draft. It is recommended that a clearance of at least 50 cm should be maintained between the barge and corals during barge entrance and exit.

The next monitoring report is planned to be submitted in December when the construction is supposed to be completed. The JICA expert team will also report and consult with the DOE if any issues arise in the process.

Department of Environment

Project for Pilot Gravel Beach Nourishment against Coastal Disaster of Fongafale Island

Environmental Monitoring Report No.2

January 2016

JICA Expert Team

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1. Introduction

The JICA Expert Team of the "Project for Pilot Gravel Beach Nourishment against Coastal Disaster of Fongafale Island (hereinafter abbreviated as "Project") is responsible for conducting environmental monitoring during the construction and post-construction phases of the Project in accordance to the Environmental Monitoring Plan (EMP) proposed under the Project's Preliminary Environmental Assessment Report (PEAR).

The monitoring method proposed under PEAR was slightly modified due to some alterations to the construction method and for greater efficiency and effectiveness. Table 1-1 shows the outline of the EMP proposed under PEAR and contents of the modifications.

Table 1-1 Outline of the original EMP and contents of the modifications

	Item	EMP proposed under PEAR	Modified EMP
1	Water quality (turbidity)	**Objective:** To monitor impacts of sand placement works on water quality (turbidity). **Location:** Three sites along the shoreline adjacent to the Project site. **Method:** Measurement of surface turbidity with portable turbidity meter. **Frequency:** Daily during sand placement works.	・Monitoring sites was increased from 3 to 16 sites to cover a wider area. ・The additional sites were monitored 1/week.
2	Corals	**Objective:** To monitor impacts of gravel collection works on corals. **Location:** Reef area adjacent to the gravel collection sites of Papaelise and north/south Funamanu. **Method:** Monitoring of coral status by transect (3 transects per site) and quadrat (6 quadrats per site) surveys. **Frequency:** Once a month during gravel collection works and once every 6 months in post-construction stage until end of 2016.	・Monitoring method was modified to focus only on the corals distributed along the barge entrance route. Consequently, the number of transects at each gravel collection site were reduced from 3 to 2 and no quadrat survey was conducted. ・Monitoring at south Funamanu was cancelled as gravels were no longer to be collected from there.
3	Marine life	**Objective:** To monitor impacts of the gravel nourishment works on marine life. **Location:** Reef area front of the Project site. **Method:** Observation of marine life along 3 x 50 m transects. **Frequency:** Once each in pre-construction and post-construction stages.	・The north groin area was added to the post-construction stage monitoring.
4	Shoreline topography	**Objective:** To monitor change in shoreline around the Project site and gravel collection sites. **Method:** Measurement of shoreline cross-section profile **Frequency:** Once in pre-construction stage and 4 times in post-construction stage until end of 2016.	・Addition of satellite image analysis

Source: JICA Expert Team

This monitoring report summarizes the monitoring results obtained during the pre-construction, construction (August-December 2015) and post-construction stages (December 2015). Monitoring of coral and shoreline topography will continue until the end of 2016.

2. Implemented construction works

Table 2-1 shows the main construction works implemented during the construction stage starting from August 2015 and ending in late December 2015.

Table 2-1 Main construction works implemented during the construction stage

Month	Week	Construction works
August	1st-29th	・ Transportation of construction materials ・ Site establishment
September	Aug. 30th-19th	・ Transportation of construction materials ・ Site establishment
	20th-Oct.3rd	・ Collection and transportation of gravels from Papaelise ・ Gravel placement and levelling works ・ Construction of south groin
October	4th-17th	・ Collection and transportation of gravels from Papaelise ・ Gravel placement and levelling works ・ Construction of south groin
	18th-24th	・ Collection and transportation of gravels from north Funamanu ・ Gravel placement and levelling works ・ Construction of south groin
	25th-1st	・ Gravel placement and levelling works ・ Construction of south groin
November	2nd-15th	・ Gravel levelling works ・ Construction of south and north groin
	16th-22nd	・ Collection and transportation of gravels from Papaelise and North Funamanu ・ Gravel placement and levelling works ・ Construction of south and north groin
	23rd-29th	・ Collection and transportation of gravels from North Funamanu ・ Gravel placement and levelling works ・ Construction of south and north groin
December	Nov. 30th-6th	・ Gravel placement and levelling works ・ Transportation of sand from burrow pit no.2 ・ Sand placement and levelling works ・ Construction of north groin
	7th-13th	・ Collection and transportation of gravels from Papaelise ・ Gravel placement and levelling works ・ Transportation of sand from burrow pit no.2 ・ Sand placement and levelling works ・ Construction of north groin
	14th-20th	・ Gravel levelling works ・ Sand placement and levelling works ・ Site clearance

Source: JICA Expert Team

3. Methods and results of monitoring

3.1. Monitoring of water quality

(1) Objective

To monitor the impacts of sand-placement works on water quality (turbidity).

(2) Method

During sand-placement works, surface turbidity levels were measured daily at three monitoring sites (Stations 1-3) set along the shore using portable turbidity meter (DKK-TOA TB-31). To understand the background turbidity levels, turbidity was also randomly measured at Stations 1-3 in the period prior to sand-placement works (August-November 2015). Although it was not a requirement under PEAR, turbidity was also measured over a wider area 1/week (Stations 4-16) to check the extent of turbidity dispersion. Figure 3-1 shows the location of the turbidity monitoring sites. The turbidity values measured at Stations 1 and 3 were compared with the threshold value of 15 NTU set under PEAR.

Source: Prepared by JICA Expert Team using Google Earth

Figure 3-1 Location of the turbidity monitoring sites

(3) Results

Table 3-1 shows the turbidity levels measured prior to sand-placement works. The average turbidity level at Stations 1-3 were 5.7 NTU, 3.6 NTU and 2.3 NTU respectively. These values are considered as background turbidity levels.

Table 3-1 Turbidity levels measured prior to sand-placement works

Date/time	Turbidity (NTU)		
	St.1	St.2	St.3
2015/08/06 14:00	4.3	4.7	3.5
2015/08/07 13:50	9.4	1.9	2.4
2015/08/08 16:40	6.2	2.6	2.5
2015/08/09 16:00	3.6	0.0	0.6
2015/08/10 16:00	14.5	11.9	2.0
2015/08/20 17:00	1.6	0.4	1.9
2015/08/24 15:10	2.3	1.0	1.1
2015/08/27 15:40	13.9	1.2	0.5
2015/09/25 16:30	3.9	0.7	2.1
2015/09/28 16:30	4.3	21.7	2.0
2015/10/16 16:00	7.8	3.5	8.9
2015/10/19 17:00	5.6	0.6	1.1
2015/10/24 14:15	2.2	1.0	1.5
2015/10/30 14:30	4.2	1.0	2.0
2015/11/14 15:30	2.3	2.5	1.8
Average	**5.7**	**3.6**	**2.3**

Source: JICA Expert Team

Table 3-2 shows the turbidity levels measured during and after sand-placement works. Main findings of the monitoring are as follows:

- During sand-placement works, turbidity levels at the daily monitoring sites (St.1-3) were higher than normal but exceeded threshold level (15NTU) only once (December 9th at St.1).
- During sand-placement works, turbidity levels rapidly decreased to low levels (around 0-1 NTU) from around 100 m offshore of the Project site.
- During sand-placement works, high turbidity levels were recorded at St.10 and 13. This was due to the reclamation project implemented in front of the government office.
- Turbidity levels rapidly returned to normal levels 1-2 days after sand-placement works was completed.

Table 3-2 Turbidity levels measured during and after sand-placement works

	Date/time	Turbidity (NTU)															
		St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11	St.12	St.13	St.14	St.15	St.16
During sand-placement works	2015/12/9 09:30	22.4	27.0	6.7	-	-	-	-	-	-	-	-	-	-	-	-	-
	2015/12/10 09:00	8.3	31.7	0.5	4.1	1.3	1.2	0.0	1.4	0.0	15.7	1.7	4.8	20.4	5.7	2.3	0.1
	2015/12/11 16:30	10.3	24.0	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-
	2015/12/12 09:30	11.2	38.6	5.9	-	-	-	-	-	-	-	-	-	-	-	-	-
	2015/12/14 15:00	3.8	10.5	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-
	2015/12/15 10:30	4.8	39.5	1.0	7.5	0.7	4.3	4.0	0.1	1.9	4.1	1.9	2.3	17.0	5.5	3.2	0.7
	2015/12/16 15:30	13.9	34.2	8.6	-	-	-	-	-	-	-	-	-	-	-	-	-
	2015/12/17 17:00	13.2	7.8	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-
	2015/12/18 13:00	6.3	37.1	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-
After sand-placement works	2015/12/20 9:30	5.5	2.7	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-
	2015/12/21 13:30	2.9	1.8	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: Results highlighted in grey exceeds the threshold value of 15 NTU. Note that threshold value is not set for Stations 2 and 4-16.

Source: JICA Expert Team

(4) Conclusion

During sand-placement works, while turbidity levels in the vicinity of the Project area were in general higher than the background concentration, high turbidity levels were more or less limited to an area within around 100 m from the shore. Also turbidity levels rapidly returned to normal levels 1-2 days after sand-placement works was completed.

3.2. Monitoring of corals

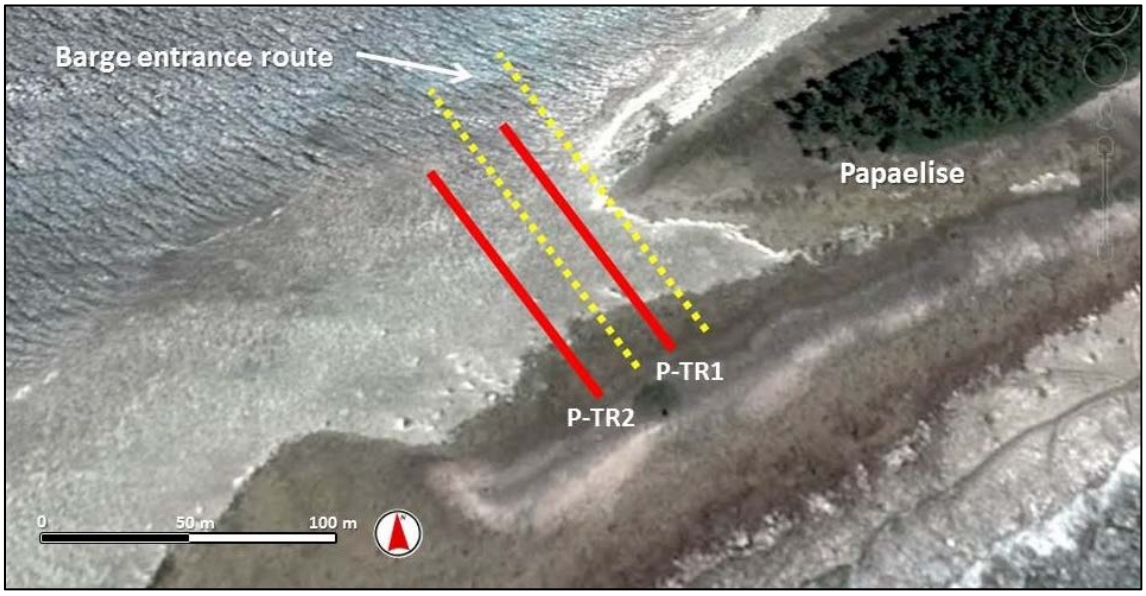
(1) Objective

To monitor whether the corals distributed inside the barge entrance route of Papaelise and north Funamanu are not damaged by the gravel-transporting barge.

(2) Method

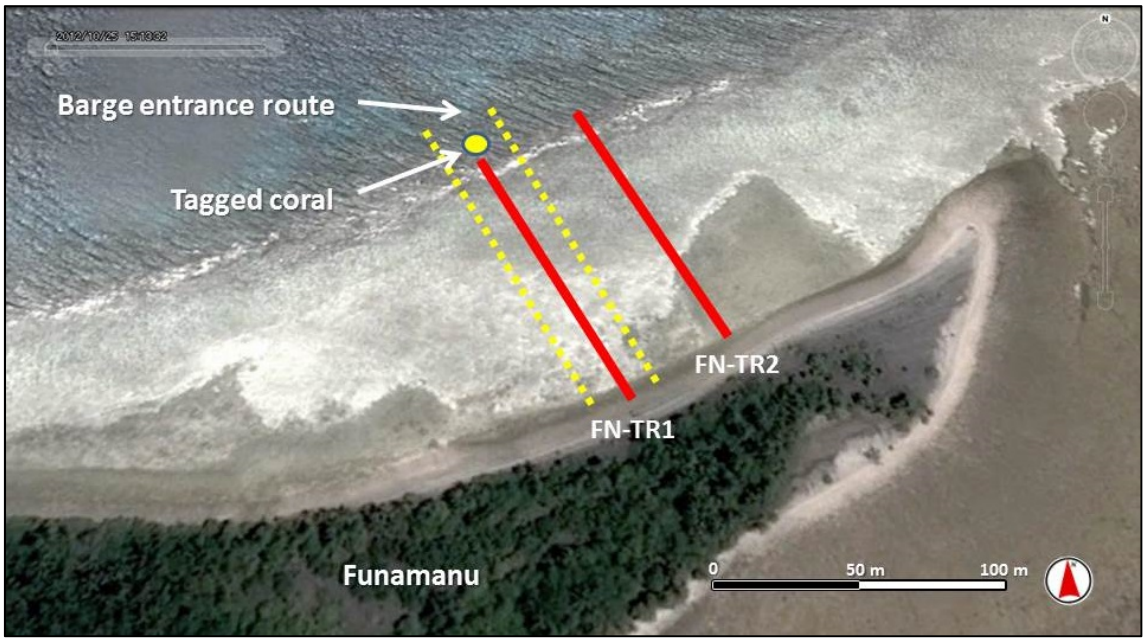
1) Baseline survey

Initially, a baseline survey was conducted to understand the status of coral distribution and live coral coverage along the barge entrance route. The survey was conducted along two transects of approximately 100 m length: one inside the barge entrance route and the other adjacent to the barge entrance route. The percent live coral coverage was recorded every 10 m along the transect. Figures 3-2 and 3-3 show the location of the transects at Papaelise and north Funamanu respectively.



Source: Prepared by JICA Expert Team using Google Earth

Figure 3-2 Location of the coral monitoring transect (Papaelise)



Source: Prepared by JICA Expert Team using Google Earth

Figure 3-3 Location of the coral monitoring transect (north Funamanu)

2) Survey of coral damage

The area inside the barge entrance route was surveyed around once a month to see if any corals were damaged by the gravel-transporting barge. If any obvious damage was observed, the location was recorded and photograph taken.

In addition, in north Funamanu, a branching *Acropora* coral located at the entrance of the barge entrance route was tagged using a rope and float. The coral was tagged because the area around the tagged coral was considered highly susceptible to damage by the barge due to the relative shallowness of the area (see Figure 3.3 for the location).

3) Monitoring schedule

Table 3-3 shows the dates of the monitoring and outline of conducted monitoring activities.

Table 3-3 Dates and outline of conducted monitoring activities

Date	Activity
October 17th, 2015	・ Baseline survey at Papaelise and north Funamanu ・ Survey of coral damage at Papaelise and north Funamanu
October 20th, 2015	・ Survey of coral damage at north Funamanu
November 13th, 2015	・ Survey of coral damage at north Funamanu
December 13th, 2015	・ Survey of coral damage at north Funamanu
December 20th , 2015	・ Survey of coral damage at Papaelise

Source: JICA Expert Team

(3) Results

1) Baseline survey at Papaelise and north Funamanu

a. Papaelise

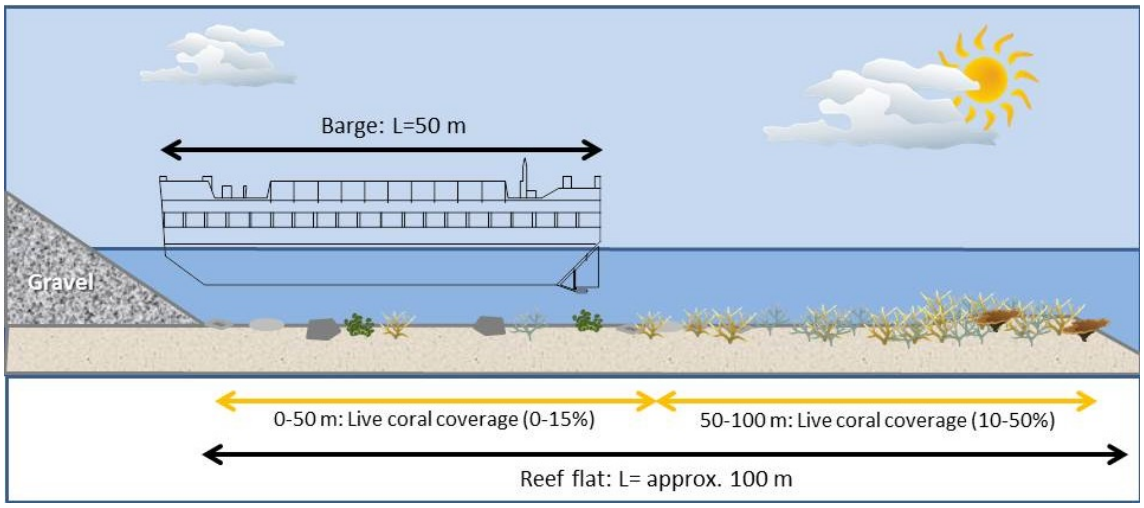
In Papaelise, live corals were mainly found between the outer reef flat and reef slope (i.e. around 50-100 m from the shore). Live coral coverage ranged between 10-50% in this area. Patches of dead corals were found in some areas (e.g. 60-70 m from the shore at transect P-TR2).

Live corals in the inner reef flat (i.e. around 0-50 m from the shore) were scarce ranging between 0-15% coverage. Substrate in this area was mainly comprised of algae, rocks, rubbles and sand. Table 3-4 shows the live coral coverage observed along the two monitoring transects. Figure 3-4 is a cross-section image of coral distribution along the monitoring transect.

Table 3-4 Live coral coverage observed along Papaelise monitoring transects

Distance from shore (m)	Live coral coverage (%)	
	P-TR1 (barge entrance route)	P-TR2 (reference)
0-10	No live corals	Approx. 5%
10-20	Approx. 5%	Approx. 5%
20-30	Approx. 5%	Approx. 15%
30-40	Approx. 5%	Approx. 5%
40-50	Approx. 5%	Approx. 10%
50-60	Approx. 50%	Approx. 20%
60-70	Approx. 45%	No live corals
70-80	Approx. 30%	Approx. 15%
80-90	Approx. 40%	Approx. 45%
90-100	Approx. 50%	Approx. 50%

Note: Survey conducted on October 17th, 2015.
Source: JICA Expert Team

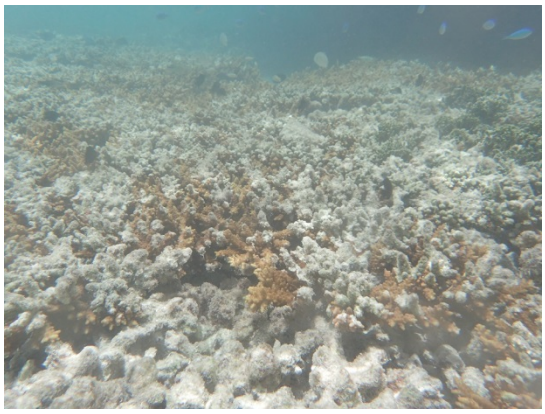
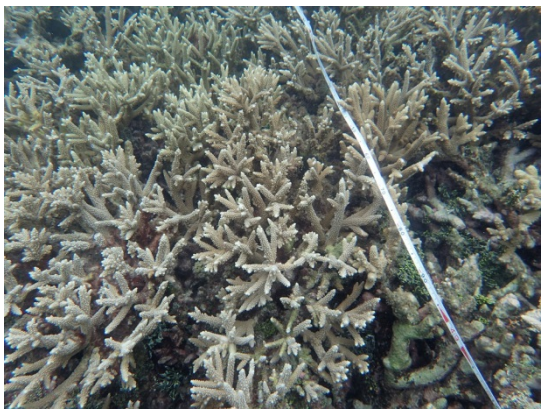


Source: Prepared by JICA Expert Team using IAN Symbols Libraries (http://ian.umces.edu/symbols/)

Figure 3-4 Cross-section image of coral distribution along Papaelise monitoring transect

Figure 3-5 shows typical substrate feature along the inner and outer reef flat of Papaelise

monitoring transects.

Inner reef flat (0-50 m)	Outer reef flat (50-100 m)
	
No coral area (rubble, sand)	Dead patches of *Acropora* coral
	
Small patch of live Acropora coral among dead corals	High coverage of live *Acropora* coral

Note: Photo taken on October 17th, 2015
Source: JICA Expert Team

Figure 3-5 Typical substrate feature along the inner and outer reef flat of Papaelise monitoring transects

b. North Funamanu

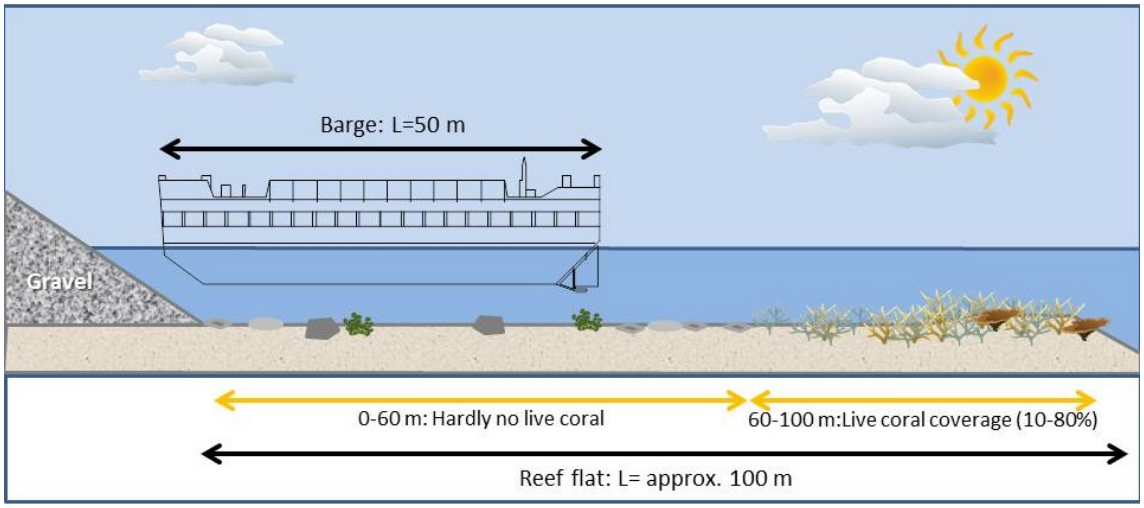
In north Funamanu, live corals were mainly found between the outer reef flat and reef slope (i.e. around 60-100 m from the shore). Live coral coverage ranged around 10-80% in this area. Patches of dead corals were found in some areas (e.g. 70-80 m from the shore at transect FN-TR1).

Hardly any live corals were found in the inner reef flat area (i.e. around between 0-60 m from the shore), hence there is no risk of coral damage from barge anchoring as in Papaelise. Substrate in this area was mainly covered by rocks, rubbles, sand and algae. Table 3-5 shows the live coral coverage observed along the two monitoring transects. Figure 3-6 is a cross-section image of coral distribution along the monitoring transect.

Table 3-5 Live coral coverage observed along north Funamanu monitoring transects

Distance from shore (m)	Live coral coverage (%)	
	FN-TR1 (barge entrance route)	FN-TR2 (reference)
0-10	No live corals	No live corals
10-20	No live corals	No live corals
20-30	No live corals	No live corals
30-40	No live corals	No live corals
40-50	No live corals	No live corals
50-60	Approx. 5%	No live corals
60-70	Approx. 15%	Approx. 10%
70-80	No live corals	Approx. 40%
80-90	Approx. 55%	Approx. 55%
90-100	Approx. 60%	Approx. 80%

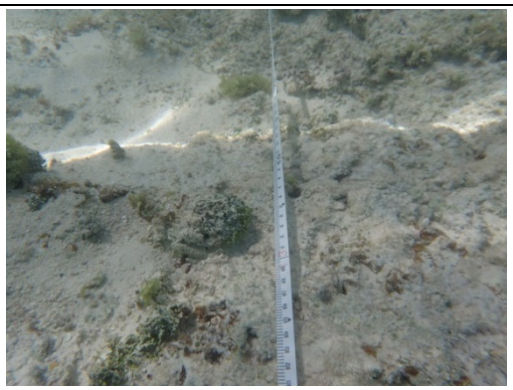
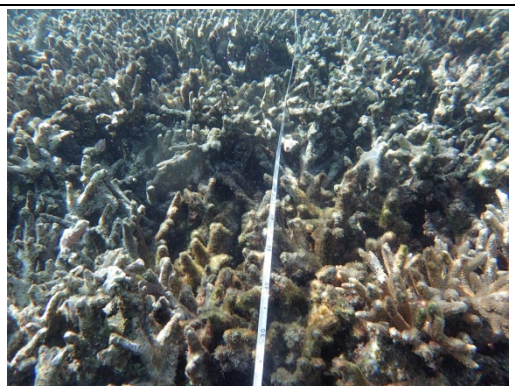
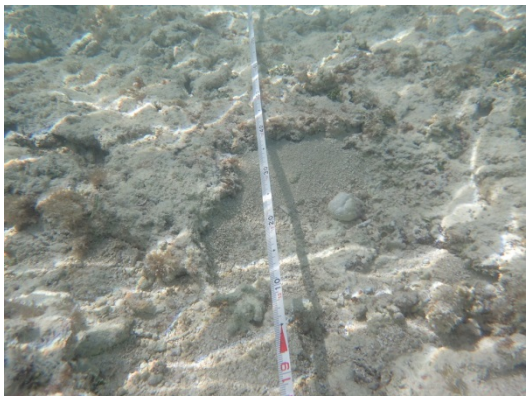
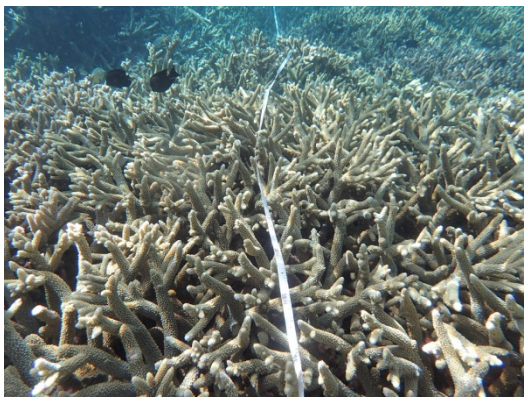
Note: Survey conducted on October 17th, 2015.
Source: JICA Expert Team



Source: Prepared by JICA Expert Team using IAN Symbols Libraries (http://ian.umces.edu/symbols/)

Figure 3-6 Cross-section image of coral distribution along north Funamanu monitoring transect

Figure 3-7 shows typical substrate feature along the inner and outer reef flat of Funamanu north monitoring transects.

Inner reef flat (0-60 m)	Outer reef flat (60-100 m)
	
No coral area (algae, sand, rubble)	Dead patches of *Acropora* coral
	
No coral area (rubble, sand)	High coverage of live *Acropora* coral

Note: Photo taken on October 17th, 2015
Source: JICA Expert Team

Figure 3-7 Typical substrate feature along the inner and outer reef flat of north Funamanu monitoring transects

2) Status of coral damage

a. Papaelise

No signs of notable coral damage by the barge (e.g. large bands of newly broken corals) were observed in the outer reef flat area where coral coverage is highest. This implies that the barge had been entering the reef flat area when there was sufficient depth (i.e. high tide).

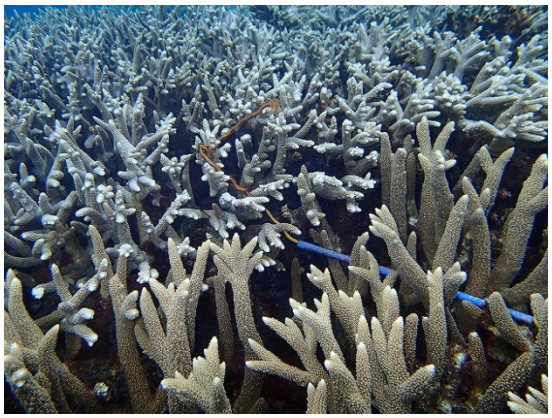
Few broken live corals were found in the inner reef flat area where the barge anchored. However, this is considered to be of minor significance as the extent of coral damage was limited to a small area and the high abundance of the damaged coral species (branching *Acroprora*) in the area.

b. North Funamanu

No signs of notable coral damage by the barge (e.g. large bands of newly broken corals) were observed in the outer reef flat area where coral coverage is highest. Figure 3-8 shows photos of the tagged coral taken during gravel collection stage and post-gravel collection stage.

Gravel collection stage (October 17th, 2015)

Gravel collection stage (November 13th, 2015)



Post-gravel collection stage (December 13th, 2015)

Source: JICA Expert Team

Figure 3-8 Photos of the tagged corals taken during gravel collection stage and post-gravel collection stage

(4) Conclusion

Apart from few broken live corals in the inner reef flat area of Papaelise, no coral damage by the barge was identified.

3.3. Monitoring of marine life

(1) Objective

To monitor the impacts of the gravel nourishment works on the marine life adjacent to the project site.

(2) Method

Three 50 m transects were set adjacent to the Project site. The marine life (benthic fauna and fish species) observed along the transects were recorded. The survey was conducted twice: first in the pre-construction stage (August 1st, 2015) and second in the post-construction stage (December 21st, 2015). In the post-construction survey, observations were also made along the north groin built through this Project. Figure 3-9 shows the location of the survey transects.

Source: Prepared by JICA Expert Team using Google Earth

Figure 3-9 Location of the marine life monitoring transects

(3) Results

The substrate in front of the survey area was primarily composed of sand with a mixture of dead corals, rocks and rubbles. Seaweeds were abundant in the area most notably Sargassum seaweeds. Other common seaweeds were *Padina* species and *Halimeda* species. No notable changes in seaweed distribution and abundance were observed between pre- and post-construction stages. Figure 3-10 shows typical substrate feature of the survey area.

Typical substrate (mixture of sand, rock, rubble and seaweeds)

Sargassum sp.

Halimeda sp.

Padina sp.

Note: Photo taken on August 1st, 2015

Source: JICA Expert Team

Figure 3-10 Typical substrate features of the survey area

During both the pre- and post-construction surveys, the most common marine fauna observed in the survey area were fishes (mostly young fishes) and sea cucumber. A total of 10 and 14 species of fishes were identified in the pre- and post-construction surveys respectively. Fish diversity was highest in the north groin area, implying that the groin is functioning as a new habitat for fishes. While sea cucumber was highly abundant during both pre- and post-construction surveys, only one species (*Holothuria atra*) was observed. Table 3-6 is a list of marine fauna identified in the pre- and post-construction surveys.

Table 3-6 List of marine fauna identified in the pre- and post-construction surveys

Stage	Fauna type		Family	Scientific name	TR1	TR2	TR3	North groin
Pre-construction	Fish	1	Apogonidae	*Cheilodipterus quinquelineatus*	✔			-
		2	Chaetodontidae	*Chaetodon auriga*	✔	✔	✔	-
		3	Mullidae	*Mulloidichthys* sp.	✔			-
		4		*Mulloidichthys vanicolensis*	✔		✔	-
		5		*Parupeneus multifasciatus*			✔	
		6	Pomacentridae	*Pomacentrus coelestis*	✔			-
		7		*Dascyllus* sp.	✔	✔	✔	
		8		*Chrysiptera* sp.	✔	✔		
		9	Blennidae	Unidentified		✔		-
		10	Labridae	Unidentified		✔		-
	Invertebrate	1	Holothuriidae	*Holothuria atra*	✔	✔	✔	-
Post-construction	Fish	1	Acanthuridae	*Acanthurus triostegus*				✔
		2		*Acanthurus xanthopterus*				✔
		3	Balistidae	*Rhinecanthus* sp.	✔			✔
		4	Blennidae	Unidentified				✔
		5	Chaetodontidae	*Chaetodon lunula*				✔
		6	Lethrinidae	*Lethrinus harak*	✔	✔		✔
		7		*Monotaxis grandoculis*		✔		
		8	Lutjanidae	*Lutjanus fulvus*				✔
		9	Mullidae	*Mulloidichthys* sp.				✔
		10		*Parupeneus barberinus*	✔	✔		
		11	Pomacentridae	*Abudefduf* sp.				✔
		12		*Pomacentrus coelestis*	✔			✔
		13		*Dascyllus aruanus*	✔			
		14		*Chrysiptera biocellata*				✔
	Invertebrate	1	Holothuriidae	*Holothuria atra*	✔	✔	✔	✔

Source: JICA Expert Team

(4) Conclusion

In conclusion, no notable changes in marine life were observed between pre- and post-construction stages. In fact, the Project seems to have created a new habitat for various fish species as evidenced by the observation of many young fishes along the north groin.

3.4. Monitoring of shoreline topography

(1) Objective

To monitor the change of shoreline topography around the Project site and gravel collection sites (Papaelise and north Funamanu).

(2) Method

The shoreline topography around the Project site and gravel collection sites were monitored through topographic survey and satellite image analysis. Table 3-7 describes the outline of each method.

Table 3-7 Outline of shoreline topography monitoring method

	Method	Frequency	Location
Topographic survey	Measurement of shoreline cross-section profile along 50 m transect	**Total 5 times** Pre-construction: 2015/2, 2015/6 Post-construction: 2015/12, 2016/3, 2016/6, 2016/12	**Project site:** 3 transects south of the south groin (See Figure 3-11 for the locations)
Satellite image analysis	Comparison of shoreline topography with satellite image	**Total 3 times** Pre-construction: 2015/6 Post-construction: 2016/1, 2016/12	Project site, Papaelise and North Funamanu:

Source: JICA Expert Team

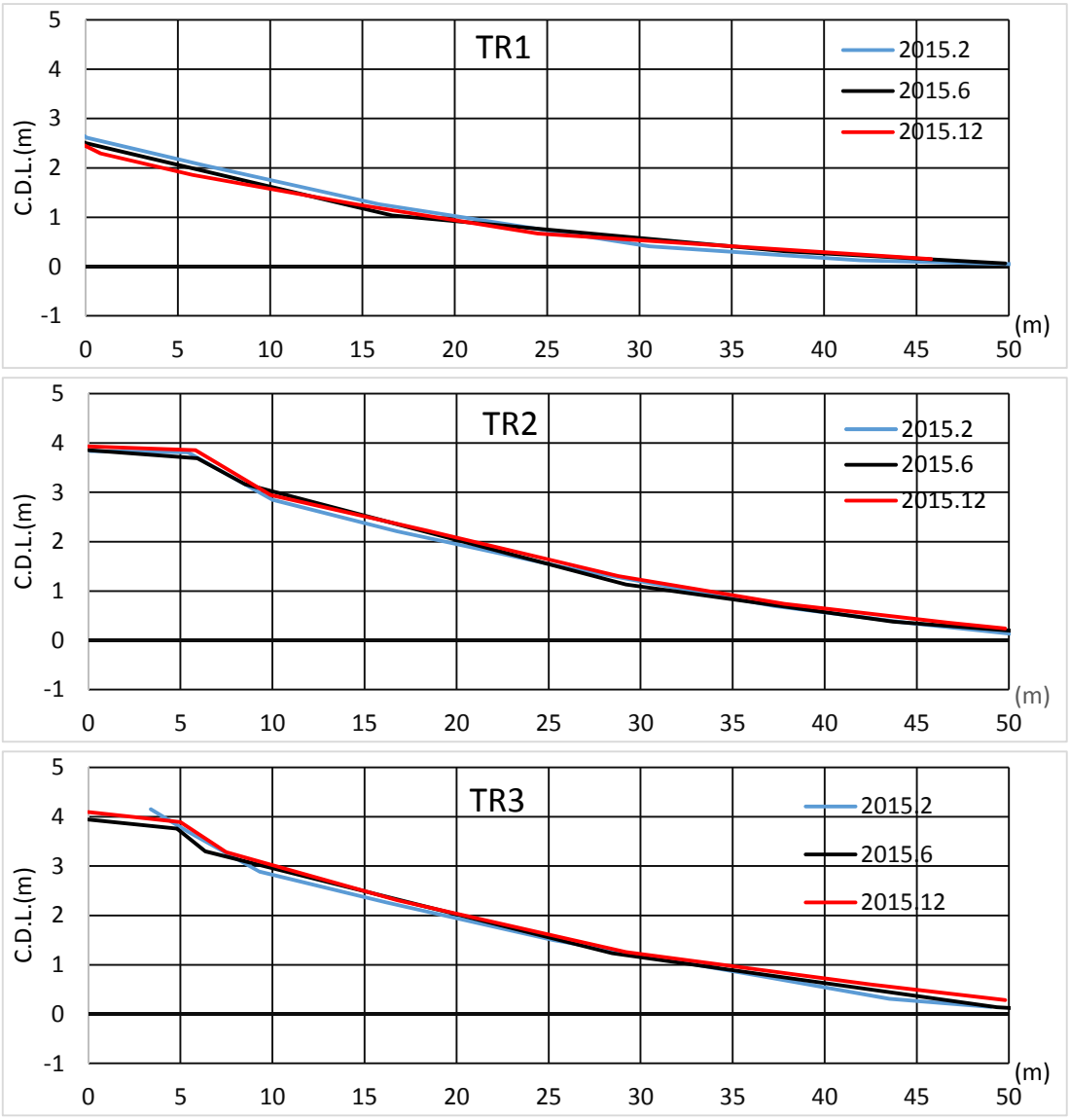
Source: Prepared by JICA Expert Team using Google Earth

Figure 3-11 Location of topographic survey monitoring transects

(3) Results

1) Topographic survey

Figure 3-12 compares the shoreline cross-section profile south side of the south groin measured in the pre-construction stage (February 2015: blue line, June 2015: black line) and post-construction stage (December 2015: red line). The results show no major change in the shoreline cross-section profile between pre-construction and post-construction stages.



Source: JICA Expert Team

Figure 3-12 Results of topographic survey

2) Satellite image analysis

a. Project site

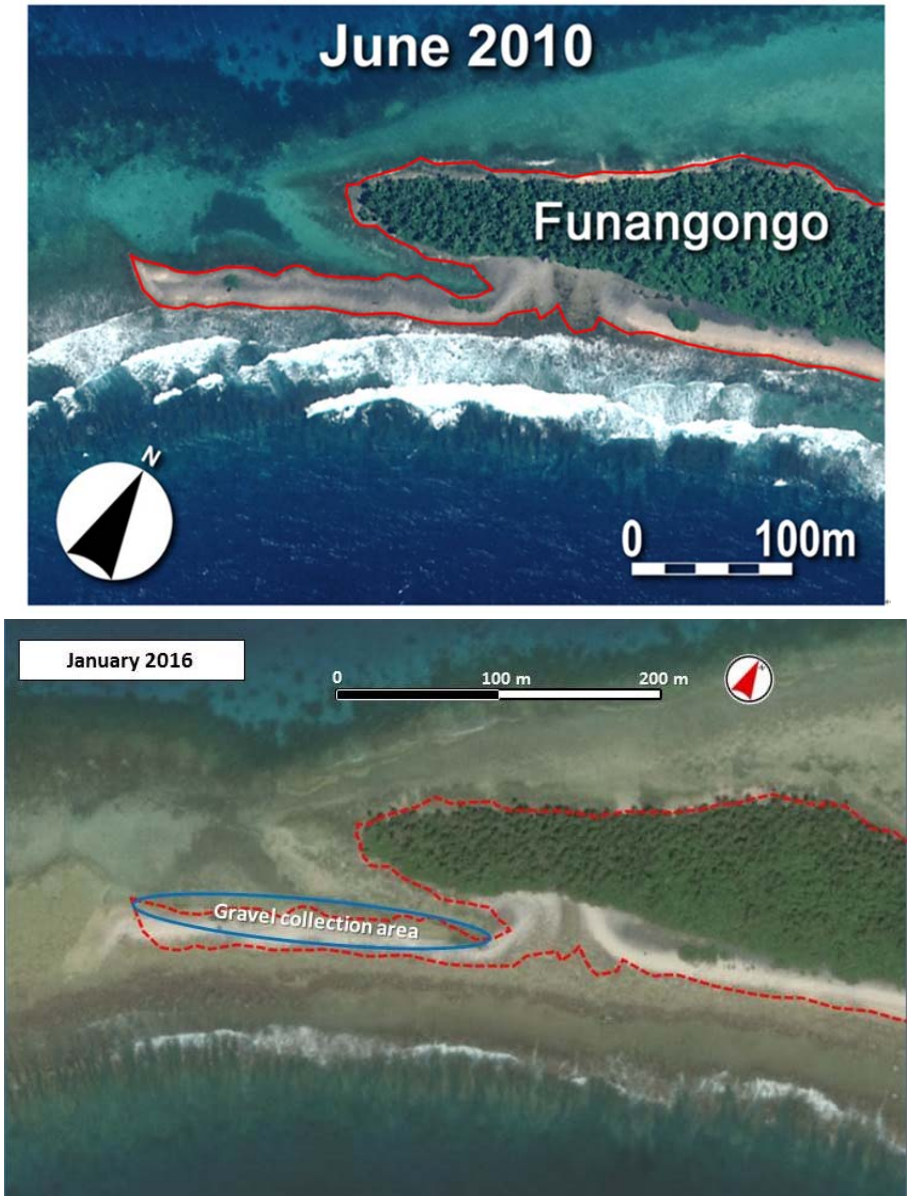
Figure 3-13 shows the satellite image of the shoreline around the Project site in June 2010 and post-construction stage (January 2016). The broken red line shown in the post-construction image indicates the shoreline boundary in June 2010. The post-construction image shows significant accretion of sand along the shoreline, which is likely due to the dispersion of sand from the reclamation project in front of the government building.

Source: JICA Expert Team

Figure 3-13 Satellite image of the shoreline around the Project site in June 2010 and January 2016

b. Papaelise

Figure 3-14 shows the satellite image of the shoreline around Papaelise gravel collection area in June 2010 and post-construction stage (January 2016). The broken red line shown in the post-construction image indicates the shoreline boundary in June 2010. Apart from the gravel collection area no major shoreline erosion or accretion seems to have occurred after the gravel collection works.

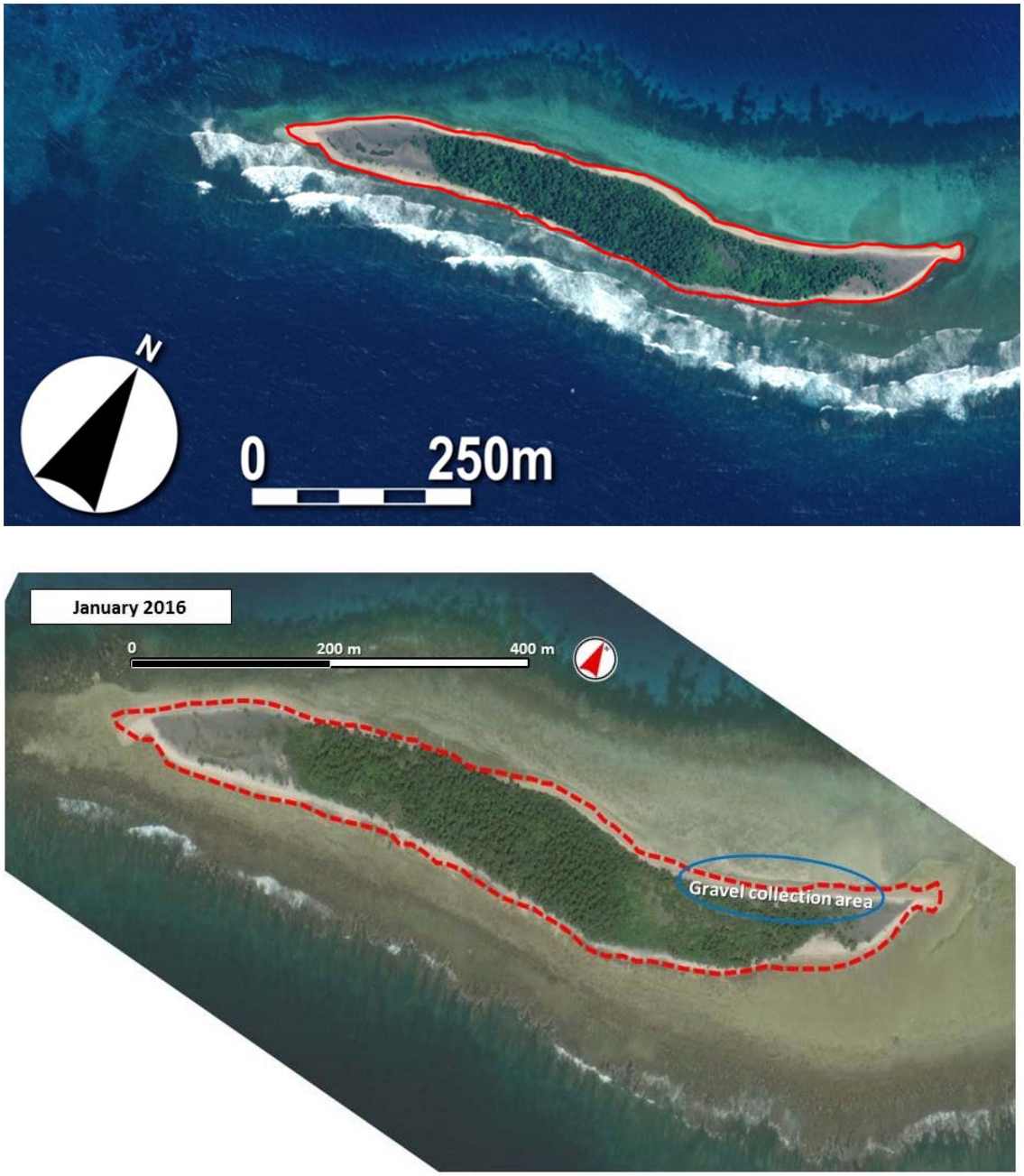


Source: JICA Expert Team

Figure 3-14 Satellite image of the shoreline around the Papaelise gravel collection area in June 2010 and January 2016

c. North Funamanu

Figure 3-15 shows the satellite image of the shoreline around North Funamanu gravel collection area in June 2010 and post-construction stage (January 2016). The broken red line shown in the post-construction image indicates the shoreline boundary in June 2010. Apart from the gravel collection area no major shoreline erosion or accretion seems to have occurred after the gravel collection works.



Source: JICA Expert Team

Figure 3-15 Satellite image of the shoreline around the North Funamanu gravel collection area in June 2010 and January 2016

(4) Conclusion

According to the topographic survey, there was no major change in the profile of the shoreline adjacent to the Project area between pre-construction and post-construction stages. However, according to the satellite image of January 2016, significant sand accretion has occurred in the period after the topographic survey was conducted. This sand accretion is likely to have occurred through the dispersion of sand from the reclamation project area, which probably was induced by the strong storm at the end of December.

At the gravel collection area in Papaelise and North Funamanu no major shoreline erosion or accretion has occurred along the adjacent areas after the gravel collection works.

4. Overall conclusion

Apart from some minor impacts on water quality (turbidity dispersion) and corals, no significant adverse impacts were identified through the monitoring surveys. In fact, there were some beneficial impacts such as the recruitment of young fishes along the new north groin.

The JICA Expert Team will continue necessary monitoring activities until the end of 2016, and the results will be reported to DOE.

Department of Environment

Project for Pilot Gravel Beach Nourishment against Coastal Disaster of Fongafale Island

Environmental Monitoring Report No.3

July 2016

JICA Expert Team

Table of contents

1. Introduction

The JICA Expert Team of the "Project for Pilot Gravel Beach Nourishment against Coastal Disaster of Fongafale Island (hereinafter abbreviated as "Project") is responsible for conducting environmental monitoring during the construction and post-construction phases of the Project in accordance to the Environmental Monitoring Plan (EMP) proposed under the Project's Preliminary Environmental Assessment Report (PEAR).

This monitoring report summarizes the monitoring results obtained during the post-construction stage from December 2015-July 2016 which includes the following activities:

- Monitoring of water quality
- Monitoring of marine life
- Monitoring of shoreline topography

2. Methods and results of monitoring

2.1. Monitoring of water quality

(1) Objective

To check impacts of the Project beach on seawater quality (turbidity and Coliform bacteria) around the Project beach and surrounding areas.

(2) Method

Turbidity was measured along the shore of the Project and surrounding areas on January 27th, February 13th and June 29th, 2016 using portable turbidity meter (DKK-TOA TB-31). Figure 2-1 shows the location of the turbidity monitoring sites.

Although monitoring of coliform bacteria was not initially planned, it was added to the monitoring program to check whether the waters around the Project site are safe for bathing and swimming. Coliform bacteria concentration was measured at 5 sites along the shore of the Project in July 2nd, 2016 using coliform detection paper (Suncoli Coliform Detection Paper No. 6). After sampling, the detection paper was incubated at around 36˚C for 24 hours. Figure 2-2 shows the location of the Coliform bacteria monitoring sites.

Source: Prepared by JICA Expert Team using Google Earth

Figure 2-1 Location of the turbidity monitoring sites

Source: Prepared by JICA Expert Team using Google Earth

Figure 2-2 Location of the coliform bacteria monitoring sites

(3) Results

1) Turbidity

Table 2-1 shows the results of the turbidity monitoring. Turbidity levels in January and February were high especially along the shore (Stations 1, 4, 7, 10) with maximum of 105 NTU recorded in January at Station 1. These high turbidity levels are due to another land reclamation and beach nourishment project that was ongoing at that time. Turbidity levels in July were generally low ranging between 0-1 NTU, which implies that the Project beach is not causing any elevation in turbidity levels of the surrounding waters.

Table 2-1 Results of turbidity monitoring in post-construction stage (unit: NTU)

Station	2016/1/27	2016/2/13	2016/6/29
1	105	16.9	-
2	4.5	7.1	-
3	1.7	1.8	-
4	41.1	7.5	-
5	5.7	12.5	-
6	1.2	1.9	-
7	12.3	4.7	4.0
8	1.4	2.2	0.0
9	0.5	0.5	0.0
10	10.5	4.2	1.0
11	0.3	0.5	0.1
12	0.7	0.7	0.3
13	4.5	1.9	0.6
14	1.5	0.8	0.0
15	0.6	3.6	0.0
16	3	6.2	0.4
17	1.9	2	0.0
18	0.6	3.8	0.0

Source: JICA Expert Team

2) Coliform bacteria

Coliform bacteria was not detected at all the sites, which implies that the waters adjacent to the Project beach is safe for bathing and swimming. Figure 2-3 shows the detection paper after incubation for 24 hours.

Note: Detection paper for St.3 not included in the photo as it went missing. Ref. was taken from local tap water which apparently was quite contaminated.
Source: JICA Expert Team

Figure 2-3 Detection paper after incubation for 24 hours

2.2. Monitoring of marine life

(1) Objective

To check impacts of the Project beach on nearshore marine life.

(2) Method

Three 50 m transects were set adjacent to the Project site and the marine life (benthic fauna and fish species) observed along the transects were recorded. Observations were also made along the north groin built through this Project. The survey was conducted in December 21st. 2015 and June 30th, 2016. Figure 2-4 shows the location of the survey transects.

Source: Prepared by JICA Expert Team using Google Earth

Figure 2-4 Location of the marine life monitoring transects

(3) Results

The substrate in front of the Project beach was primarily composed of sand with a mixture of dead corals, rocks and rubbles. Seaweeds were abundant in the area most notably Sargassum seaweeds. Other common seaweeds were *Padina* species and *Halimeda* species. No notable changes in seaweed distribution and abundance were observed between the two post-construction surveys and pre-construction stage.

The most common marine fauna observed in the survey area were fishes (mostly young fishes) and sea cucumber. A total of 15 and 18 species of fishes were identified in the December 2015 and June 2016 surveys respectively. These numbers were a slight increase compared to the pre-construction survey (August 2015) which identified 10 fish species. Fish diversity was relatively high in the north groin area, implying that the groin is functioning as a new habitat for fishes and consequently increasing the fish diversity of the area. These results imply that the Project beach are not causing any adverse impacts on nearshore marine fauna and in fact may be contributing to increasing the fish diversity. Table 2-2 is a list of marine fauna identified in the December 2015 and June 2016 surveys. Figure 2-5 shows photos of some of the fishes observed in the survey.

Table 2-2 List of marine fauna identified in the post-construction surveys

Period	Fauna type		Family	Scientific name	Common name	TR1	TR2	TR3	North groin
December 21st, 2015	Fish	1	Acanthuridae	*Acanthurus triostegus*	Convict surgeonfish				✔
		2		*Acanthurus xanthopterus*	Yellowfin surgeonfish				✔
		3	Atherinidae	*Atherinomorus* sp.	Silverside				✔
		4	Balistidae	*Rhinecanthus* sp.	Triggerfish	✔			✔
		5	Blennidae	Unidentified	-				✔
		6	Chaetodontidae	*Chaetodon lunula*	Raccoon butterflyfish				✔
		7	Lethrinidae	*Lethrinus harak*	Thumbprint emperor	✔	✔		✔
		8		*Monotaxis grandoculis*	Humpnose big-eye bream		✔		
		9	Lutjanidae	*Lutjanus fulvus*	Blacktail snapper				✔
		10	Mullidae	*Mulloidichthys* sp.	Goatfish				✔
		11		*Parupeneus barberinus*	Dash-and-dot goatfish	✔	✔		
		12	Pomacentridae	*Abudefduf* sp.	Damsel fish				✔
		13		*Pomacentrus coelestis*	Neon damselfish	✔			✔
		14		*Dascyllus aruanus*	Whitetail dascyllus	✔			
		15		*Chrysiptera biocellata*	Twinspot damselfish				✔
	Invertebrate	1	Holothuriidae	*Holothuria atra*	Black sea cucumber	✔	✔	✔	✔
June 30th, 2016	Fish	1	Apogonidae	*Cheilodipterus quinquelineatus*	Five-lined cardinalfish			✔	
		2	Acanthuridae	*Acanthurus nigrofuscus*	Lavender tang		✔		
		3		*Zebrasoma veliferum*	Sailfin tang			✔	
		4		*Acanthurus triostegus*	Convict surgeonfish				✔
		5		*Acanthurus xanthopterus*	Yellowfin surgeonfish				✔
		6	Atherinidae	*Atherinomorus* sp.	Silverside				✔
		7	Blennidae	Unidentified	-				✔
		8	Chaetodontidae	*Chaetodon auriga*	Threadfin butterflyfish	✔			
		9		*Chaetodon ephippium*	Saddle butterflyfish			✔	
		10	Lutjanidae	*Lutjanus fulvus*	Blacktail snapper		✔		✔
		11	Mullidae	*Parupeneus barberinus*	Dash-and-dot goatfish		✔		
		12	Muraenidae	*Echidna nebulosa*	Snowflake moray			✔	
		13	Pomacentridae	*Dascyllus aruanus*	Whitetail dascyllus			✔	
		14		*Abudefduf* sp.	Damsel fishes				✔

Period	Fauna type		Family	Scientific name	Common name	TR1	TR2	TR3	North groin
		15		*Chrysiptera biocellata*	Twinspot damselfish				✔
		16	Scaridae	*Scarus ghobban*	Blue-barred parrotfish		✔		
		17		*Chlorurus sordidus*	Daisy parrotfish		✔		
		18	Serranidae	*Epinephelus merra*	Honeycomb grouper			✔	
	Invertebrate	1	Holothuriidae	*Holothuria atra*	Black sea cucumber	✔	✔	✔	✔
		2	Grapsoidea	*Grapsus* sp.	Rock crab				✔

Source: JICA Expert Team

Acanthurus triostegus

Chaetodon ephippium

Dascyllus aruanus

Echidna nebulosa

Zebrasoma veliferum

Atherinomorus sp.

Source: JICA Expert Team

Figure 2-5 Examples of fish species observed in the survey

2.3. Monitoring of shoreline topography

(1) Objective

To check impacts of the Project beach on adjacent shoreline topography.

(2) Method

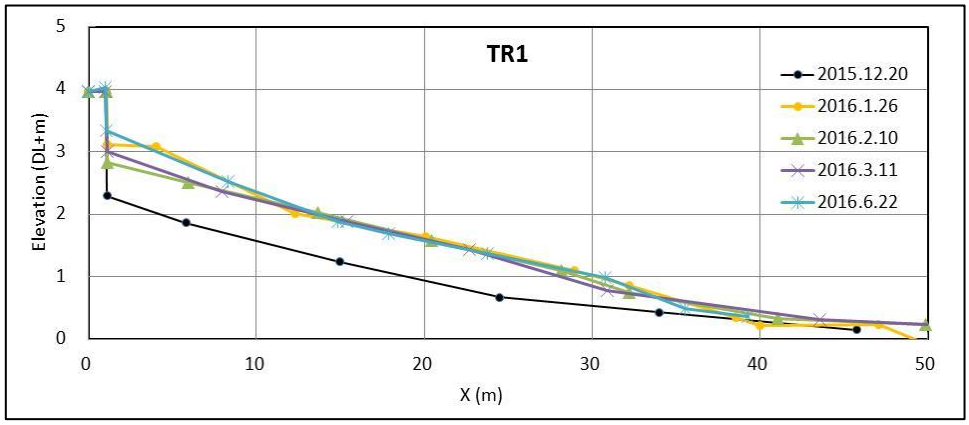
The shoreline topography around the Project site was monitored by topographic survey. Figure 2-6 shows the location of topographic survey monitoring transects.

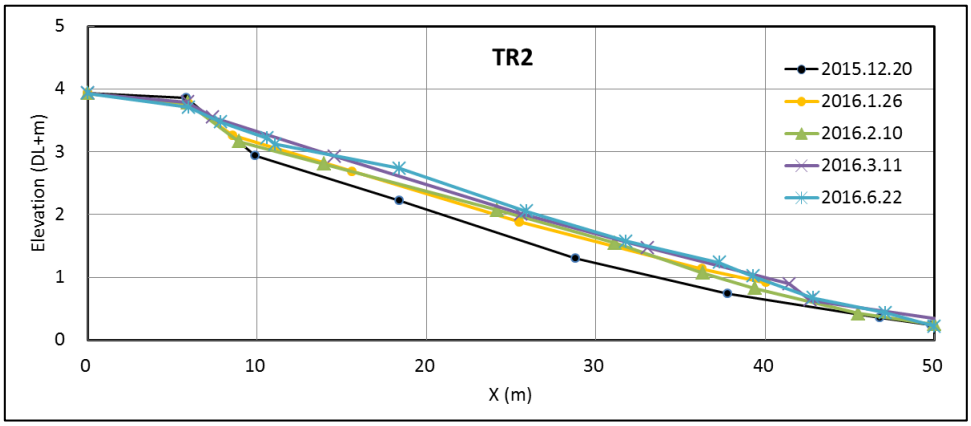
Source: Prepared by JICA Expert Team using Google Earth

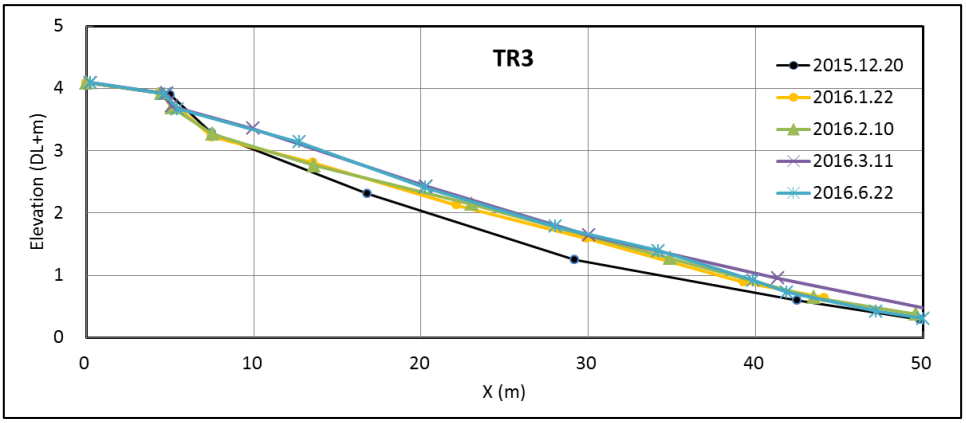
Figure 2-6 Location of topographic survey monitoring transects

(3) Results

Figure 2-7 shows the shoreline cross-section profile south of the south groin in the post-construction stage (2015/12, 2016/1, 2016/2, 2016/3, 2016/6). The results show a general trend towards sand accretion since December 2015. Sand accretion was most significant at TR1 with an approximate 1 m increase in elevation at the landside. Sand accretion is likely to be due to the sand spills from the land reclamation project and presence of the south groin.







Source: JICA Expert Team

Figure 2-7 Results of topographic survey

3. Conclusion

No notable adverse impacts on water quality, marine life and shoreline topography were identified through the monitoring surveys. In fact, there were some beneficial impacts such as the recruitment of young fishes along the new north groin.

Supporting Report-10

Technical Papers for Asian and Pacific Coasts 2017

Effectiveness of Gravel Beach Nourishment on Pacific Island

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The South Pacific Island nation of Tuvalu, which is composed of coral gravel and sand, is vulnerable to storm waves and sea level rise, resulting in beach erosion. Beach nourishment with self-produced coral gravel and sand was implemented in Tuvalu as the first trial of a user- and eco-friendly type of coastal conservation measure in Pacific Island countries. In order to examine the applicability of this type of coastal conservation measure, continuous monitoring has been carried out for one year to check the change in shoreline and beach profile. Beach monitoring for large-scale reclamation project, which was executed at the neighboring coast in almost the same period, was also conducted to compare the change of beach in the two different projects. The results show that the executed gravel beach nourishment can maintain stability under seasonal and extreme condition of wave actions.

Keywords: Gravel beach; Nourishment; Wave overtopping; Coral reef; Climate change; Adaptation; Monitoring; Tuvalu; JICA; ODA.

1. Introduction

The South Pacific Island nation of Tuvalu, which is located 1,000 km north from Fiji, consists of four small islands and five atolls. The total area is about 26 km^2 and this is the fourth smallest country in the world. Fongafale Island, which is located in Funafuti Atoll with a 2.4 km^2 area (Fig. 1), is the capital island in Tuvalu and more than half of the Tuvaluan population of about 6,000 people are

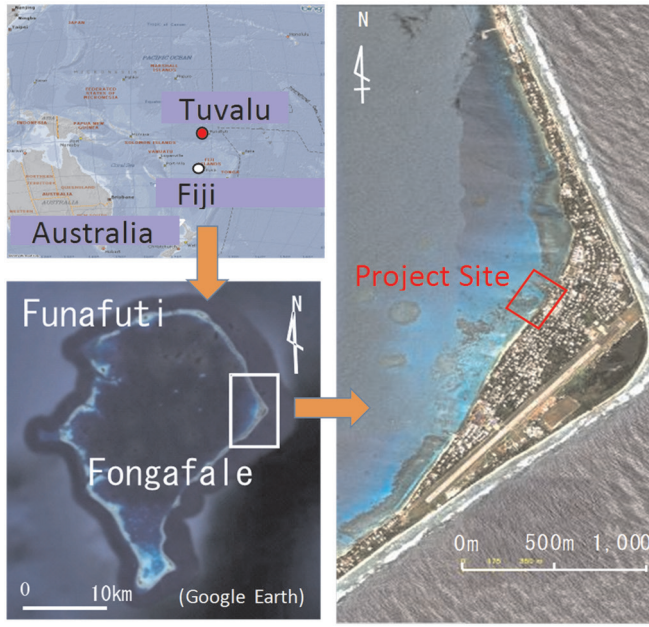


Fig. 1. Satellite Image of the Project Site in Tuvalu.

concentrated in this small island. The land was formed by the accumulated coral sand and gravel; the elevation of the land is very low and the maximum height is only about +4.5 m from the CDL. Due to the rapid concentration of the population to Fongafale Island in the last 20 years, the coastal area which was an undeveloped area before was highly utilized as a residential area, and coastal issues such as coastal erosion, wave overtopping, flooding, deterioration of water quality, and degradation of corals have been a serious problem in Tuvalu.

As one of the remedies, a pilot scale project of beach nourishment using coral gravel and sand was implemented (Ichikawa et al., 2016, Uda et al., 2013). The construction was completed in December 2015 and the beach monitoring has been carried out continuously since the completion of the construction. Apart from this project, another big-scale reclamation project was implemented at the neighboring area by the Tuvaluan government in the same period, and the sand filling was undertaken on the existing beach. This study aims to show the change in beach behavior due to gravel beach nourishment based on the monitoring results observed for one year. Also, the change in beach behavior for the two different projects, namely, gravel beach nourishment and reclamation project, was compared.

2. Project Outline

2.1. *Outline of the gravel beach nourishment project*

The Project was executed as a Japanese technical cooperation project in order to enhance the protection function against the risk of coastal disaster including the impact of climate change, and to examine the effectiveness and applicability of user- and eco-friendly type of coastal conservation measure of beach nourishment method in the small Pacific Island. The Project is divided into three phases. The first phase was the "planning and design phase", which was executed from March 2012 to March 2013. The second phase was the "construction phase", which was undertaken from January to December 2015. The third phase was the "monitoring and adaptive management phase", and this phase started in January 2016 and will continue until December 2017. This study is based on the monitoring results taken for one year which was from January 2016 to December 2016.

2.2. *Selection of coastal conservation method*

The reasons why the gravel beach nourishment method was selected are as follows:

- Each island in Tuvalu was originally formed by the accumulated coral gravel and sand due to the effect of wave action (Uda et al., 2015). The natural beach consists of coral gravel and sand which existed on the lagoon side of the Funafuti Atoll in the past. Basically, it is desirable to learn the natural process for the formation of the beach and land for the selection of the costal conservation measures.
- The coastal area at the lagoon side is now highly utilized as a residential area. The community strongly requested to consider both protection function and usage of the beach in the selection of the coastal conservation measures.
- The land of Fongafale Island in Funafuti Atoll consists of only coral gravel and sand, and the land area is very limited. Common construction materials, such as armor rock and concrete, were very hard to obtain in the country of Tuvalu. In addition, it is also desirable to use self-produced materials in Tuvalu and to select an easy protection method taking into account the sustainable beach maintenance work which will be carried out by the Tuvaluan side with their strong initiative after the construction under their own social and economic condition.

These are the reasons why beach nourishment using coral gravel and sand, which can only be procured in Tuvalu, was selected as an adequate coastal

conservation measure in Tuvalu to recover the same image of the previous natural beach.

2.3. *Beach condition before and after the project*

Due to the existence of the main community hole and church in Fongafale Island behind the target project area, a lot of residents are commonly gathering in this area since it is a main public area. However, the condition of the beach in front was seriously deteriorated. The sandy beach that existed in the past completely disappeared and the existing concrete block type seawall which was constructed as a remedy against coastal erosion also collapsed. Wave run up and overtopping in the hinter residential area frequently occurred as shown in Fig. 2. Due to such deterioration of beach condition, people could not use the beach space. Such change in the condition of the beach was causing the reduction of people's awareness on the beach environment, and the beach area became one of the dumping sites for garbage (Fig. 3).

After the implementation of the project, the beach drastically changed as shown in Fig. 4. About 3,300 m^3 of coral gravel and 4,500 m^3 of coral sand were filled into the project area (Fig. 5), with a longshore distance of 180 m. Coral gravel was taken from the surrounding island which is located in the same atoll. These coral gravels were washed ashore during the Cyclone Bebe which attacked the Funafuti Atoll in 1972 (Maragos et al., 1973). The coral sands on the other hand were provided by the Tuvaluan government. This sand was dredged from the seabed at the lagoon side of Funafuti Atoll and stocked on land under the other implemented project. Average width of the nourished beach is about 20 m, in which gravel was filled at the backshore side with 6 m width and sand was filled at the foreshore side with an approximately 15 m width. Rock armor type groins (armor rock was imported from Fiji) were constructed at both ends of the project area in order to minimize the unexpected future loss of gravel

Fig. 2. Wave Overtopping at Hinterland. (Before the Project)

Fig. 3. Deposition of Garbage on the Beach. (Before the Project)

and sand due to wave action. Construction work was commenced in August 2015 and completed in December 2015.

2.4. *Outline of the reclamation project by the Tuvaluan government*

There were several sunken areas on the land in Fongafale Island. These were leaving holes (called "borrow pit"), which were made by the excavation activity of the US military during the second world war to obtain construction material for the runway of the warplane. To rehabilitate this, a new project to backfill into the borrow pits was undertaken through the New Zealand grant project in 2015. In this project, a large amount of coral sand was dredged from the se abed at the lagoon of Funafuti Atoll by using a pump dredger, and backfilled into the borrow pits.

Fig. 4. Beach Condition Before and After the Project.

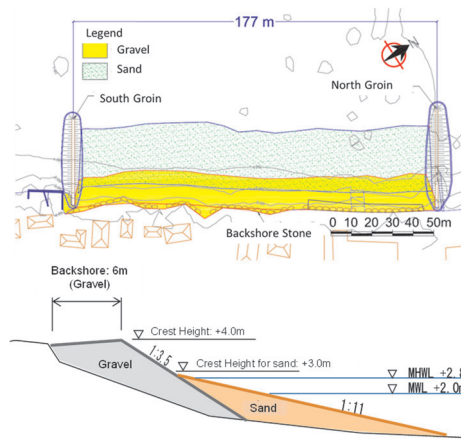


Fig. 5. Layout and Typical Cross Section of Beach Nourishment.

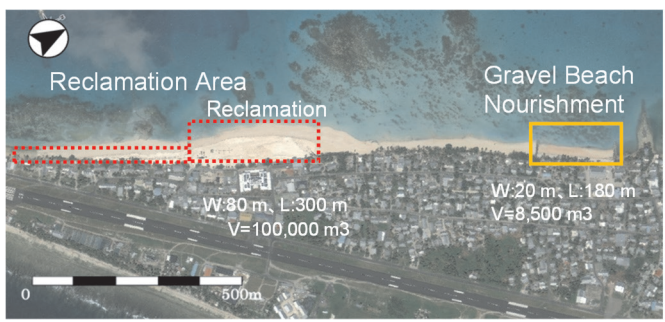


Fig. 6. Location of the Gravel Beach Nourishment and Reclamation Project.

After the completion of the project, the big-scale reclamation project was also undertaken by the Tuvaluan government at the neighboring beach in November 2015 using the same dredger. As shown in Fig. 6, the location of reclamation area is 0.7 km far from the gravel beach nourishment site to the north. About 100,000 m^3 of dredged sand was directly filled into the coastal area with a 300 m distance and 80 m width without any enclosure. This reclamation activity was completed in the latter part of December 2015. However, additional sand filling and construction of two groins were conducted due to significant sand loss which was caused by the attack of Cyclone Ula which approached to Funafuti Atoll from the end of December 2015 to the beginning of January 2016. Finally, it was completed in June 2016.

3. Beach Monitoring

3.1. *Outline of beach monitoring*

The beach monitoring has been carried out continuously since the completion of the construction in December 2015. Main items for monitoring are the beach profile survey and the photographs taken from the fixed points. Further, the shoreline positioning survey using a handy type GPS to cover a wide coastal stretch including the reclamation project area and taking oblique photograph using a drone have also been carried out. Time interval for monitoring was changed due to the expected beach behavior. Monthly monitoring was carried out during the first three months because significant profile change toward becoming a stable beach shape was expected. After that, the monitoring was carried out every three or six months. Six times of monitoring work were undertaken up to December 2016. Fig. 7 shows the position of the lines for the beach profile survey. The survey lines were set every 20 m at both the inner and

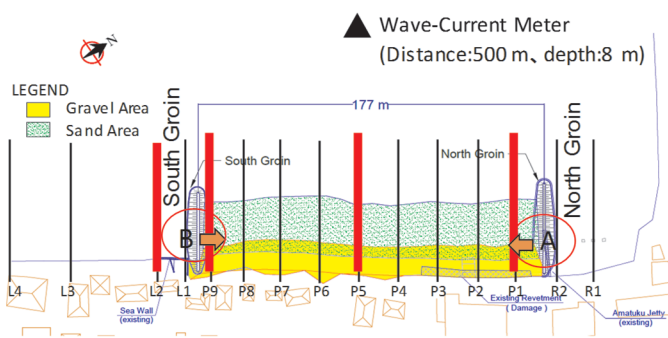


Fig. 7. Monitoring Line.

outer part of the project area. Wave observation has been conducted using a bottom mount-type self-recorded wave-current meter (Wave-Hunter) since March 2015 before the commencement of the construction work. The wave-current meter was installed offshore in front of the project site at the lagoon area with 8 m depth, and wave, current and water temperature were measured every two hours.

3.2. *Wave observation during monitoring period*

Two seasons exist in Tuvalu, i.e., winter (dry) season from April to October and summer (rainy) season from November to March. During the winter season, main wind direction is from the southeast (means wind blows from the landside at the lagoon side coast). On the other hand, during the summer season, main direction is from northwest (means wind blows from offshore side at the lagoon side coast). Average wind seed is mainly less than 4 m/s. Due to such seasonal change of wind direction, wave commonly becomes calm during the winter season. Cyclone commonly approaches Tuvalu from November to March in the summer season. During the cyclone approach, strong wind from the west of more than 10 m/s blows at the atoll, and waves at the lagoon side become rough due to this strong wind. If this happens during spring tide, high wave run-up, overtopping, and intrusion into the land side occur significantly.

Figure 8 shows the wave observation result for one year from December 2015 (completion of the construction). In this figure, the wave forecasting result (orange colored line) estimated from wind speed is also shown together with the observed one. Wave height ($H_{1/3}$) at the lagoon side was commonly less than 0.1 m; however, wave of more than 0.5 m height was observed during the storm. During this observation period, two cyclones approached the atoll; one is "Cyclone Ula", which approached from late December 2015 to early January 2016, and the other is "Cyclone Winston" which approached in the middle of February 2016. During Cyclone Ula, a 1.3 m wave height ($H_{1/3}$), which is the same level of the predicted wave height with 10-year return period, was observed.

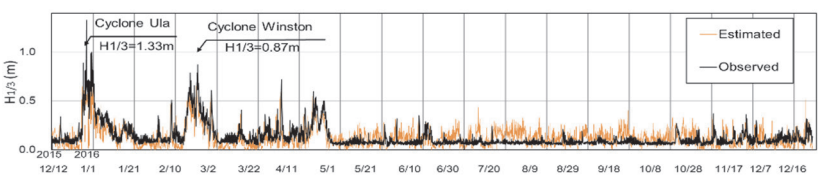


Fig. 8. Wave Height at the Lagoon Side During the Monitoring Period.

Fig. 9. Beach Change Based on Photos Taken From Fixed Point (Upper: Point A (North Side), Lower: Point B (South Side)).

3.3. *Beach change for gravel beach nourishment*

The photos taken from the fixed points at both end points (Point A and Point B in Fig. 7) for one year (just after the construction, 6 months later and 1 year later) are shown in Fig. 9. At Point A (north side of the project area), sand at the foreshore part seems to decrease and gravel is exposed. On the other hand, at Point B (south side of the project area), sand seems to be accumulated.

Figure 10 shows the change in beach profile at the four representative monitoring lines (three lines for inside of the project area and one line (L2) for outside of the project area). The beach profile before the construction is also indicated in the figure. Here, the section with elevation of +4.0 m to +3.0 m is for gravel filling, and the section with elevation of +3.0 m to +0.5 m is for sand filling.

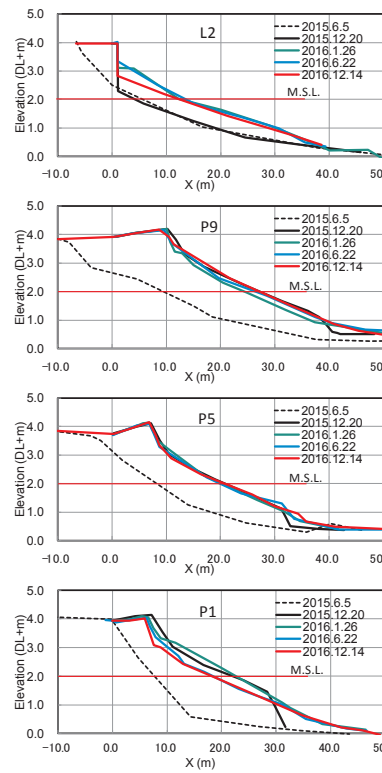
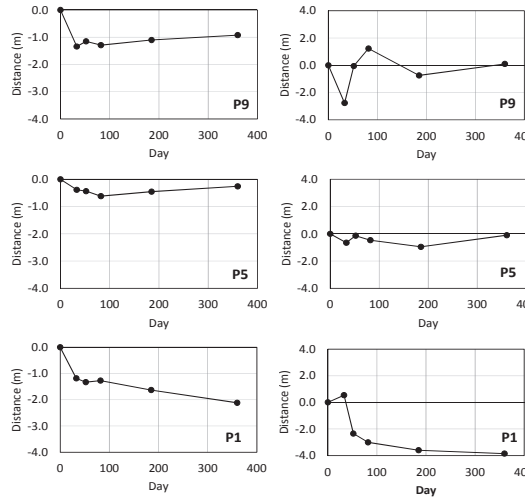


Fig. 10. Changes in the Beach Profiles as Represented by the Four Lines.

To make clear the change of the position for both sections of gravel and sand, differences of the distance from the initial position just after completion of construction at these two elevations (+3.7 m is the representative elevation for gravel section and +2.0 m is for sand section) are also shown in Fig. 11. Form these figures, the following tendency was observed:



(1) For +3.7 m (Gravel Section)

(2) For +2.0 m (Sand Section)

Fig. 11. Change in On-offshore Position at +3.7 m and +2.0 m.

- The difference of beach profiles, especially the beach slope for each section was not really significant, and almost the same slope was secured for one year. This means that the initially designed beach slope, which was determined based on the actual observed beach slope at a nearby beach, could be appropriate.
- Due to the strong waves during Cyclone Ula from late December 2015 to early January 2016, significant sand accumulation occurred at the southern outer part of the project area (L2 in Fig. 10). On the other hand, inside the project area, decrease of sand section was observed at the south side (P9 in Fig. 10) and accumulation was observed at the north side (P1 in Fig. 10). Also, the steep slope at the toe part of the sand section at P1, which existed just after the completion, became mild. Wave direction during this period was observed from the west (this means wave was incident from left side obliquely to the shoreline). From this, northward littoral drift might be significant during this period. Due to this northward littoral drift, some quantity of sand at the outer west coast flowed into the project area.
- As shown in Fig. 11, about 1 m retreat of the gravel section (backshore area) was observed at the south side (P9) due to strong wave action during Cyclone Ula. However, after that, no significant change of gravel section was observed. Retreat of the sand section of about 3 m was temporarily observed at P9 during Cyclone Ula. However, after 52 days (10 February 2016), the sand section was recovered at an almost the same level as the initial condition and can keep the stable condition.

- At the north side (P1), the gravel section retreated about 1 m during Cyclone Ula. After that, degree of retreat became small but it still decreased gradually. Total retreat for one year was about 2 m at P1. The sand section at P1 was temporarily accumulated during Cyclone Ula. However, after 52 days (10 February 2016), sand section retreated about 2 m and still decreased gradually.
- Significant change in beach profile at the center point (P5) for both sand and gravel sections was not observed during the one year monitoring period.

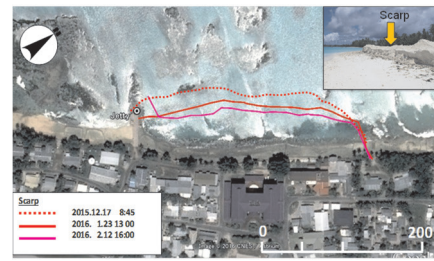


Fig. 12. Change in Shoreline at the Reclamation Area.

3.4. *Shoreline change at the reclamation project area*

The change in position of the shoreline at the reclamation project area was measured by using a handy type GPS. During the construction work, dredged sand was directly pumped to the beach area through the sand discharge pipe and no leveling work at the foreshore area was undertaken; therefore, it was difficult to identify the position of the shoreline visually. However, significant scarp was formed after the pumping due to the wave action at the foreshore part (shown in the upper photo in Fig. 12). Thus, the position of the shoreline was used to measure the position of the scarp, and the adjustment due to change in position for tidal condition was not required. Figure 12 shows the

Fig. 13. Change in Beach Condition (Upper: Before Reclamation, Middle: Before Groin Construction, Lower: After Groin Construction).

change in the position of the scarp forming for three months from December 2015 just after the completion of the sand pumping work. During this period, sand was filled into the existing beach with 300 m distance and 80 m width, and no coastal structure, such as groin, was constructed. After the approach of Cyclone Ula on 23 January 2016, significant retreat of the beach with average width of about 20 m and maximum width of 25 to 30 m was observed. Most of the disappeared sand was moved to the north side for a distance of 170 m by wave action. Such retreat continued until 12 February 2016 and roughly 10 m retreat was further observed for 20 days, even though wave was calm in this period. After that, two groins were constructed at both sides of the reclamation area to minimize further sand loss and additional filling of sand was conducted. Finally, this reclamation project was completed in June 2016.

Figure 13 shows the change in beach condition in the three stages, i.e., before the reclamation, completion of sand filling (but without groins), and the completion of the project (completion of groin construction and additional sand filling). After June 2016, which was the completion of the project, no storm waves came as shown in Fig. 8, and significant sand loss which occurred before the construction of groins was not seen even though some amount of sand near each groin flowed out to the outer area.

3.5. *Change in volume of gravel and sand*

Figure 14 shows the changes in volume of gravel, sand, and both, which were calculated from the result of the beach profile survey as shown in Fig. 10. Vertical axis means the change in the ratio of the volume to the initial one. Three lines are indicated in each figure, which means the volume rate for the total area (black line), that for 60 m interval at the south side (yellow line), and that for 60 m interval at the north side (blue line).

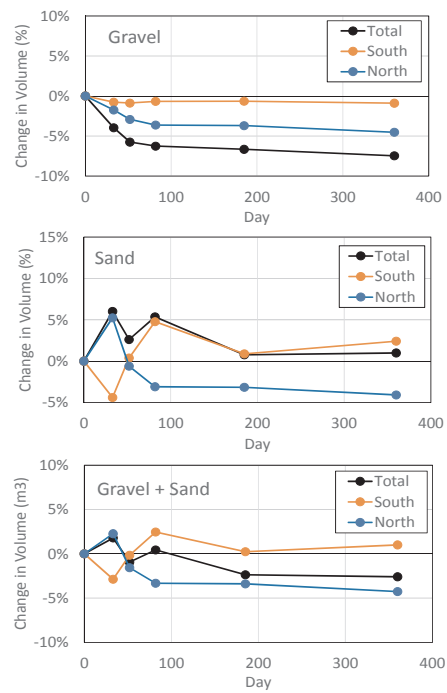


Fig. 14. Change in Volume of Gravel and Sand.

As shown in the upper figure in Fig. 14, about 7% of gravel was moved from the original backshore section to the foreshore sandy section; it was especially significant at the north side. The volume of sand was temporarily increased by the approaching two cyclones. After that, some decrease of sand volume was observed and almost the same volume of sand as in the initial condition was finally kept (middle figure in Fig. 14). The total volume of combined gravel and sand decreased a little compared to the initial condition by about 3% for one year as shown in the lower figure in Fig. 14. On the other hand, the sand loss at the reclamation area from January to February 2016 was estimated to be about 34% (about 34,000 m^3 of sand) based on the analysis for area change. This significant sand loss was mainly caused by the lack of consideration for construction of supplementary coastal structure even though the sand was filled with wide width of 80 m.

4. Conclusion

As a result of beach monitoring of gravel beach nourishment for one year, it was demonstrated that the high stability of the nourished beach can be secured even though strong waves, which have the same level as the predicted wave height for 10-year return period, attacked the beach. Nourished beach is now highly utilized by the residents as a user- and environment-friendly beach. On the other hand, this result was based only on one year monitoring data, and further continuous monitoring is required to prove the long-term stability of the beach.

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Approaches to Establish a Community-based Beach Management in the Pacific Island Country

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As a part of the Pilot Gravel Beach Nourishment Project in Tuvalu by Japan International Cooperation Agency (JICA), approaches to establish a community-based beach management had been implemented as the first trial among the Pacific Island countries. A community-based beach management requires an active public participation; however, public awareness on beach seemed to be quite low in the beginning of the Project because of the terrible beach condition with dumped rubbish scattered on the beach. Therefore, raising public awareness on beach and making people understand and experience the benefits from the beach were considered necessary to establish the community-based beach management. In the Project, several public relations and educational activities were implemented for these purposes and one notable effective activity was the beach sports festival that was firstly held in Tuvalu. Public awareness on beach, especially on beach use and environment, was much improved through these activities so that community and residents voluntarily started beach management activities such as periodic beach cleaning and public notification of illegal activities on the beach. These changes contributed to maintain the good condition of the Project beach for almost one and half year after the construction.

Keywords: Community-based beach management; Public relations; Environmental education; Gravel beach nourishment; Pacific Island country.

1. Background and objective

Gravel beach nourishment was implemented on Fongafale Island in Tuvalu[1,2] in 2015, as the first application of beach nourishment in Pacific Island countries, under a Japanese official development assistance (ODA) Project to protect low-elevated coastal area and to restore functions of beach use and environment (Fig. 1 and Fig. 2). The gravel beach nourishment consists of two layers of gravel and sand, respectively, which was originally designed based on a healthy beach in Tuvalu. The gravel layer was adopted to improve its stability against waves and sand layer was done to improve beach use and environment. To maintain a beach with good condition for a long term requires continuous beach management by the community in which the beach is located. Since a beach is a part of the local community life, their active participation is essential for beach management. People in the small pacific islands, however, have little knowledge and experience in beach management and, therefore, it was not easy to obtain their cooperation directly. Thus, changing public awareness on beach through public relations and educational activities was considered as the first approach to realize community-based beach management.

In this paper, the methodologies applied to establish a community-based beach management through the Project were described, and their effects were evaluated in terms of beach management.

2. Policy on activities to establish a community-based beach management

Beach condition before the Project implementation directly showed the people's lack of interest on the beach; concrete blocks used for temporary protection were scattered and rubbish dumped by residents was accumulated and smelled bad on the beach as shown in Fig. 3. Furthermore, it is anticipated that even if beach environment has been improved by the Project, it would go back to the same bad situation sooner or later if nothing changes regarding public awareness on beach.

Thus, the following step-by-step approaches were considered to be necessary to realize community-based beach management: 1) people become interested on the beach, 2) people experience and understand the benefits from the beach, and 3) people begin to take concrete actions on beach management. To accomplish these objectives, approaches through several public relations and educational activities were applied during the entire Project period, which were for planning, design, construction, and post construction phases.

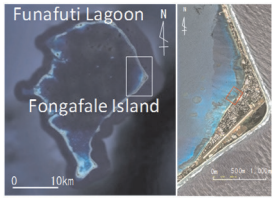

Fig. 1. Location of the Project site in Tuvalu.

Fig. 2. Before and after the Project (gravel beach nourishment).

Fig. 3. Beach condition before the Project with scattered concrete blocks (left) and accumulated rubbish on the beach (right).

3. Activities implemented to establish a community-based beach management

The following sections show activities implemented to establish a community-based management mainly with two purposes, i.e., to improve public interest on beach as a first step and to make people recognize and experience the benefits from beach as a second step.

3.1. *Activities to improve public interest on beach*

The activities had been implemented mainly from the beginning of the Project to the completion of the construction, which took about one year. Expecting a widespread effect to men and women of all ages, various types of public relations activities were implemented as shown in Table 1 and Fig. 4.

For example, a radio announcement, which was the only public media in Tuvalu, could widely broadcast the Project information to the public not only in Fongafale Island where the Project was implemented but also in other islands. On the other hand, beach cleaning event gathered nearby stakeholders such as local community members and residents who live near the Project site to make them more interested in the beach condition and a beach tour during construction targeted primary school students to raise the interest on beach of younger generations.

Table 1. Activities implemented to improve public interest on beach.

Type of activity	Phase	Target	Involved numbers
Radio announcement	All	Public	N/A
Stakeholder meeting on the Project	Planning, design and construction	Community, residents	150
Beach cleaning event	Planning, design	Community, residents	150
Singing competition	Planning, design	Public	30
Drawing competition	Planning, design	School students	30
Beach tour during construction period	Construction	School students, community leaders from all islands	100
Opening ceremony of beach	Construction	Government, community, residents	70

Fig. 4. Activities to improve public interests on beach; left) beach cleaning event before construction, center) beach song competition, right) beach tour during construction.

3.2. *Activities to make people recognize and experience the benefits from the beach*

Since gravel beach nourishment is a measure with multiple functions, i.e., protection, beach use, and environment, activities were implemented to make people recognize and experience benefits in each aspect as follows.

3.2.1. *Activities to make people realize the benefits in protection*

A cyclone hit Tuvalu in December 2015 just after the construction was completed and residents living near the Project area firstly experienced high waves after the construction. A brief interview survey was conducted with the residents to see whether they recognize any Project effects or not. Results showed that more than 80% answered that there was a significant effect in protection against high wave during the cyclone compared with the situation before the construction and with adjustment beaches. This survey results were also utilized as materials to publicize the protection function of the Project beach for public relations and educational activities afterwards.

3.2.2. *Activities to make people recognize the benefits in beach use and environment*

Typical beach uses in Tuvalu were mainly for bathing in the morning and early evening and for boat parking and landing for local fishery industries. To make people recognize other ways of beach use, the beach sports festival involving primary school students was planned and implemented through the cooperation between the government and the local community. It was the first trial in Tuvalu to hold a sports festival on the beach area and more than 800 people including the students' family participated in the festival. It should be noted that this beach sports festival also aimed to create opportunities for participants to consider their roles in using the beach area safely and pleasantly.

Firstly, to create an opportunity for school students to think about the importance of beach, classes on beach environment were held in cooperation with the teachers in the school. Secondly, to make participants understand and experience their roles of using the beach area pleasantly, a beach cleaning event was held a few days before the beach sports festival involving school students, teachers, community, and the government. Finally, the beach sports festival was held to make participants experience the pleasantness of playing on the beach. Figure 5 summarizes this stepwise sequence of activities, i.e., environmental education, beach cleaning event, and beach sports festival. In the beach sports festival, two types of program were prepared, namely, one that uses sandy beach area and another that uses shallow water area. These programs were organized depending on the beach area changes due to tidal fluctuations during the festival so that participants could experience different types of beach use as shown in Fig. 6.

Fig. 5. Sequence of public relations and education activities related to beach sports festival.

Fig. 6. Programs that use sandy beach during low tide (Left) and that use shallow water area during high tide (right).

4. Outcome of the activities

Outcomes of the activities in terms of public awareness and actual activities related to beach management were described as follows:

4.1. *Changes in public awareness on beach*

Interview survey to residents was conducted in January 2017 to grasp the effects of the aforementioned public relations and educational activities quantitatively. The sample number was 62 and it was conducted not only near the Project site but also outside of the site as shown in Fig. 7 and was done irrespective of age or sex to grasp the extent of the effect. At first, the survey results were quite positive because 92% of the respondents replied that they already know the Project beach. The following four sections show changes in public awareness based on the interview survey results.

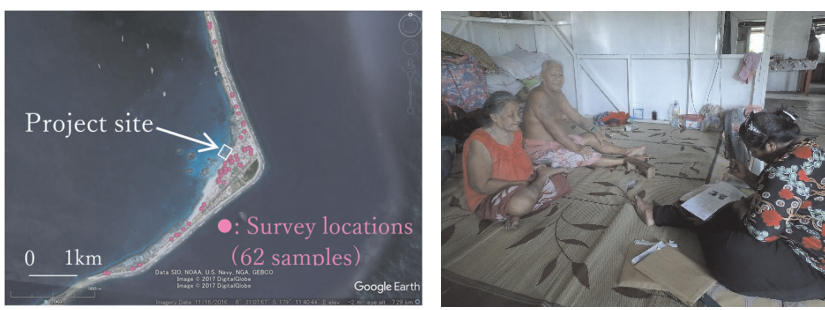

Fig. 7. Locations of interview survey (January 2017) and photo during survey.

4.1.1. *Shift from protection-oriented awareness to that of beach use- and environment-conscious*

Figure 8 shows the interview survey results on both "project purpose" and "project effect". More than 90% of the respondents recognized that the Project was implemented to protect the vulnerable coastal area. This seems not to be a particular trend as protection is one of the most important functions but it was also indicated that they did not put weight on the other benefits based on the Project purpose. On the other hand, in terms of Project effect, they highly evaluated environment (85%) and beach use (56%) compared with protection (29%). Therefore, the shift from protection-oriented awareness to that of beach use- and environment-conscious was concluded from these results.

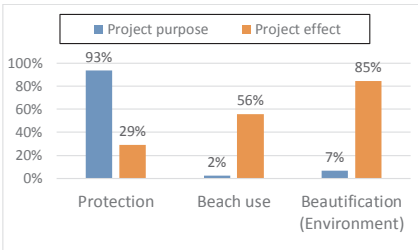

Fig. 8. Interview survey results on project purpose and project effect.

4.1.2. *Awareness on beach use and environment was developed for a wider range of people especially through the beach sports festival*

Interview survey results on "opportunities that people become familiar with the Project beach" showed that 70% of the respondents become familiar with the beach through the events related to the beach sports festival (Table 2). On the other hand, the radio announcement scored the lowest among these opportunities though it is the only public media in Tuvalu. Therefore, experience-based activities are considered more effective to improve or change public awareness.

Table 2. Interview survey results on opportunities that people become familiar with the Project beach.

Opportunity that people become familiar with the Project beach	Ratio
Stay nearby	23 %
Visiting beach area	35 %
Construction work	37 %
Radio announcement	12 %
Sequence of events related to beach sports festival (Sec. 3.2.2)	70 %
Other PR activities (singing competition, drawing contest, opening ceremony)	47 %

4.1.3. *Importance of beach maintenance was recognized due to improvements of public awareness on beach use*

Figure 9 shows the interview survey results on "concerns on the Project beach in the future" for both surveys conducted in January 2016 and January 2017. In January 2016, which was just after the completion of the construction in December 2015, the gravel collapse had the highest proportion while in January 2017, beach maintenance had the highest proportion of 29%, which was 0% in 2016. Most of these respondents replied that maintenance is required to remove some scattered gravel on the beach so that people can use sandy beach area pleasantly. Therefore, changes in public awareness on beach maintenance were concluded from these results.

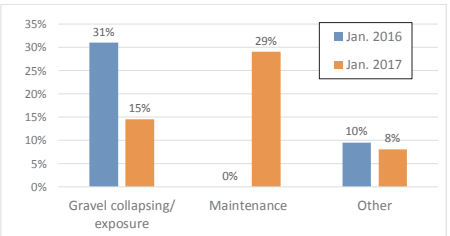

Fig. 9. Interview survey results on concerns on the Project beach in the future (if any).

4.1.4. *People firstly realized the effects of gravel beach nourishment and desired to extend the same measure to other coastal areas in Tuvalu*

As aforementioned, typical coastal protection measure applied in Tuvalu is mainly concrete block wall and this Project was the first trial to apply beach nourishment in Tuvalu. Interview survey results on "desirable coastal conservation measure to be applied to other areas in Tuvalu" showed that beach nourishment became well recognized and 73% of the respondents replied that they prefer beach nourishment to concrete block wall as shown in Table 3. It should be noted that most of them did not even know beach nourishment before the Project started, about one and half year ago.

Table 3. Interview survey results on desirable coastal conservation measure to other areas in Tuvalu.

Type of Measure	Beach Nourishment	Seawall	Both	Not Sure
Ratio	73%	3%	19%	6%

Finally, changes in people's awareness related to the beach through the Project can be summarized in Fig. 10. Awareness on protection remains at a high level at all times because it is directly related to their safety and their property. On the other hand, awareness on beach use and environment was initially very low as these concepts had never been developed in Tuvalu before. However, it was much improved just after the construction as people confirmed its effects by themselves and the awareness was continuously improved after the construction through public relations and educational activities, especially through the sequence of events related to the beach sports festivals. Awareness on beach maintenance was newly developed after public awareness on beach use had increased.

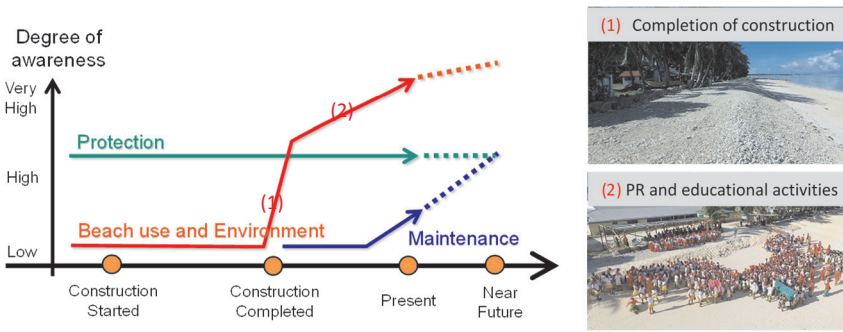

Fig. 10. Changes in peoples' awareness on beach through the Project period.

4.2. *Changes in activities related to beach management and beach use*

The following three sections show changes in actual activities related to beach management and beach use:

4.2.1. *Community started periodic beach cleaning and beach environment was kept at a good condition*

Community started beach cleaning voluntarily involving residents just after the completion of the construction and continued it every two weeks until the present for one and half year (Fig. 11). At the same time, dumping of garbage from residents was reduced to almost nothing because their manner was also improved through public relations and educational activities. As a result, the environment of the Project beach has been maintained well.

Fig. 11. Periodic beach cleaning by community.

Fig. 12. Signboards installed on the beach.

Fig. 13. A new beach use: fishing at groin.

4.2.2. *Illegal activities on the beach had been prevented through multiple measures implemented by the community*

Gravel and sand used for the beach nourishment are common materials utilized for housing construction in Tuvalu. There also existed several private boat landing slopes at the Project area before the implementation. Thus, it was initially anticipated that illegal activities such as stealing of materials and private constructions on the beach would occur after the construction. To prevent these illegal activities, the community established bylaws on beach use and informed the regulations to the public widely through radio announcement, periodic patrol, and installation of signboard as shown in Fig. 12. As a result, no illegal activities had been confirmed up to the present.

4.2.3. *A new way of beach use became widespread among the public*

Through the beach sports festival, a new way of beach use became widespread among primary school students and the local community. They enjoyed some sports on the beach referring to programs that had been implemented during the beach sports festival. In addition, fishing from groins, which are located at both ends of the Project site to prevent sand outflow, were getting more popular among local residents as groins functioned as a good fish bed (Fig. 13). Furthermore, since primary school, community, and the government plan to make beach sports festival an annual event, continuous and active beach use is highly expected in the following years.

5. Preparation for maintenance works initiated by the community and the government

Beach nourishment in general requires periodic maintenance works as adaptive management such as re-nourishment and reprofiling after implementation.

Details of maintenance work and its frequency differ based on purpose, natural conditions, and nourishment materials.

In this Project, as public awareness on beach use and environment was rapidly increased, they are required to maintain the beach at a level where it can be used pleasantly like a playground. To respond to such requests, the community and the government decided to implement maintenance works and would continue periodic re-nourishment and reprofiling on a yearly basis. The first maintenance work would be implemented under the supervision of the JICA Expert Team to learn basic procedure and methods. In addition, to make the maintenance works sustainable in the future, a win-win relationship among schools, community, and the government was proposed as shown in Fig. 14. One example of this relationship is that the school will hold a beach sports event involving the community and the community will do beach maintenance in return so that the beach area can be used for the festival. It might not be so easy to establish such kind of sustainable maintenance structure in practice, however, considering the drastic changes in people's awareness and activities through this Project, it is possible that this can be realized.

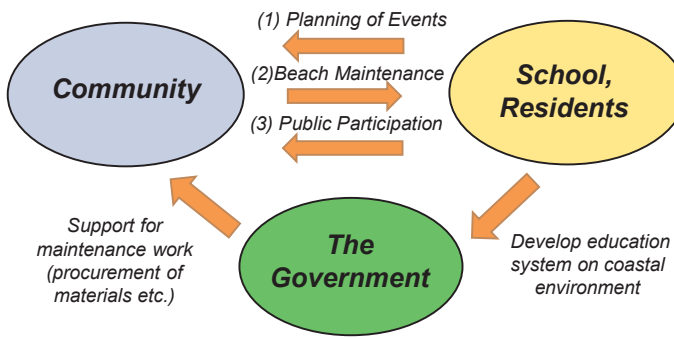

Fig. 14. Idea on sustainable beach management structure.

6. Conclusion

Public awareness on beach was much improved through public relations and educational activities under the Project. People experienced benefits from the beach through these activities and realized their roles in using the beach area pleasantly. The community started voluntary beach cleaning involving residents and prepared bylaws on beach use and disseminated these rules to the public. As a result of these activities, beach environment had been kept at a good condition and no illegal activities such as dumping of rubbish, stealing of materials, and

private construction on the beach had occurred for one and half year after the completion of the construction. In addition, with an increased desire for beach maintenance, the community and the government decided to implement periodic maintenance works such as reprofiling and re-nourishment. It is, therefore, concluded that a community-based beach management was established and functioned successfully during the Project period.

However, it also should be noted that continuous public relations and educational activities will be needed to maintain public awareness on beach at a high level so that they would voluntarily keep participating in the beach management in the future.

Acknowledgement

This paper described the Pilot Gravel Beach Nourishment Project in Tuvalu which was executed by JICA as one of the Japanese ODA projects. The authors would like to express their deep appreciation to the Nauti Primary School, Funafuti communities, and the Tuvaluan government for their active support for the Project.

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