

Ex-Post Evaluation of Japanese Grant Aid  
“Project for Reinforcement of the Dredging Capabilities for Beira Port”

External Evaluator: Mitsue MISHIMA, OPMAC Corporation

**0. Summary**

The relevance of the project is judged to be fair. Although the objective of this project was consistent with the development plan and the development needs of the Republic of Mozambique, as well as with Japan’s ODA policy, it was not that feasible for EMODRAGA to conduct the dredging plan suggested by the project for the achievement of the project objectives. Efficiency was high with regard to the construction of the dredgers; however the objective of the project, which was to dredge 8 m of water in the old channel, was not achieved by the two dredgers constructed through Japanese grant aid. In spite of this however, the two dredgers did contribute to deepening the old channel, allowing it to reopen. Maintenance dredging was also made possible, and therefore the security of the access to the Beira Port was improved. The effectiveness of the project is fair, as the capacity utilization rate of the dredgers was maintained at more than 60 percent. To improve the deficit producing financial condition of EMODRAGA, it is indispensable that an optimal operation of all the dredging equipment is achieved. This would require comprehensive dredging planning and its efficient implementation. The sustainability of the project effects, therefore, is admitted to be fair.

In light of the above, this project is evaluated to be partially satisfactory as although the project had some effect, there remained some issues for improvement.

**1. Project Description**



Project Location



Dredger “Alcântara Santos”

**1.1 Background**

The access channel to the Port of Beira had been dredged to 8m depth during 1989 and 1990 with the assistance of the Netherlands so that the port could accommodate ships up to 30,000 DWT<sup>1</sup>. Empresa Moçambicana de Dragagens<sup>2</sup> (hereinafter referred to as “EMODRAGA”) was in charge of the maintenance dredging of the access channel. However, since that time, no appropriate maintenance dredging had been carried out due to insufficient

<sup>1</sup> The abbreviation of Dead Weight Ton, the maximum amount of cargo that a ship can actually carry.

<sup>2</sup> A public company under the control of the Ministry of Transport and Communications (MTC). EMODRAGA is dredging all ports nationwide under contract with Portos e Caminhos de Ferro de Moçambique which is also under MTC.

dredging capacity of the equipment. As a consequence, the channel had become shallow in many places due to incessant sedimentation of silt and sand. The worst area was a bend in the channel, named “Macuti Bend”, where the administrator of the Port, Portos e Caminhos de Ferro de Moçambique (hereinafter referred to as “CFM<sup>3</sup>”), had been obliged to construct a new provisional access channel, approximately 200 meters south of the old channel, in 1996.

To improve dredging capacity, the Government of Mozambique requested that the Government of Japan provide a dredger under the grant aid scheme. In response to this request, the Government of Japan conducted a development study, “the Study for Maintenance and Improvement Plan of Access Channel of Beira Port in the Republic of Mozambique ” between 1996 and 1998, and a “Basic Design Study Report on the Project for the Improvement of Facilities for Dredging at Beira Port in the Republic of Mozambique” between 1997 and 1998. It was decided that “Aruangwa”, a Trailing Suction Hopper Dredger (hereinafter referred to as “TSH dredger”) with 1,000 m<sup>3</sup> capacity would be provided under the grant aid scheme in 1999, in order to maintain 6.5 m depth for the provisional access channel.

After four years of dredging work in the provisional channel by Aruangwa, it was revealed that the bottom of the bend in the provisional channel consisted of gravel and was partly clay. Thus, it was hard for Aruangwa to dredge in the channel efficiently. At the same time, the size of ships calling at the Port of Beira (containers and bulk ships, etc.) had been increasing, thus making it necessary for a remarkably deep draft at entry and exit. Consequently, in Beira port, the waiting time for high tides for ships entering was further increased. In addition, grounding accidents had occurred frequently at the bend in the provisional channel and there were an increasing number of complaints from ship owners/operators about the entry and exit channel of the Beira port. To tackle these issues, CFM decided to reopen the old channel, which consisted of earth and sand and which was easier to dredge.

As a huge amount of dredging work was required to reopen the old channel, the Government of Mozambique decided that the only solution was to increase the capacity of the dredgers working at the Port and again requested grant aid assistance from the Government of Japan.

## 1.2 Project Outline

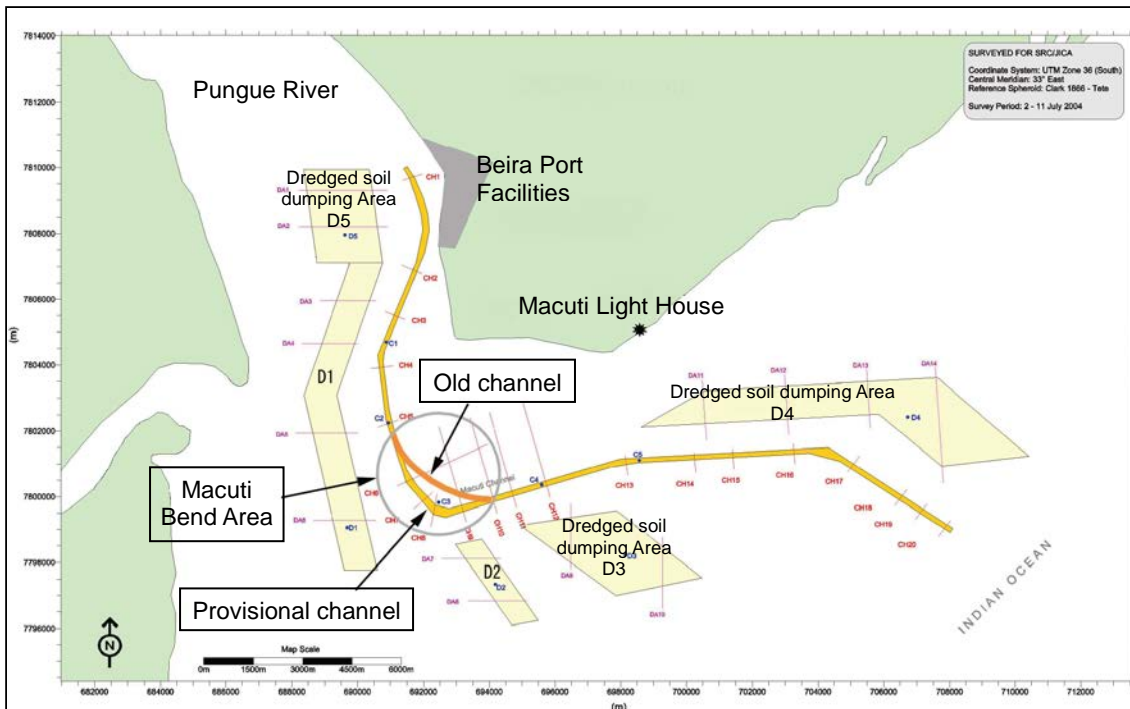
The objective of this project is to maintain a water depth of 8m for the entry and exit route in the port of Beira in Sofala Province through the reinforcement of dredging capability by provision of one dredger<sup>4</sup> to develop the old channel.

Grant Limit / Actual Grant Amount	2,167 million yen / 2,147 million yen
Exchange of Notes Date	May, 2005
Implementing Agency	Mozambique Dredging Company (EMODRAGA)
Project Completion Date	July, 2007
Main Contractor	Mitsubishi Heavy Industries, Ltd.
Main Consultant	Shipbuilding Research Center of Japan
Basic Design	January, 2005

<sup>3</sup> CFM is in charge of the management and operation of the Port and the oil terminal and a joint venture company between Cornelder of Netherland and CFM is in charge of administering cargo and container handling.

<sup>4</sup> 1,000 m<sup>3</sup> type TSH dredger newly constructed and equipped for EMODRAGA under this project.

Related Projects	<p>[Development Study]  “the Study for Maintenance and Improvement Plan of Access Channel of Beira Port in the Republic of Mozambique” (FY 1996 – 1997)</p> <p>[Grant Aid]  “Basic Design Study Report on the Project for Improvement of the Facilities for Dredging at Beira Port in the Republic of Mozambique” (FY 1997)</p>
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Source: The Republic of Mozambique “Basic Design Study Report on the Project for reinforcement of the Dredging Capabilities for Beira Port” (December, 2004)

Figure 1: Access Channel to the Beira Port

**2. Outline of the Evaluation Study**

**2.1 External Evaluator**

Mitsue MISHIMA, OPMAC Corporation

**2.2 Duration of Evaluation Study**

Duration of the Study: November 2010 – May 2011  
Duration of the Field Study: January 30, 2011 – February 12, 2011 and March 27, 2011 – April 3, 2011

**2.3 Constraints during the Evaluation Study**

None

### 3. Results of the Evaluation (Overall Rating: C<sup>5</sup>)

#### 3.1 Relevance (Rating: ②<sup>6</sup>)

##### 3.1.1 Relevance with the Development Plan

###### (1) The Development Plan and Policy of the South African Development Co-ordination Conference (SADC)

Under the 10-year Development Plan for the Beira Corridor, prepared by SADC in 1980, railway, road, port and oil pipeline systems had been constructed between the Beira Port and Zimbabwe by 1996 with financial assistance from Europe and the USA. SADC prepared a Regional Indicative Strategic Development Plan (RISDP) in 2003 to establish a SADC free trade zone by 2008, a customs union by 2010 and a common market by 2015. Thus SADC again placed a high priority on the improvement of ports in Mozambique which were to be bases for trade with SADC countries.

While the targets set by RISDP are still being pursued and a common market has been established, the customs union is yet to be realized and efforts to achieve this target are on-going. The development of the Beira Corridor is promoted for the export of products to, and the transport of materials to and from, neighboring inland countries such as Zambia, Malawi and Zimbabwe. Thus the development and expansion of the Beira Port is emphasized as one of the components of the Beira Corridor Development,.

###### (2) The Development Plan and Policy of Mozambique

The economic policy of Mozambique has been formulated, based on the Economic and Social Rehabilitation Program (PRES), since 1987. This economic policy has given priority to the transport and communications sector after the agricultural sector. Within this, the improvement of ports as well as roads has been given high priority.

At the time of the ex-ante evaluation of the project, the Action Plan for the Reduction of Absolute Poverty (PARPA) 2001-2005 emphasized the importance of roads improvement in infrastructure projects as a first priority. This was followed by the rehabilitation of ports connected to such roads, which would be bases for the distribution of goods and materials to the main internal regions. The PARPA II 2006-2009, formulated later, contained a discussion of the maximum utilization of the Beira Port in its transportation system development policy for the “promotion of integration in the region and the international economy” – part of “Economic Development” (one of the three pillars of PARPA II). This maximum utilization was for social and economic development in order to enhance the market competitiveness of the area surrounding the Beira Corridor. Therefore, the project is deemed to be important in the national development plan of the country.

In light of the above, it can be seen that this project was relevant to the policy of SADC and to the country’s development plan from ex-ante to ex-post evaluation.

##### 3.1.2 Relevance with the Development Needs of Mozambique

The Beira Port handles the second largest amount of cargo after the Maputo Port in the Capital and there has been no change in the importance of its location and the very high demand for its use in terms of the distribution system connected to the inland provinces of the country and to neighboring inland countries. Recently, a coal mining project has begun at the Moatize Coal Mine in Tete Province which is located next to Sofala Province and the Beira port is used to export coal. The railway between Tete Province and the Port has been rehabilitated with financial assistance from the World Bank and the European Investment Bank, and the coal terminal at the Beira Port, to which the railway connects, has been expanded. It is expected that the need for the Beira Port will be even greater in the future.

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<sup>5</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>6</sup> ③: High, ② Fair, ① Low

At the time of the ex-ante evaluation, due to insufficient depth in the old channel, some ship owners were diverting their ships to the Durban Port in South Africa,. Thus ships were avoiding the Beira port. Most of those that did use the port were obliged to reduce cargo volume in order to enter. There was a great need to improve the channel in order to reduce waiting time for the high tide and to provide safe access to the Beira Port, in order to meet the increasing demand on the part of large cargo ships (30,000DWT). The flow of sediment from the Pungue River to the channel had necessitated continuous dredging for the access channel and for anchorage at the Beira Port. According to the development study “The Study for Maintenance and Improvement Plan of Access Channel of Beira Port in the Republic of Mozambique” (1996 to 1998), the total amount of soil volume that it was necessary to dredge in order to maintain 8m depth in the channel was 2.5 million m<sup>3</sup> per annum. For this dredging work, the study suggested one TSH dredger with 2,000 m<sup>3</sup> capacity. As an alternative, the procurement of two 1,000 m<sup>3</sup> type TSH dredgers was suggested. In 1999, Japan provided “Aruangwa” – a TSH dredger with 1000 m<sup>3</sup> capacity – under the grant aid scheme as a part of this alternative plan. EMODRAGA negotiated with other donors to seek the possibility of procuring a dredger to fill the gap in the necessary capacity. However, this proved to be impossible. In order to reopen the old channel by dredging to assure water depth and to implement maintenance dredging, the existing equipments of EMODRAGA were insufficient. It was, therefore, indispensable that the dredging capacity of EMODRAGA be reinforced.

Bearing in mind the above, the need to dredge the access channel and develop the Beira Port has remained high since from time of the ex-ante evaluation to the present time of the ex-post evaluation.

### 3.1.3 Relevance with Japan’s ODA Policy

The Guidelines of ODA assistance to Mozambique in FY 2004, prepared by the Ministry of Foreign Affairs of Japan, placed the priority on education, water supply, transportation infrastructure and so on, in accordance with the priority areas of the PARPA. The project is consistent with this ODA assistance policy as it deals with transport infrastructure as prioritized in the Guidelines.

### 3.1.4 Relevance of the plan to achieving the objectives of this project

To achieve the project objective of dredging the old channel to a depth of 8m water depth, the Basic Design Study of the project proposed that an additional TSH dredger of the same capacity as Aruangwa be procured and that the two dredgers both be used for initial dredging (to assure water depth) and for maintenance dredging of the old channel. The Study concluded that it would be possible to achieve the target water depth in 3years if EMODRAGA conducted 24-hour operation of the two dredgers (hopper capacity 1,000m<sup>3</sup> for each) with two shifts of 3 crew teams. However, after the Study, the Mozambique side decided that it would be impossible for EMODRAGA to implement this plan considering its organizational as well as budget constraints and it started to seek financial assistance from other donors from around 2007. Finally, it was decided that deepening the old channel to a depth of 8m would be implemented as an emergency dredging project and as one of the components of the Beira Corridor Project, signed in April 2009 with financial assistance from European Investment Bank (EIB). For this, 4,700m<sup>3</sup> type and 8,000m<sup>3</sup> type TSH dredgers would be used. Dredging work with the 4,700m<sup>3</sup> TSH dredger started in July 2010 and the 8,000m<sup>3</sup> type TSH dredger started to operate as well in March 2011. At the time of ex-post evaluation, the dredging work was being implemented smoothly and it was expected that it would be complete by July 2011 as scheduled.

The original operation plan proposed by the Basic Design Study of the project (24-hour, two shifts of 3 crew teams) was never implemented. It was too ambitious for EMODRAGA, with its organizational and implementation capacity constraints, to have dredged 8m in the old channel with two 1,000m<sup>3</sup> hopper capacity TSH dredgers in 3 years. The possibility of realizing this operation plan had been slim at the time of the Basic Design Study for the following

reasons:

- EMODRAGA had no experience of 24-hour operations at the time of the ex-ante evaluation. It would have been considerably difficult to immediately implement the 24-hour, 2 shifts system of 3 crew teams from the very beginning of the operation. New crew members were needed for the project, and these required a certain period of time for training.
- The estimated cost of the operation and maintenance for the project in the Basic Design Study was around 4 to 5 million dollars, which was about twice as much as that which had been needed for Aruangwa before the ex-ante evaluation. It was difficult for the Mozambican side to funds to cover such rapidly increasing expenses<sup>7</sup> without specifically envisaged additional financial sources.
- The original plan was that both Aruangwa and a new dredger, “Alcântara Santos”, procured by the project, would operate in the access channel to the Beira Port. However, EMODRAGA is in charge of dredging all ports in the country under Government Decree No.38/94, which was enacted in 1994 and which established EMODRAGA. Although its operation may be concentrated at the Beira Port where the demand for dredging is high, EMODRAGA has the responsibility of dredging other ports when necessary. In fact, Aruangwa had operated at ports other than Beira before the Basic Design Study. EMODRAGA’s jurisdiction of operations should have been duly incorporated in the Study.

In addition to all this, as it was urgently necessary to deepen and maintain a depth of 8m in the channel, a bigger dredger could have worked more efficiently, achieving the work, especially the initial dredging, in a shorter period of time. In the Basic Design Study there was no active movement seen in support from other donors and a full analysis on the relationship between the project and other donor support was not provided. However, in fact, EMODRAGA requested the provision of a new dredger from Denmark and Denmark conducted a feasibility study for this in 2004.

In conclusion, there were some problems in terms of the appropriateness of the plan to achieve the project objective. The scope of work of the project could in fact only achieve the objective of reopening and partial maintenance dredging of the old channel.

In light of the above, this project has been highly relevant to the country’s development plan and development needs, as well as to Japan’s ODA policy. However, there was a some problems regarding the appropriateness of the plan in achieving the project objective and therefore the relevance of the project is fair.

### **3.2 Efficiency (Rating:③)**

#### **3.2.1 Project Outputs**

One 1,000m<sup>3</sup> capacity Trailing Suction Hopper dredger was constructed as planned. There were some very minor changes in specifications from the Basic Design Study, as in Table 1, which were deemed necessary to meet actual needs. (There was no output from the Mozambique side mentioned in the ex-ante evaluation.)

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<sup>7</sup> More details are discussed later in “3.5.3Financial Aspects of Operation and Maintenance”.

Table 1: Project Output

Plan (At the time of Basic Design Study)	Actual
One 1,000m <sup>3</sup> capacity Trailing Suction Hopper (TSH) Dredger	As in the plan. There were, however, some very minor changes in equipment specification as below.
[Summary of Major Equipment]	[Changes in Specification]
<ul style="list-style-type: none"> <li>· Length overall: approx. 70m</li> <li>· Length between perpendicular :65.00m</li> <li>· Breadth: 14.00m</li> <li>· Depth: 4.70m</li> <li>· Draft: 4.00m</li> <li>· Dead Weight Ton: approx.1,800t</li> <li>· Hopper Capacity: 1,000m<sup>3</sup></li> <li>· Maximum Depth of Dredging: 20.0m</li> <li>· Capacity of the dredging pump: 4,000m<sup>3</sup>/h x approx.20mTH 1</li> <li>· Main Engine Output: approx.1,200PS</li> <li>· Propeller (fixed pitch type): 2</li> <li>· Service Speed: About 10.2kt</li> <li>· Dredging Speed : About 6.0kt</li> <li>· Number of crew members: 36</li> </ul>	<ul style="list-style-type: none"> <li>· Length overall: approx.68m</li> <li>· Dead Weight Ton: approx.1,705t</li> <li>· Hopper Capacity: 1,019 m<sup>3</sup></li> <li>· Service Speed: 10.5kt</li> </ul>

### 3.2.2 Project Inputs

#### 3.2.2.1 Project Cost

The cost borne by the Japanese side is shown in Table 2. The actual cost was 2,147 million yen, which was within the planned cost of 2,167 million yen (99 % compared to the plan). The reason for the slight reduction in cost was that the design and administration costs were less than planned. According to the Japanese consultant for the project, a part of the design cost was saved as the dredger to be constructed was of the same type as Aruangwa, which had already been constructed under the grant assistance of the “Basic Design Study Report on the Project for the Improvement of Facilities for Dredging at Beira Port in the Republic of Mozambique”.

The Mozambique side furnished the fees and charges incurred in the country, and secured a safe quay for the dredger as planned.

Table 2: Project Cost

Item	Plan	Actual
<b>Total</b>	<b>2,167</b>	<b>2,147.5</b>
Construction	} 2,100	1,081
Equipment		1,009
Design and Administration	67	57.5

Source: JICA Document

#### 3.2.2.2 Project Period

The actual project period (from E/N to the handover of the dredger) was 27 months, as planned. As is shown in Table 3, it took two further months, from bidding to handover, than the planned schedule; however, the total project period was within the plan as it was shortened by the two months from E/N to the detailed implementation plan.

Table 3: Project Period

Items	Plan (At the time of Basic Design Study)	Actual
<b>E/N Signing - Handover</b>	<b>May, 2005 - July, 2007 (27Months)</b>	<b>As planned</b>
E/N Signing - Implementation Plan	May - November , 2005 (7 Months)	May - September, 2005 (5 Months)
Bidding - Construction Contract	December - February, 2006 (3Months)	October, 2005 - January, 2006 (4 Months)
Construction (Design-Handover)	March, 2006 - July, 2007 (17 Months)	February, 2006 - July, 2007 (18Months)

Source: JICA Document

In light of the above, both project cost and project period were within the plan, therefore the efficiency of the project is high.

### 3.3 Effectiveness (Rating: ②)

#### 3.3.1 Quantitative Effects

##### 3.3.1.1 Depth Dredging of the Old Channel

As mentioned in **3.1 Relevance** above, depth dredging (initial dredging) was to be implemented as an emergency dredging project separately from the original project plan as proposed by the Basic Design Study Report. This was decided in around 2005 when Alcântara Santos, procured by the project, was still under construction. However, due to the lack of finance of the Mozambican side, it was not until February 2009 that tender for the emergency dredging project was announced. It was finally planned that the emergency project would be financed by EIB and other donor agencies.

With the delay in emergency dredging, there was the option of using the two dredgers procured by Japanese grant aid to reopen the old channel, immediately after the construction of Alcântara Santos was complete. However, the two dredgers actually started depth dredging in September 2008, not in July 2007 immediately after Alcântara Santos was handed over to the Mozambican side.

The reason for this delay was that, if the two dredgers, Aruangwa and Alcântara Santos, did not implement dredging work at the same time to deepen the old and provisional access channel it would have been necessary to temporarily close the access channel to the Beira port. EMODRAGA judged that implementing the dredging work by the two dredgers was indispensable to avoid this. At that time, it was already planned that Aruangwa would operate at Maputo Port from July to December 2007 and at Quelimane Port from May to August 2008 and it was not possible to change this. In addition to deepening the access channel to the Port, it was also necessary to dredge the quay area of the Port. The two dredgers could be used for intensive deepening of the access channel only after September 2008 and this delayed the start of the initial dredging. While Aruangwa operated at other ports, Alcântara Santos conducted dredging work at the provisional and at other channels for about one year after the commencement of operations in 2007.

As the result of the operation of the two dredgers procured by the Japanese government, the water depth at the Macuti Bend was improved as shown in Table 4. The old channel was deepened by 2.6m, from a 3m depth at the time of commencement of dredging to a 5.6m depth by 2010. As the original target depth was 8m,



Photo1: Dredger “Aruangwa”



requiring dredging of 5m, the completion of 2.6m of work meant an achievement ratio of about 52%. Comparing the results of dredging with the annual plan of EMODRAGA shown in Table 4, the achievement ratio was more than 80% in 2009 and 2010. As a result of dredging, the old channel was reopened in June 2009. The two dredgers were operating in the old channel until June 2010, just before the commencement of emergency dredging financed by EIB.

Table 4: Water Depth of the Access Channel to Beira Port (Average at Channel at Macuti Bend)

Year		2007	2008	2009	2010
Water Depth in Provisional Channel (m)	Actual	3.5 (May)	4.5 (September)	-	-
	Plan	-	5	6	6.5
Water Depth in Old Channel (m)	Actual	-	3.0 (October)	5.3 (September)	5.6 (April)

Source: EMODRAGA Documents

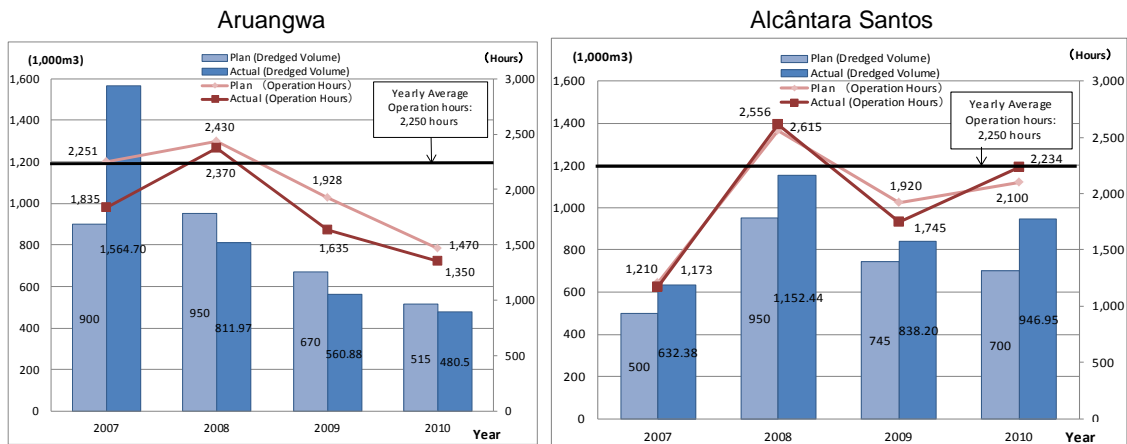
Note: Month in ( ) is the time of measurement. The indicators for the plan were set by EMODRAGA at the beginning of the year.

### 3.3.1.2 Operation of the Dredgers

The two dredgers were used in places other than the old channel of the Beira Port. They were used for dredging the quay area as well as the newly planned coal handling terminal area of Beira Port, Quelimane and Maputo Port. While such additional works were not included in the original objective of the project, the need of such work was already clear at the time of the Basic Design Study. For the sake of analyzing the effectiveness of the project, these additional works were included in the calculation of the operation time of the two dredgers in order to compare the actual operation time with the annual plan of EMODRAGA and the estimated standard annual operation time.

The annual operation target was 4,224 hours based on 19.6 hours per day and 220 days of annual operation; however, this target was not relevant as stipulated in **3.1 Relevance**. Based on discussions with EMODRAGA, considering its implementation structure and budget, the standard annual operation time was thought to be 2,250 hours, based on actual average daily operation hours of 9 to 10 hours per day and 220 days of annual operation.

As shown in Figure 2, the annual volume of dredging carried out by Alcântara Santos exceeded the EMODRAGA annual plan from 2007, and its operation time was more than 90% of that planned. Compared with the standard annual operation time of 2,250 hours, however, the actual time was 116% in 2008, 73% in 2009 and 99% in 2010. The actual dredging volume of Aruangwa was between 80% and 90% from 2008 to 2010 when compared to the EMODRAGA annual plan. The actual operation time of Aruangwa was 105 % in 2008, 72% in 2009 and 60% in 2010, of the standard annual operation time.



Source: Data provided by EMODRAGA

Note: Operation in 2007 of Alcântara Santos is from the July commencement of operation.

Figure 2: Operation of Each Dredger

The actual volume of dredging as well as the operation time of the two dredgers decreased in 2009. According to EMODRAGA, the main reason for this was the 2009 decrease in CFM budget allocation for dredging, which was caused by the worldwide financial crisis in 2008. The operation time of Aruangwa decreased further in 2010 as it was in dock, for large scale repairs for a longer time than it had been in previous years.

In conclusion, the deepening of the old channel and the operation time of two dredgers was more than 80% of the target set by the EMODRAGA annual plan. However, a limited performance of 60% to 70% of the standard annual operation time was seen during the evaluated period. A more efficient dredging plan and additional budget allocation could have maintained the annual average operational ratio above a certain level and this would have achieved more progress in dredging of the old channel. Thus the quantitative effects are fair.

### 3.3.2 Qualitative Effects

As has been noted, that there was a great number of complaints from ship owners and operators at the time of the Basic Design Study, when the evaluator conducted interviews with them in order to hear their views on the reopened access channel (see Box below). However, the operating company of the Port as well as major shipping companies who used the Port affirmed that the reopening of the old channel had improved safety of access. One of the interviewees even pointed out that without the dredger procured by the project, the Beira Port would have been closed. Considering all comments by stakeholders, such as ship owners, and bearing in mind the fact that there was no dredger as large as the one provided by the project at that time, even though there was a delay of five years until the emergency dredging started after planning, because of the project, the worst case scenario - the closing of the Beira Port – was avoided.

In light of the above, this project can be said to have achieved its objective to a certain level; therefore its effectiveness is fair.

### **(BOX) Opinions from the Beira Port Operation Company and Shipping Companies**

At the time of the ex-post evaluation, the evaluator conducted interviews with Cornelder de Mozambique S.A., the operating company of the Beira Port, and three shipping companies (the Mediterranean Shipping Company, MSC, Sturrock Shipping Ltd., and Beira Bulk Services). The interviewees from the shipping companies were selected from companies on a list prepared by CFM. They were selected because they were typical in their operations and because their personnel in charge could be interviewed in Beira city. Those selected were from two large companies handling large ships (the person in charge at MSC was a representative of the Association of the Shipping Companies) and one comparatively small company, dealing with vegetable oil and other products. The following is the results of the interviews.

#### **[Comparison of the Old Channel Before and After the Project]**

- After the reopening of the channel, ships have been able to navigate faster and more safely (MSC).
- Before the project, as the channel was only about 3.5m deep, ships always had to wait for high tide. Bad weather conditions often meant that the waiting time was longer. Thanks to the project, ships could navigate the Macuti Bend area more safely and without fear of grounding (Cornelder).
- The reopening of the old channel improved conditions in the channel remarkably. The number of serious grounding cases caused by insufficient dredging decreased. Current grounding cases do not result in ships being stranded and unable to move for some time but ships can now continue to navigate even if they touch the bottom of the channel. Anxiety and tension on the part of crews decreased when navigating the Macuti Bend. (Sturrock Shipping)
- Without the reopening of old channel, the Beira Port would have been closed (Sturrock Shipping). The number of ships visiting the Port would have decreased, thus stagnating the development of the Port (Cornelder). The situation would have been worse than it is today (Beira Bulk Service).
- EMOBRAGA has been doing their best considering the constraints of dredging capacity (Sturrock Shipping).

#### **[Impact on their Operation]**

- There used to be three ships using the Port before, but now there are six large ships, one of which is a Panamax tanker entering the Port (MSC).
- There was no major impact on operations (Sturrock Shipping, Beira Bulk Service, Cornelder). Compared to before, the access channel has been partly improved. The need to use the Port will remain unchanged (Cornelder).

#### **[Demand for Cargo handling and Infrastructures Related to use of the Port]**

- The operation of the Port needs to be improved. The cargo handling capacity does not meet demand. The Port facility is yet to be developed and there is a particular need to expand the cargo storage space. Waiting time has increased not only because of the problem of the channel but also because of the increasing number of ships using the Port while problems in the operation of the Port still remain (MSC).
- Currently, the connecting railway is neither well operated nor maintained. It was estimated that 70 % of the goods handled at the Port could be carried through connecting roads and 25% through the railway. However, the railway is carrying only 10% and the smooth distribution of goods is constrained (Cornelder).

#### **[Requests Regarding to the future Dredging Work]**

- It is necessary to monitor the water depth of the channel continuously. The total capacity of the existing dredgers is less than necessary, considering the volume of silt and sand to be dredged in the channel. A larger dredger is needed in the future. It is hoped that the Beira Port may provide good access for cargo distribution for Malawi and Zimbabwe, where economic growth is expected to increase. If this happens, demand for cargo distribution will become higher (MSC).
- It is hoped that 24-hour use of the access channel will become possible in order to reduce waiting time. One visiting ship is reported to have waited for 20 days before being moored at the quay (MSC).
- In addition to the need to dredge the access channel, it is also always necessary to dredge the quay area (Beira Bulk Service).

Source: Result of Interviews at Ex-post evaluation

### 3.4 Impact

#### 3.4.1 Intended Impacts

##### (1) Increase in the size of visiting ships and the volume of cargo

As shown in Table 5, the number of bulk and cargo ships among all large-size ships entering the Port increased in 2009, when the old channel was reopened, and continued to increase in the following year. The average total tonnage as well as the maximum tonnage of visiting ships also increased somewhat. A higher volume of cargo was distributed to neighboring inland countries such as Zimbabwe, Malawi and Zambia, than to inland provinces of Mozambique, and this trend was picked up at the time of the ex-ante evaluation. It is expected that neighboring countries will continue to need to use the port in the future. Interviews with ship owners (see Box) imply that there is a high demand for cargo handling.

CFM admits that the project partly contributed to the increase in the number of bulk and cargo ships and the volume of cargo handling. There has been increasing demand for cargo handling created by the recovery of the Zimbabwe economy after 2009. With the improvement in the access channel to the Port, it can be seen that the project has contributed to meeting this demand.

Table 5: Number, Maximum and Average gross tonnage, and cargo handling volume of Ships Entering the Beira Port

Indicators		2007	2008	2009	2010
<b>Total number of the ship entering to the Port</b>		<b>366</b>	<b>330</b>	<b>386</b>	<b>398</b>
(By Type of the Ship in the above)	Number of Container Ships	110	114	144	124
	Number of the Bulkers and Cargo Ships	163	118	139	170
	Number of the Tankers	93	98	103	104
<b>Maximum Gross Tonnage (Ton)</b>		<b>32,458</b>	<b>32,520</b>	<b>31,144</b>	<b>33,005</b>
<b>Average Gross Tonnage (Ton)</b>		<b>12,233</b>	<b>13,663</b>	<b>13,720</b>	<b>15,567</b>
<b>Total Cargo Volume (1,000ton)</b>		<b>2,961.1</b>	<b>3,036.90</b>	<b>3,029.70</b>	<b>4,059.81</b>

Source: CFM- Central documents

##### (2) Decrease in Marine Accidents

At the time of the Basic Design Study, it had been expected that the deepening of the old channel to 8m would result in a decrease in the number of marine accidents such as grounding at the Macuti Bend. It is difficult to verify the degree of the causal relationship between the project and grounding accidents since accidents are caused by various factors such changes in tide, human error, and so on. However, as shown in Table 6, compared to the period 2006 to 2008, a tendency towards decrease can be seen since 2009 when the old channel was reopened. As CFM Central pointed out, without the project, the number of grounding accidents would have increased more. Accordingly, the change of access from the provisional channel to the old channel has undoubtedly contributed to the decrease in the number of the accidents at least to some extent.

Table 6: Grounding accidents around the access channel to the Beira Port

Indicator	2006	2007	2008	2009	2010	2011
Number of Grounding Accidents	6	5	8	3	5	1

Source: CFM- Central

Note: Indicator in year 2011 is at the time of May. Two accidents out of the five in 2010 happened outside the channel.

##### (3) Decrease in Waiting Time for High Tide

According to the Basic Design Study, it was expected that the project would lessen the

average waiting time for high tide by 10 hours per ship. However, the actual waiting time more than doubled between 2009 and 2010 (see Table 7) . Above all, the reason for this is that the water depth of the channel has not reached the target depth, which limits the access of large ships. In addition to this, according to CFM, the number of quays for the use of general cargo ships has been reduced due to development work at the Port and cargo handling capacity has decreased by 30% On the other hand, the number of general cargo ships as well as the volume of cargo have increased. This has caused the waiting time for quays to increase leading also to increases in the waiting time for high tide. A breakdown of each cause of increase in waiting time (shown in Table 7) indicates that the proportion of quay waiting time increased between 2009 and 2010.

Table 7: Waiting time for the tide in the access channel of the Beira Port and its causes

Indicator	2007	2008	2009	2010
Waiting Time for the Tide (Hours)	5,106	6,119	8,505	14,315
Waiting Time for the Tide per Ship (Hours /Ship)	30.56	28.04	29.82	76.08
<b>Causes of Waiting time</b>				
Convenience of Ship	8%	6%	n.a.	5%
Arrival at Night	4%	35%	6%	2%
Waiting for the Quay	24%	4%	22%	42%
Waiting for the Tide	52%	13%	60%	47%
Bad Weather	10%	34%	7%	3%

Source: CFM- Central

In conclusion, the project contributed to an improvement in safe access to the port and thus partly to meeting the increase in demand for cargo handling. However, the objective of the project (maintaining 8m depth in the channel) was not achieved, and therefore, the intended impact has not been realized.

#### 3.4.2 Other Impacts

##### (1) Impacts on the natural environment

Neither resettlement nor land acquisition was required for the project. According to CFM and EMODRAGA, there was no negative impact on the natural environment caused by the dredging works, and no negative report was filed with regard to the disposal of dredged silt and sand. The five disposal sites identified at the time of the Basic Design Study are near to the old channel, three of which are now at full capacity and rarely used. A study of is being carried out to look at the availability of additional disposal sites at places farther from the channel.

##### (2) Other indirect impacts

None.

### 3.5 Sustainability (Rating:②)

#### 3.5.1 Structural Aspects of Operation and Maintenance

The Basic Design Study proposed that dredging operations be implemented for 24-hours a day using two shifts of 3 team crews with a total number of 54 (18 per one team). At the time of the procurement of the project dredger, it was decided that deepening of the channel to 8m would be implemented as an emergency dredging project with an alternative financial source. The proposed dredging work shifts were never implemented. The actual operation time was 11 hours a day (6:00 to 17:00) from Monday to Friday in July 2010 just before emergency dredging began. This was less than half of the proposed operation hours. After the emergency dredging project, it was planned that operation hours would be extended gradually to 16 hours

per day (Monday to Friday, 4:00 to 20:00) without an increase in the number of staff. EMODRAGA reported that they could manage longer operation hours as they had previous experience of operating 16 hours a day.

The organization of EMODRAGA is shown in Figure 3. The total number of staff is 160, of which 74 are allocated to the Operation Department in charge of dredging, and 30 allocated to maintenance. A total of 65% of staff is in charge of dredging and maintenance. Aruangwa and Alcântara Santos have crews of 33 and 29 respectively: 50% to 60 % of the 54 members proposed by the Basic Design Study. The number of staff in charge of machine operation is less than planned; however, the minimum requirement has been secured for the allocation of staff to each section in order to implement up to 16 hours of operation. At the time of this evaluation survey, EMODRAGA intended to increase the number of staff to at least three for machine operation in the future.

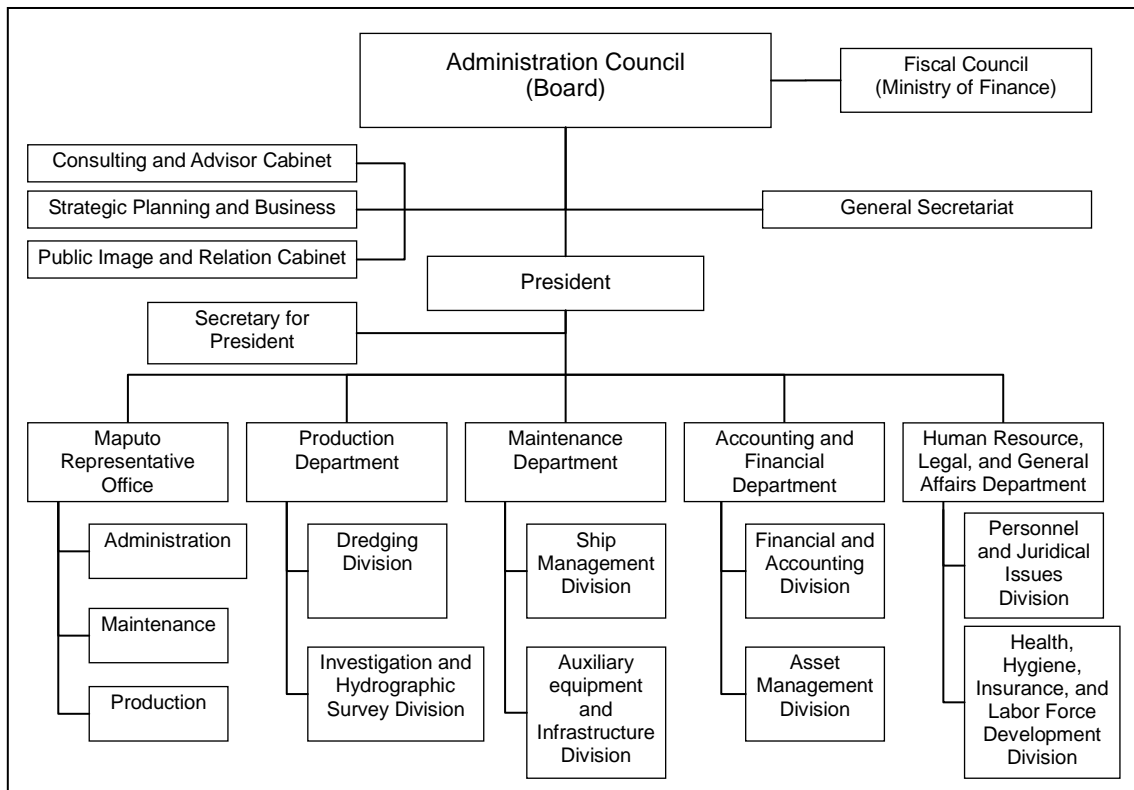


Figure 3: Organization Chart of EMODRAGA

### 3.5.2 Technical Aspects of Operation and Maintenance

EMODRAGA implements a weekly (on Saturdays) as well as an annual inspection of the equipment as proposed by the Basic Design Study and in accordance with the instructions of the manufacturer. Inspection by the supervising consultant confirmed that proper maintenance was being carried out for the two dredgers. At the time of inspection, the staff in charge of operation and maintenance of equipment (such as the main engine and power generators) were instructed by the consultant. There were no major problems found at the time of the ex-post evaluation. The crews of the two dredgers had the basic knowledge necessary for the handling of the equipment and could deal with minor troubles, thus proving their basic capacity for operation. EMODRAGA staff have seafarers' qualifications as established by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). EMODRAGA internally arranges capacity evaluation and training courses for their staff, to improve their technical capabilities. (see Table 8).

Table 8: EMODRAGA Training Courses

Training Program	Target	No. Of Trainees	Frequency (times/Year)	Duration
Repair of electric boards	Electric Engineers	10	2	2weeks
Repair of diesel motors	Machinery Engineer	12	2	2weeks
Safety on board	All crews	33	2	1 week
Equipment operation on board	Machine Technician	10	3	1 week

Source: EMODRAGA

As the natural conditions of the Port require continuous dredging of the access channel which in turn demands a large amount of dredging work, it is important that the techniques, capacity and efficiency of dredging operations are improved. The Basic Design Study pointed out the need for EMODRAGA to acquire ship management methodology such as medium and long term operation planning and evaluation of achievements, utilization and maintenance techniques for dredging equipment, and improvement in the techniques for navigating dredgers, including hydrographic surveys. Such recommendations had not been acted upon at the time of ex-post evaluation. In the light of this, the JICA Mozambique office has been monitoring EMODRAGA's operations and has listed support for EMODRAGA as one of its grant follow up projects for fiscal 2010. Finally, support for EMODRAGA was implemented not by a follow-up grant but by a counter-part fund<sup>8</sup> which was created when the Japanese Government provided Mozambique with non-project and food assistance grants. The fund was used to procure the machine parts needed for maintenance and operation, as well as one year technical guidance by Portuguese experts (an engineer and a surveying engineer) which started at the end of February 2011 and is expected to continue to December 2011. In addition, at the time of the procurement of the 2,500m<sup>3</sup> TSH dredger in 2012, with the financial assistance from Denmark, it is planned that technical assistance will provide intensive operational training. It is expected that this training will lead to technical improvements in ship management as well as in dredging operation.



Photo 2: "Alcântara Santos" Captain and Navigation Room

### 3.5.3 Financial Aspects of Operation and Maintenance

EMODRAGA is a public company with a general self-support accounting system. The actual costs of the operation and maintenance of the two dredgers, Aruangwa and Alcântara Santos, is set out in Table 9 below. The Basic Design Study Report does not include the estimated costs of operation. However, the estimated annual cost of maintenance was \$252,500 for the two dredgers. Table 9 shows that the actual expenses exceeded the estimate considerably. Particularly in 2010, more intensive repairs than in a normal year caused a large increase in maintenance costs.

<sup>8</sup> When the Japanese Government provides developing countries with non-project grants, food grants and poor farmers' assistance, the recipient countries are required to deposit the money acquired by selling the goods provided into a special account. This is then used for social-economic development projects in the recipient countries. Such deposited funds are called counter-part funds.

Table 9: O &amp; M Costs of “Aruangwa” and “Alcântara Santos”

Unit: US dollars

Item	2007	2008	2009	2010
Operation Costs (Personnel, fuel, tax, etc.)	1,497,270	2,101,606	1,260,066	1,458,192
Maintenance Costs (Annual dock, purchase of spare parts etc.)	406,224	612,704	534,169	1,117,607
<b>Total</b>	<b>1,903,495</b>	<b>2,714,311</b>	<b>1,794,235</b>	<b>2,575,800</b>

Source: EMODRAGA

The major financial indicators of the EMODRAGA Profit and Loss Account are shown in Table 10. It has continuously recorded a deficit, as the operating expenses have exceeded the operating profit every year. Most of the income from dredging operations has come from dredging works directly contracted with CFM, except dredging works at Maputo Port carried out by Aruangwa in 2007. The contract for this was awarded as a result of competitive bidding. The income from dredging did not cover the costs of operations during 2007 and 2010. The estimated income from dredging was 2.0 – 2.5 \$ per m<sup>3</sup> while the estimated costs were 2.3-5.0 \$ per m<sup>3</sup>. While it is necessary to try to reduce the dredging expenses, first priority should be given to securing sufficient income to cover costs.

As shown in Table 10, the share of the operation and maintenance costs of Aruangwa and Alcântara Santos is around 30% to 40% of the total operation costs. Increases in personnel expenses and fuel costs has pushed up operation costs every year since 2007.

On the revenue side, the income from dredging operations improved in 2007 and 2008 due to the newly procured Alcântara Santos. However, income decreased with the decrease in the CFM budget in 2009, and EMODRAGA dredging works also decreased due to the emergency dredging project in 2010. On the other hand, EMODRAGA has received financial support from the National Dredging Fund (NDF), established to finance dredging works in 2006. This mainly (40%) comes from port charges. While the amount of financial support has been increased yearly, the decrease in income from dredging has only been complemented for the recent two years.

The financial situation up to 2010 has implied that fundamental improvement was not realized by the efforts to increase income and cut expenses. After the procurement of the additional dredger through Danish assistance in 2012, it is predicted that the costs of operation and maintenance, and depreciation expenses, will further increase and this will require a management strategy in order to increase income. In the future, after the two dredgers procured through Japanese assistance resume ordinary operation as before, it is desirable that EMODRAGA attempts to improve its financial condition, establishing a medium and long term operation plan to secure steady income and to implement cost efficient management.

Table 10: Major Financial Indicators of EMODRAGA Profit and Loss

Unit: 1,000MZN

Major Indicators	Year 2006	2007	2008	2009	2010
<b>Revenue</b>	<b>142,350</b>	<b>201,246</b>	<b>277,152</b>	<b>248,683</b>	<b>250,310</b>
<b>Operation Income</b>	<b>66,266</b>	<b>120,942</b>	<b>162,883</b>	<b>142,963</b>	<b>217,987</b>
Income from dredging work	65,495	120,301	126,423	83,184	107,281
Subsidies from National Dredging Fund	n.a.	n.a.	35,610	58,408	84,141
<b>Expenditure</b>	<b>183,984</b>	<b>217,217</b>	<b>294,711</b>	<b>294,223</b>	<b>278,224</b>
<b>Operation Cost</b>	<b>111,345</b>	<b>135,080</b>	<b>174,376</b>	<b>175,142</b>	<b>255,575</b>
Personnel	14,169	23,720	34,208	38,783	48,184
Goods and equipment supply and service contracts	53,694	62,921	74,746	65,370	106,776
Depreciation	32,439	46,947	63,030	68,901	92,019
<i>O &amp; M Cost of Aruangwa and Alcântara Santos ( ) is percentage to total operation cost</i>	-	44,732 (33.1%)	67,857 (38.9%)	52,983 (30.2%)	82,811 (32.4%)



Major Indicators	Year 2006	2007	2008	2009	2010
Loss	-41,634	-15,970	-17,559	-45,540	-27,913

Source: EMODRAGA

Note: Reference 1MZN=2.50JPY (Exchange Rate at the time of end 2010)

### 3.5.4 Current Status of Operation and Maintenance

At the time of the ex-post evaluation field study in February 2011, with emergency dredging on-going, the two dredgers had been moored at the quay (see Picture 3) since the beginning of 2011. EMODRAGA was conducting maintenance work and changing of parts while also carrying out intensive staff training for their crews. Maintenance dredging of the old channel was planned to start with the two dredgers in June 2011, just before emergency dredging is completed. According to EMODRAGA, while there was no official medium and long term operation plan for all of their dredging equipment, they were planning to use mainly the new dredger procured through Danish assistance for the maintenance dredging of the access channel of the Beira Port. The other two dredgers would be used for the maintenance dredging of the other part of the Beira Port and for other ports. When the Danish dredger is out of the Port, the other two dredgers will implement maintenance dredging of the access channel of the Beira Port.



Photo 3: Aruangwa and Alcântara Santos anchored at the Pier



Photo 4: Alcântara Santos anchored at the Pier and Crews

When the ex-post evaluation field study was conducted, some equipment, which had experienced trouble from over-use or damage, was found to be unrepaired in Alcântara Santos, although equipment trouble had been dealt with as much as possible, for example, broken dredging pumps had been changed. Since the only thing that could be done would be to change parts, it was intended that the counter-part fund established with Japanese assistance and mentioned above would be used for procurement of the parts necessary. It is also planned that the counter-part fund would be used to employ technical experts in order to strengthen the planning capacity of EMODRAGA in drafting a medium and long term plan for maintenance and management (as of July 2011). In order to improve the operation, maintenance and management capacity of EMODRAGA, a greater technical as well as operation management capacity is required and some efforts were being made towards improvement.

In light of the above, as some problems were observed in terms of the technical and financial aspects of maintenance and management, the sustainability of the project effects were considered to be fair.

## **4. Conclusion, Lessons Learned and Recommendations**

### **4.1 Conclusion**

While the objective of this project was consistent with the development plan and the development needs of the Republic of Mozambique, as well as with Japan's ODA policy, the relevance of the project is fair, as the implementation plan was not appropriate in achieving the project objective in the context of the actual conditions of the implementing agency. The efficiency was high with regard to the construction of the dredger. However, the objective of the project, which was to dredge the old channel to a depth of 8m, had not yet been achieved even with additional dredging works carried out with financial assistance from other donors. The two dredgers constructed with Japanese grant assistance contributed to deepening and to maintenance dredging of the old channel which then reopened. Therefore the safety of the access to the Beira Port was improved. The effectiveness of the project is fair, as the two dredgers had maintained a certain level in operation rate, dredging quays and the new terminal area of the Port as well as other ports in Mozambique. To improve the financial condition of EMODRAGA, it would be necessary for EMODRAGA to make efforts towards the optimal and efficient operation of all dredgers, which would require both comprehensive dredging work and operation and maintenance planning from the point of view of a medium and long term management strategy. Therefore, the sustainability of the project effects is fair.

In light of the above, this project is evaluated to be partially satisfactory as although the project had some effect, there remained some issues for improvement.

### **4.2 Recommendations**

#### **4.2.1 Recommendations to the Implementing agency**

It is planned that the new dredger, to be procured with Danish assistance in 2012, will mainly be used to dredge the access channel to the Port. The two dredgers procured with Japanese assistance will be used until that time and it is recommended that these two dredgers are properly maintained, managed and utilized thereafter in accordance with the long term management strategy. It is important that EMODRAGA formulates a medium and long term plan which takes into account the utilization of all EMODRAGA equipment to meet with the needs for dredging at the ports in the country under their jurisdiction, as well as a strategy for expanding operations together with increased dredging capacity in the future. It is also important that this plan clarifies the maximum operation of the two dredgers and that EMODRAGA implements it firmly.

#### **4.2.2 Recommendations to JICA**

At the time of the ex-post evaluation, the status of the operation, maintenance and management of EMODRAGA, as well as the long term operation plan for the two dredgers were uncertain. It is recommended that JICA monitor whether the procurement of parts and technical guidance by experts financed by the counter-part fund will result in an improvement in the operation, maintenance and management of EMODRAGA in one or two years.

### **4.3 Lessons Learned**

The relevance, effectiveness, and sustainability of the project are fair because the project was not implemented based on a realistic analysis of the project implementation structure, capacity and finance. The ex-ante evaluation should have given comprehensive analysis to the organization, capacity and financial condition of the implementing agency and then set inputs and outputs of the project in order to achieve the objective. The following two points should have been considered when formulating the project at the time of the ex-ante evaluation.

- (1) A feasible implementation plan should have been formulated based on a comprehensive

analysis of the implementation capacity and organizational structure of EMODRAGA. It was impossible for them to implement a 24-hour two shift operation immediately given the actual condition of the implementing agency and its capacity. In terms of the financial aspect, the possibility of mobilizing finance should have been assessed before the project with an estimation of actual costs to be incurred to the implementing agency (O &M cost analysis in particular, and operation costs) based on the future operational structure of the implementing agency. Recommendations made to the implementing agency at the ex-ante evaluation for technical improvements (the training component) and human resource development should have been implemented at an early stage of the project. If these needs had been well analyzed and included as inputs and outputs of the Project or cooperation sought from other assistance schemes at the time of ex-ante evaluation, the project might have had more fruitful results.

- (2) When assessing the objectives of the project and drafting a dredging plan, it was also important to have taken into consideration the whole picture of the operation of the implementing agency and other donors' activities. The ex-ante evaluation should have examined the relationship between the overall operation plan of the agency and that for the project. This overall operation plan should have included dredging of the access channel as well as other parts of the Beira Port, as well as dredging in other ports. Also, it was critical that the relationship between other donors' activities and the project was examined. It was desirable that after consideration of internal and external factors which might affect the implementing agency, the project was analyzed, its objective established, and proper inputs and outputs determined for the achievement of the project objective. Finally, the target indicators for the Project objective should have been set within a range attainable within three years after Project completion.

End