Ministry of Transport,
Public Works and Equipment
Burundi

The Study of Master Plan for Port Sector in the Republic of Burundi

Final Report
(Summary)

September 2012

JAPAN INTERNATIONAL COOPERATION AGENCY

PADECO Co., Ltd.
Nippon Koei Co. Ltd.
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Abbreviations and Acronyms

BMPRA	Burundi Maritime, Port and Railway Authority
BIF	Burundian franc
COMPTRADE	COMPtrade Technologies GmbH
CTB	Belgian Technical Cooperation
DRC	Democratic Republic of Congo
DWT	Dead weight tonnage
EIA	Environmental Impact Assessment
E.P.B.	Société Concessionnaire de L'Eploitation du Port Bujumbura
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
IMF	International Monetary Fund
IRR	Internal Rate of Return
JICA	Japan International Cooperation Agency
MT	Motor Tanker
MTTPE	Ministére des Transport, des Travaux Publics et de l'Equipment
MV	Motor Vessel
ODA	Official Development Assistance
PCB	Polychlorinated Biphenyl
RoRo	Roll-on/Roll-off
RWF	Rwandan franc
SEA	Strategic Environmental Assessment
SNCC	Société Nationale des Chemis de Fer du Congo
SNCZ	Société Nationale de Fer Zaïrois
STS	Ship to Shore
TEU	Twenty Unit Equivalent
TPA	Tanzania Ports Authority
TRL	Tanzania Railway Limited
USD	United States Dollar

1. Introduction

The port of Bujumbura is the biggest port not only in Burundi but also on Lake Tanganyika. It was built in the 1950's, and its facilities and equipment are now facing a rapid increase of cargo due to the economic growth of Bueundi and its neighboring countries.

Bujumbura Port is the economic hub of transportation in Burundi. Government of Burundi (GOB) has already established the Burundi Maritime, Port and Railway Authority (BMPRA) in accordance with the Presidential Decree No. 100/252 dated October 4, 2011. BMPRA has started its activities in January 2012. The establishment of BMPRA is to consolidate the port as a land-lord port and enhance private sector participation in port management and operation.

Rumonge Port was virtually a natural beach. Ministère des Transport, des Travaux Publics et de l'Equipment (MTPPE) has completed a fence and gate surrounding the port premises. Unloaded cargo is mainly agricultural produce coming from the west shore of Lake Tanganyika in DRC by small wooden ships.

The objectives of "The Study of Master Plan for Port Sector in the Republic of Burundi" (the Study) are to carry out the demand forecast of cargo transport on Lake Tanganyika, prepare the master plan of port development for the target year of 2025, and prepare the short term development plan of port facilities in Burundi.

The Study was conducted at Bujumbura Port, Rumonge Port, and their vicinity. In consideration of the important role of the lake transportation, the JICA Study Team has visited Kigoma Port in Tanzania, Mpulungu Port in Zambia, and Kalemie Port in DRC.

This report covers a wide range of topics including the socio-economic framework of Burundi, cargo demand forecast, development strategy of the port sector of Burundi, facilities development of Bujumbura Port and Rumonge Port, maritime transport on Lake Tanganyika, environmental considerations including strategic environmental assessment (SEA), urgent, short, and medium-term development of the ports, preliminary facilities design, cost estimates, financial analysis, and a study on the conceding procedure of Bujumbura Port to a private entity.

2. Socio/Economic Developments in Burundi

2.1 Trend in Socio/Economic Status

Burundi has an area of 278,500 km^2 and a population of 8.5 million at present, making it one of the most densely populated countries in Africa with the population density being 230 persons per km^2. The GDP of Burundi is currently USD 13 billion. The growth rate has been steadily increasing over past few years. It grew 4.5% in 2009, 3.9% in 2010, and 4.5% in 2011. The per capita income of the country is USD 150, which is the lowest in the world. However, a number of economists point out that the actual level of per capita income is supposedly much higher.

Coffee is one of the major exports, contributing to about two-thirds of the total national exports. Food imports account for about 20% of the national total imports as Burundi is not self-sufficient in food supplies. The country is endowed with a variety of mining resources, such as gold, nickel, columbite, and tantalite along with several kinds of construction materials. Manufacturing is very limited, except for beer production, and necessarily, most of the manufactured products have to be imported. Furthermore, vehicles and fuels also count as one of the major imports of Burundi.

- Burundi has five major potentials for growth as follows:
  1. The political stability has continued since the late 2000s.
  2. Burundi is situated at a major inland crossroads, connecting Rwanda, Democratic Republic of Congo (DRC), and Tanzania. The population within 200 km from Bujumbura is estimated to be about 20 million, including 3.2 million in cities.
  3. The strategic position stimulates urban economic activities and investments, such as transport, wholesale, construction, real estate, and banking.
  4. Private investments have accelerated especially since investment activities have been streamlined.
  5. There is a proved nickel reserve of 185 m illion tons. If developed, it would substantially contribute to the country's export earnings.
- Despite the growth potentials, Burundi suffers from three basic constraints on economic growth as follows:
  1. The fluctuating international prices of export commodities and the dependence of agricultural produce on varying weather conditions.
  2. The large cost of transportation representing 45% of the total export value and 35% of the import value.
  3. Excessive intervention of the government in direct economic activities, typically the proliferation of government enterprises.
- The government of Burundi and international organizations recently prepared a number of policy/planning documents as follows:
  - AfDB, An Infrastructure Plan for Burundi: Accelerating Regional Integration, September 2009
  - IMF, Growth and Poverty Reduction Strategy Framework II, October 2010
  - The Burundian Government, the Burundi Vision 2025 in June 2011
  - AfDB, Country Strategy Paper: 2012–2016, October 2011.

2.2 Current Plans for Economic Development

"Burundi Vision 2025" has a target of attaining a per capita income of USD 720 in 2025, which is about five times the present figure. In response to the vision, AfDB has prepared the Country Strategy Paper: 2012–2016, October 2011. It emphasizes on agricultural export, mining development, maximum use of strategic position, food self-sufficiency, infrastructure development, improvement of business climate, and strengthening of the government capability to plan and implement developmental activities.

- A possible and sustainable scenario for the Burundian economy may be as follows:
  - Bujumbura will not only be the trade center of the Burundian economy, but the main base for intermediate trade among land-locked neighboring regions as well as Tanganyika lakeside regions.
  - Burundi, Bujumbura in particular, will be a major center for trade and quality improvement of coffee produced in neighboring regions.

3. Current Status of Port Sector of Burundi

3.1 Bujumbura Port

(1) Natural Conditions

There are only wind-generated waves on the lake. Relatively high waves intrude the port when the southerly winds continuously blow. As the port entrance of Bujumbura is open to the south, the wave height near the port entrance occasionally becomes about 1 m high when the strong winds blow from the south in the afternoon.

Figure 3.1 shows the chronological changes of the water level from 1929 to 2010. Since the highest water level was recorded in 1964, the water level appears to be staggeringly lower and recently has been close to the lowest level recorded in 1950. The maximum seasonal change of 1.50 m was observed in 2005, while the minimum was 0.40 m recorded in 1994. The average annual water change is 0.82 m.

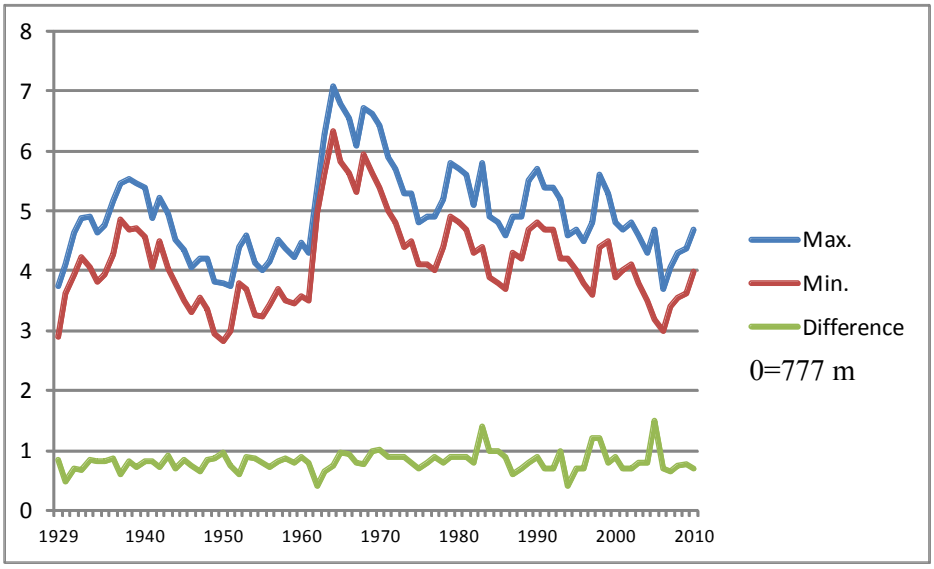


Figure 3.1: Chronological Change of Water Level of Lake Tanganyika

The Ntahangwa River flows very near to Bujumbura Port at about 1 km north. From the secular change of river estuary in the Ntahangwa River, it is considered that the accretion took place behind the Oil Jetty and the sediments and sands were transported by the river.

A storm water canal called “Buyenzi Canal” flows into the port basin. It passes along the Buyenzi district, the hinterland of Bujumbura Port. The canal debouches to the port basin sediments and sand along with domestic wastewater, debris, and factory disposals.

The terrain where Bujumbura Port exists has been formed with diluvial materials debouched from the River Ntahangwa. The terrain gradually gets higher towards the east as it nears the mountains formed by the orogenic movement of the Great Rift Valley. The results of the topographic and bathymetric surveys at Bujumbura Port are as shown in Figure 3.2.

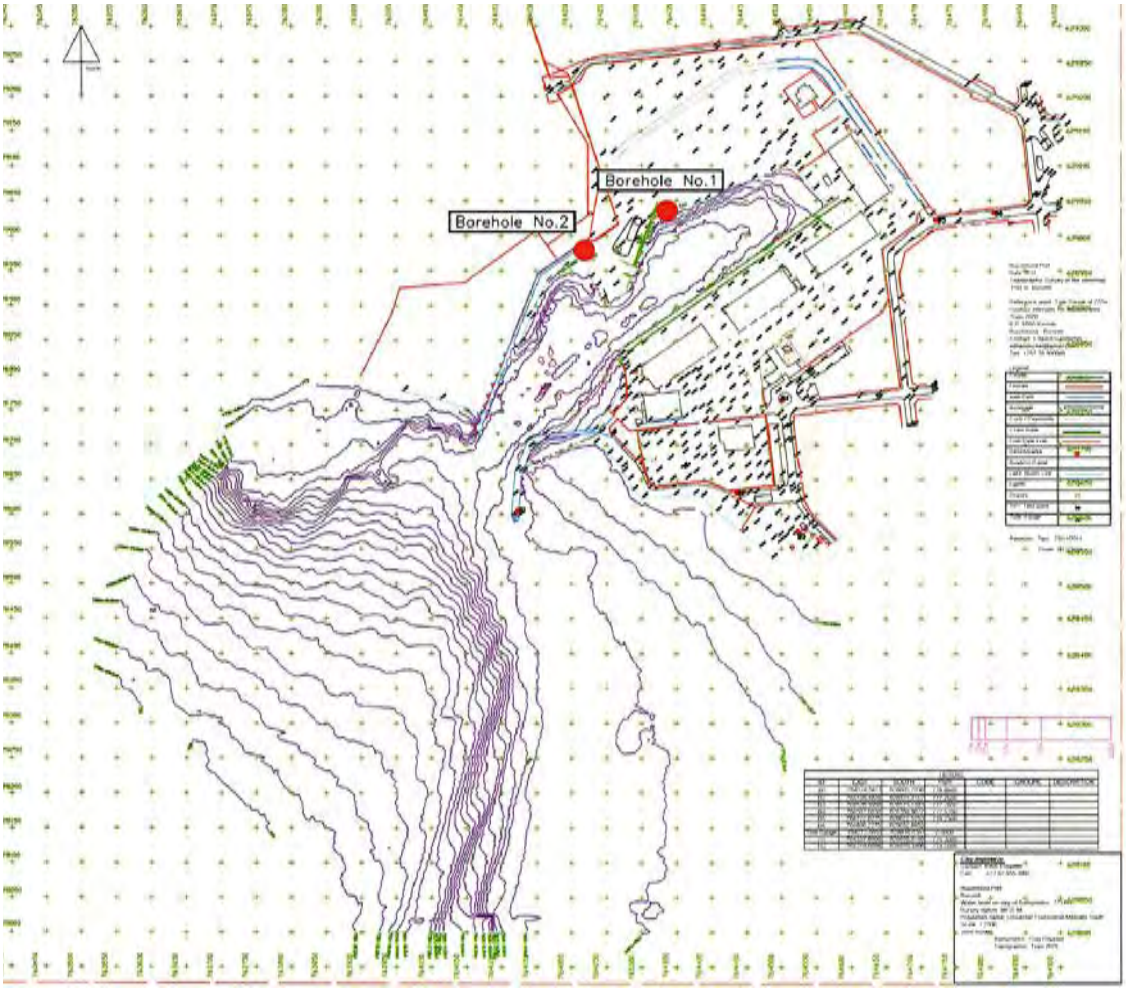


Figure 3.2: Topography and Bathymetry at Bujumbura Port

The subsoil mostly consists of the sand and boulders of diluvial origins debouched by the River Ntahangwa. The subsoil has sufficient bearing strength to support the heavy structures but will resist the penetration of piles.

(2) Operation and Management

The Burundi Maritime, Port and Railway Authority (BMPRA) was established as the "land lord" of the ports of Burundi according to the Presidential Decree No. 100/252 dated October 4, 2011. BMPRA commenced its activities in January 2012, but their progress has been limited at present.

The port sector of Burundi is under the jurisdiction of the Ministère des Transport, des Travaux Publics et de l'Equipment (MTTPE). In Figure 3.3, the organization chart for the port sector is shown.

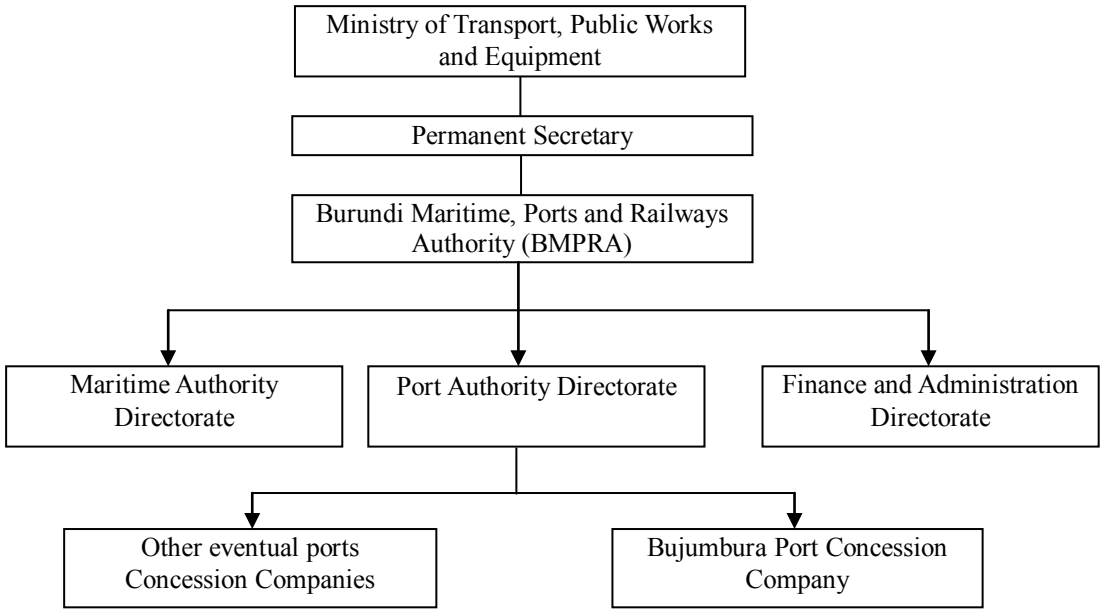
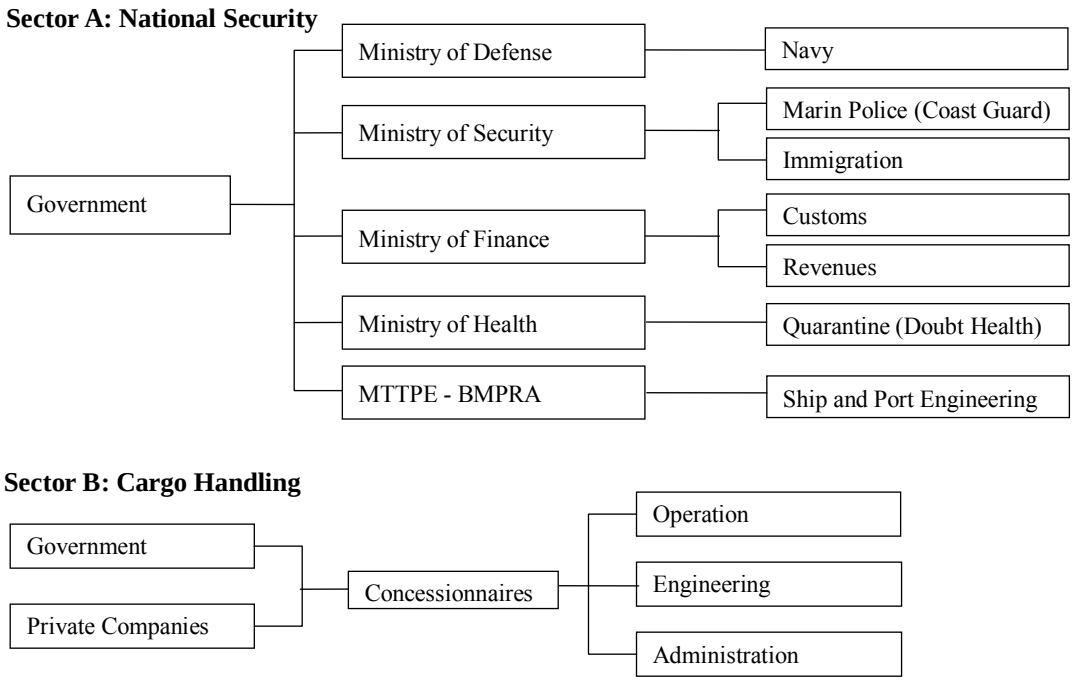


Figure 3.3: Organization Chart for Port Sector of Ministère des Transport, des Travaux Publics et de l'Equipment (MTTPE)

The port is managed and operated by 2 sectors; namely National Security and Cargo Handling, and Port Security and Port Maintenance. Outline of the organization of Port Bujumbura is shown in Figure 3.4.



MTTPE: Ministère des Transport, des Travaux Publics et de l'Equipment
Concessionnaire (EPB): PPP Corporation for Operation of the Port

Figure 3.4: Organization for Bujumbura Port

Cargo handling, port security, and port maintenance are carried out by a public corporation "Bujumbura Port Company" called by E. P. B. (Société Concessionnaire de l'Exploitation du Port de Bujumbura). E. P. B. was established by the Burundi Government and Burundi private companies group (mostly consisting of shipping companies). The investment ratio is 42% for Government and 58% for private companies. E.P.B. is the concessionaire for port operation of Bujumbura Port. The concession contract will cease at the end of 2012. A new concessionaire will be selected beforehand, so as to implement a smooth transaction from E. P. B. to the new concessionaire. The organization chart of E.P.B. is shown in Figure 3.5.

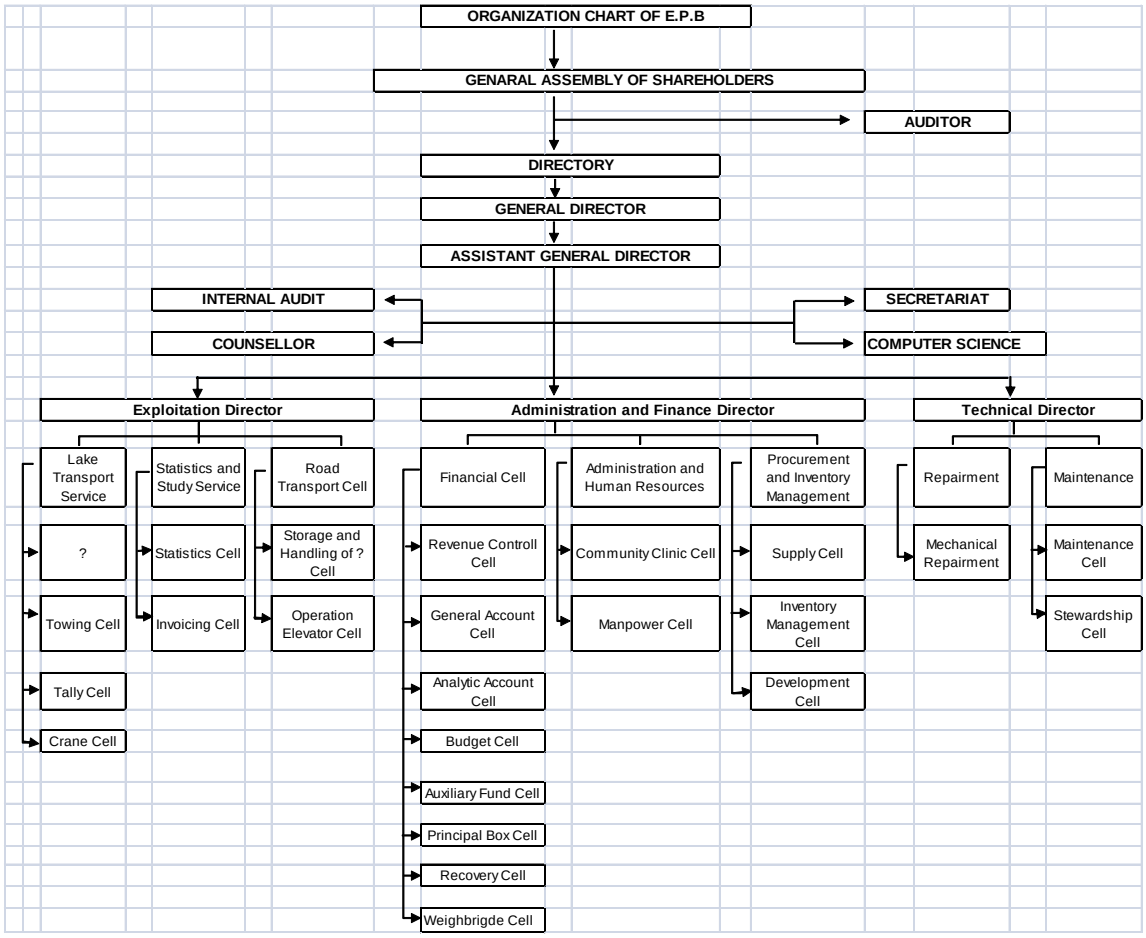


Figure 3.5: Organization Chart for E.P.B.

(3) Port Facilities

There are three wharfs existing in the Port of Bujumbura; general cargo wharf, container wharf, and oil wharf.

The general cargo wharf is 400 m in length with 4 units of 5 ton rail-mounted jib cranes, which are standard port cranes of 7.5 m/25 ft rail spun, and they appear to be well-maintained.

Four warehouses of 2,000 square meters each are along the quay line. There is a triangle-shaped paved backyard behind warehouses No. 1 and 2, which is now used as parking space for external trucks. Three old, small warehouses are at the corner.

One unit of a 50 ton revolving crane is fixed on the 100 m "container wharf" at the opposite side of the general cargo wharf. The crane cannot be used to handle containers because it moves too slowly and has no container spreader.

A 150 m Petroleum wharf is adjacent to this container wharf with several oil tanks settled closed by.

Most of the existing port facilities were completed before 1960. They are still maintained, operational, and are in relative good conditions. Figure 3.6 shows the area of Bujumbura Port. Figure 3.7 shows the location of major port facilities.

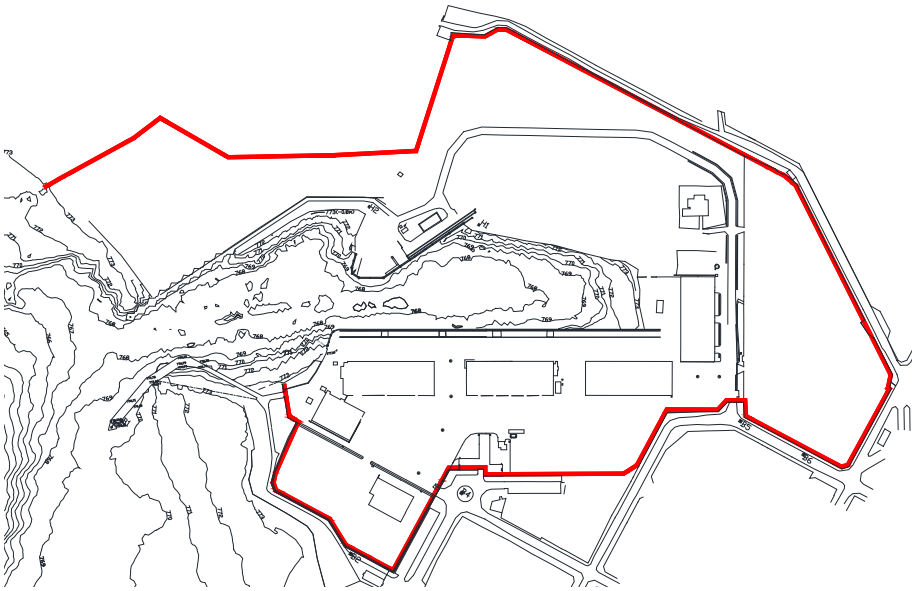


Figure 3.6: Bujumbura Port Area

Figure 3.7: Major Port Facilities of Bujumbura Port

(4) Cargo Handling

Cargo flow of Bujumbura Port is shown in Figure 3.8. More than 90% of the cargo it handles is import cargo. Out of the import cargo, about 40% is transported by truck.

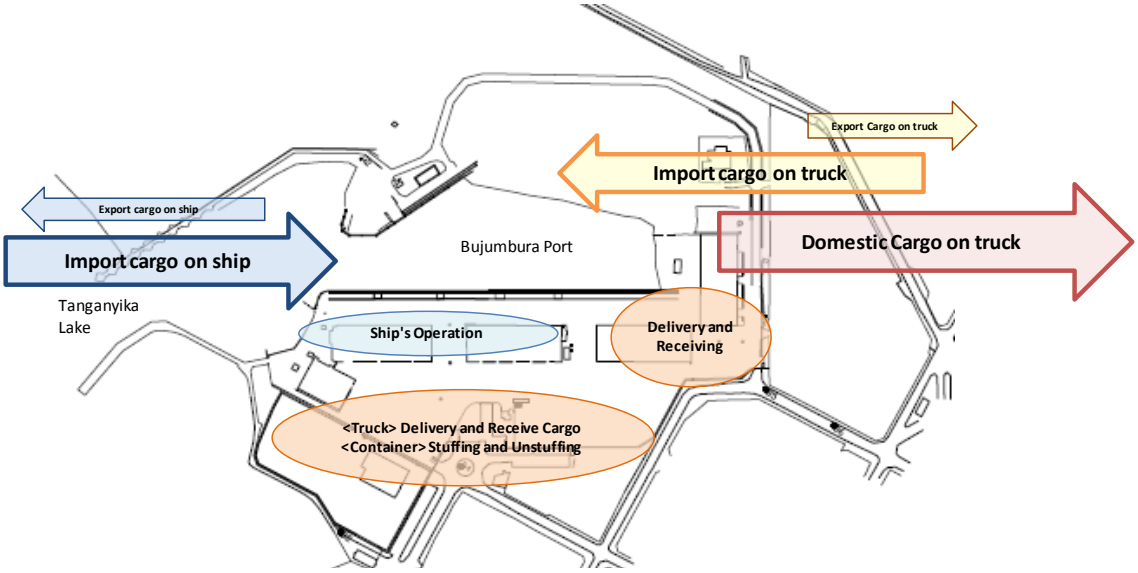


Figure 3.8: Working Zone of Bujumbura Port

(5) Fleet of Ships of Burundi

The fleet registered in Bujumbura Port is the largest on Lake Tanganyika when compared to those of other countries situated around the lake; namely, Tanzania, Zambia and DRC. The fleet is tabulated below:

Table 3.1: Burundian Fleet

Ship Owner	Name of Vessel	Type of Vessel	Length Overall (m)	Width (m)	Dead Weight (ton)	Draft in Charge (m)	State	In-service Date (year)
1 ARNOLAC	Kizigenza	Tug Line	33.50	7.58	66	3.25	G.E	1955
	Tanganyika	Tug Line	31.20	5.18	37	1.58	G.E	1889
	Krimiro	Tug Line	23.50	4.55	25	–	S	1915
	Moso	Harbour Tug in Kigoma	12.25	3.00	9	–	G.E	1958
	Ruremesha	Mixed Cargo Ship	41.25	9.00	350	2.25	G.E	1981
	Ndaje	Mixed Cargo Ship	54.75	8.70	600	3.20	G	2002
	Cohoha	Tank Barge	42.35	7.00	336	2.71	G.E	1955
	Rweru	Tank Barge	32.71	5.58	115	1.64	G.E	1953
	Sagamba	Bulk Cargo Barge	65.70	10.00	1,397	3.77	S	1955
	Murinzi	Bulk Cargo Barge	59.60	9.02	885	3.26	G.E	1931
	Buragane	Bulk Cargo Barge	54.50	8.50	627	2.61	S	1937
	Mumirwa	Bulk Cargo Barge	52.77	8.82	544	2.75	G.E	1955
	Buyenzi	Bulk Cargo Barge	52.77	8.82	538	2.75	S	1955
	Remera	Bulk Cargo Barge	47.25	8.00	477	2.36	S	1927
	Buyogoma	Bulk Cargo Barge	36.50	6.00	278	2.17	S	1918
	Imbo	Bulk Cargo Barge	37.77	6.50	246	2.08	S	1929
	Baraka	Bulk Cargo Barge	47.25	8.00	–	–	W	1925
	Tanganyika	Tourism and Research Vessel	25.30	6.86	125	–	V.G	1994
2 BATRALAC	Tora	Bulk Cargo Ship	58.00	10.00	1,110	3.50	G	1988
	Rwegura	Bulk Cargo Ship	45.00	8.00	500	2.50	G.E	1984
	Teza	**Mixed Cargo Ship**	**60.00**	**11.00**	**1,500**	**3.60**	V.G	1992
3 SOTRALAC	Bwiza	Bulk Cargo Ship	54.70	8.00	508	2.75	W	1913
4 TANGANYIKA TRANSPORT	Mbaza	Bulk Cargo Ship	42.50	7.30	450	2.35	G.E	1988
5 E.P.B	Ngiri	Harbour Tug	15.75	4.30	–	–	G.E	1959

Notes: Mixed Cargo Ship = Container and/or Bulk Cargo Ship
S = Suspended
V.G = Very Good
G = Good
G.E = Good Enough

3.2 Rumonge Port

The meteorological conditions are almost the same as those of Bujumbura Port and the water level of Lake Tanganyika, including its chronological changes, is also comparatively the same. In Rumonge Port, as well as the Bujumbura Port, the wind blows from land in the morning and from the lake in the afternoon.

The terrain where Rumonge Port exists has been formed with the diluvial materials debouched from the River Murenbwe. The terrain is gradually getting higher towards the east as it is nearing the mountains formed by the orogenic movement of the Great Rift Valley. The access road is connected to National Road Route No. 3. The topography and bathymetry at Rumonge Port are as shown in Figure 3.9.

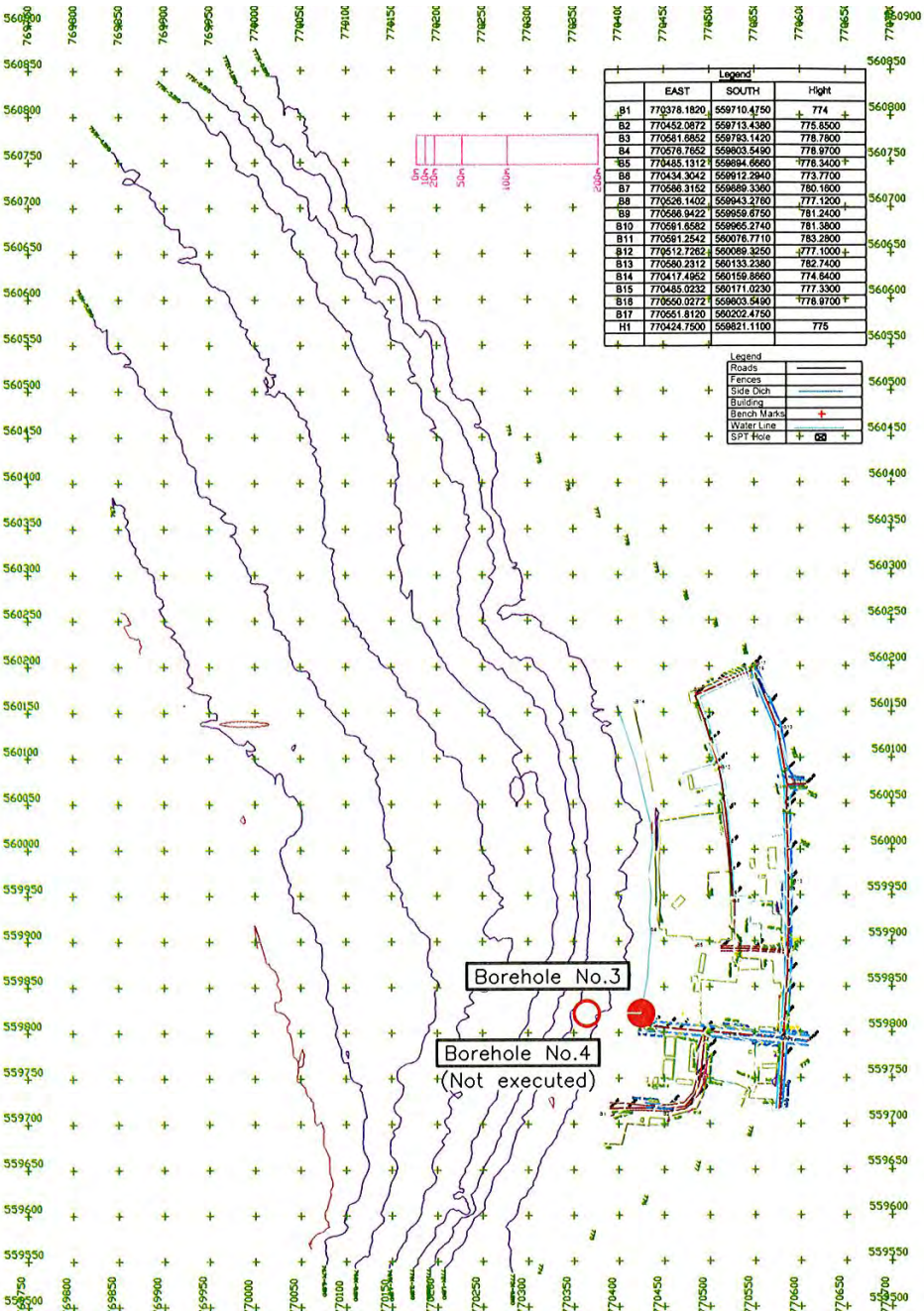


Figure 3.9: Topography and Bathymetry at Rumonge Port

The subsoil mostly consists of a mixture of sand and stones. The site of Rumonge Port is on the terrain formed with deposits debouched from the Rivers Dama and Murembwe.

A small scaled organization for operation and management of the port is established. Immigration (Ministry of Security) and Custom (Ministry of Finance) offices are located along side the access road to the port. The responsible office to maintain navigational signals, has not been functioning for a long time. The local residents' committee is formed for cargo handling operation.

Off-shore cargo handling operation is employed. Cargoes on vessels are transferred to the beach or by hand to small boats (canoe-type boats with or without an out-board engine).

The land and waterfront of Rumonge Port have been acquired by MTTPE. The port site consists of a gentle slope lowering toward the lake where an access road has been built. There are two sheds and one warehouse, all of which seem to be unused. A fence, gate, and small building for guards were completed in February 2012.

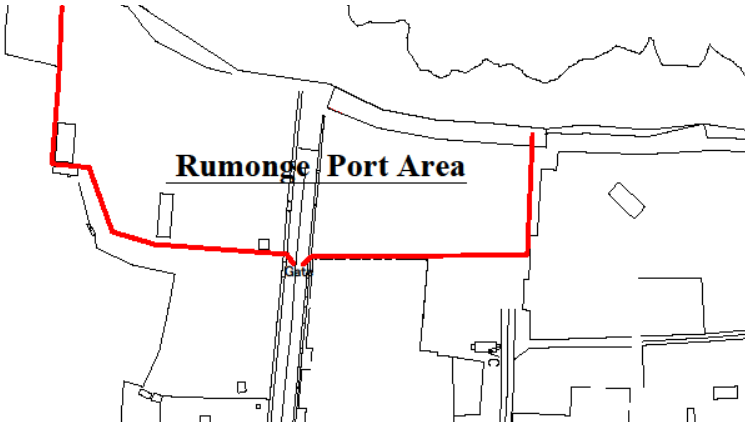


Figure 3.10: Port Area of Rumonge Port

3.3 Other Ports on Lake Tanganyika

(1) Kigoma Port

Kigoma Port used to load and unload a considerable volume of cargo to and from the TRL railway. The cargo was transported by ships plying the lake ports. However, cargo handled at Kigoma Port has been on the decline. See Table 3.2 for figures pertaining to International Traffic at Kigoma Port (2004–2010) for import and export cargo of Burundi and DRC through Kigoma.

Table 3.2: International Traffic at Kigoma Port (2004–2010)

Unit: Ton

INTERNATIONAL TRAFFIC		2004	2005	2006/7	2007/8	2008/9	2009/10
DRC	Import	69,529	86,259	52,861	51,388	67,575	30,073
	Export	11,107	10,610	11,117	4,176	10,441	14,904
	Sub total	**80,636**	**96,869**	**63,978**	**55,564**	**78,016**	**44,977**
BURUNDI	Import	17,382	21,564	20,751	14,868	32,272	13,745
	Export	2,221	2,652	0	0	0	504
	Sub total	**19,603**	**24,216**	**20,751**	**14,868**	**32,272**	**14,249**
DRC & Burundi	Import	86,911	107,823	73,612	66,256	99,847	43,818
	Export	13,328	13,262	11,117	4,176	10,441	15,408
	Sub total	**100,239**	**121,085**	**84,729**	**70,432**	**110,288**	**59,226**

Source: TPA

General cargo wharf in Kigoma Port is 301 m in length and 2.85 m in depth along the quayside. Initially, the depth was 6m but due to siltation the depth decreased to the current figure. There are two stage wharfs on ground level. Two units of portal cranes of 5 ton capacity are settled on the lower side. It is not possible for forklifts to go down on the lower stage.

A warehouse and 10,000 m^2 general cargo yard are at the higher side of the quay. The container wharf is 96 m in length with a 3,745 m^2 yard at the end of the general cargo berth. A rail-mounted gantry crane of 35 tons with cantilever is settled here for container handling, but it has not been in workable condition for the past several years due to the shortage of parts and no maintenance work.

Passenger ships go alongside the finger type pier which is 100 m in length. A small passenger terminal with an immigration office inside is located nearby. The ship is moored at a distance from the pier, with a dead ship placed between the ship and the pier.

The railway sidings are located by the general cargo wharf and container wharf.

(2) Kasanga Port

Kasanga Port will be connected with Dar es Salaam Port with the paved trunk road in a few years, once the upgrading road projects are completed. The transit cargo to/from DRC will likely pass through Kasanga Port, as this upgraded road will be a shortcut route of around 1,000 km between the west shore of Lake Tanganyika and Dar es Salaam.

Kasanga Port has one berth of 20 m length supported by concrete pedestals on the tip of the rectangular reclamation of approximately 30 m length which is unpaved. As it is located on the small hilly peninsular, considerable cut and fill work may be necessary to create a wide flat cargo/container stacking area adjacent to the port. Expecting the completion of the road upgrading, TPA has a development plan to construct a container stacking yard on the hill behind the warehouses.

Photo 3.1: Kasanga Port

(3) Kalemie Port

Kalemie Port in DRC was constructed by Belgium during 1930 and 1931. The port is owned and operated by SNCC (the Société Nationale des Chemins de Fer du Congo) which was formerly SNCZ (Société Nationale des Chemins de Fer Zaïrois). SNCC is a state owned company which is also operating the national railway of DRC except for the Matadi–Kinshasa line.

The wharf has a total length of 380 m with the width varying from 10 to 15 m. It has two different elevations. On the apron, there is no space for trucks or other vehicles to reach the gantry cranes for loading/offloading the cargo, which makes the rail wagon the only accessible means of transport entering the port.

The navigational channel is not clearly located, and the seabed depth along the berth line is around 3 m.

The port is suffering for its poor infrastructure and significantly deteriorated facilities. There are four rail mounted gantry cranes with 5 ton lifting capacity and one derrick crane of 50 ton lifting capacity, all of which were manufactured in the 1950's. Two gantry cranes are not operational or repairable. There is also one old rail wagon crane with a 5 ton lifting capacity.

Reportedly, there is no rehabilitation or development plan of the port.

The main cargo handled at the port is coal and general cargo. General cargo is offloaded from the ships manually and loaded onto the trucks which are mainly transported to Lubumbashi.

(4) Mpulungu Port

Mpulungu Port is Zambia's only port. The port is the gateway to the neighboring counties on Lake Tanganyika. Table 3.3 shows the unloaded cargo at Bujumbura Port from Mpulungu Port in the past 10 years. It should be noted that the maximum amount of cement, construction materials, and sugar exported to Bujumbura through Mpulungu Port were recorded in 2010.

Table 3.3: Import at Bujumbura Port from Mpulungu

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Consumables	12	36	41				36	668		
Drinks			5							
Bitumen		250								
Slate	230						957	61		
Cement	14,493	35,862	46,631	28,946	46,142	42,079	12,035	7,039	31,043	92,091
Engine oil			300	1,047			150	83		
Lubricants	21	7								
Construction materials	469	502	309	568	118	58	322	601		1,834
Malt	250	497		116		180	820	55		
Paper	90	213	169	113	35	111	36			
Chemical products	396	559	241	10	223	150	28	212	23	
Salt				1,557			1,322			
Sugar	11,754	10,299	14,004	9,861	12,579	14,087	10,938	9,660	14,031	15,777
Forage crops		4								
Vehicles	2	22	16	40	93	514	131	90	71	81
Cotton										
Others	301	251	197	151	301	282	351	335	237	357
Total	28,017	48,500	61,914	42,409	59,491	57,461	27,126	18,805	45,405	110,140

Note: Yellow cells show the maximum amounts in the past 10 years.
Source: E.P.B.

The port has a 20 m long berth and three warehouses. Cement and sugar for export are stored in the warehouses and transported by 4 flat bed chassis to the berth, where a crawler crane is located to load them onto the ship. The cargo handling operation is carried out by a semi-government entity.

3.4 Ship Repair Facility on Lake Tanganyika

At Bujumbura Port, there is no ship repairing facility. The ships registered at Bujumbura Port used to be repaired at the slipway at Kigoma Port or at the dry dock at Kalemie Port.

TPA Kigoma office has a transversely launching type of slipway, built in 1912 for repairing of ships, which is able to accommodate a ship of max. 70 m in length. Vessels with flags of other countries are also able to use the slipway, but the Tanzania vessels are given priority when the slipway is congested. A workshop for engines, auxiliaries, equipment, and fittings repair is located near the slipway where lathes and other machine tools are also arranged.

Kalemie Port has a dry dock 120 m in length, 21 m in width, and 7 m in depth which has a manually operated gate. However, the tools and machineries in the workshops are very old and cannot be used due to the lack of proper maintenance. There is also a 6 degree gradient slipway of 130 m in length and 5 m in rail gauge which was built during 1930 and 1931, but has not been used for the last 30 years. The winch to pull up the ships from the lake to the land was demolished.

4. Demand Forecast of Burundi Ports

4.1 General

By using socioeconomic indicators, such as population and GDP, the amount of traffic which generates and arrives at Burundi is estimated along with the approximation of traffic flow from neighboring countries through Burundi to foreign countries.

4.2 Past Trend of Freight

Alternative transportation routes for bilateral freight flow are assumed as shown in Table 4.1

Recent changes in the amount of freight, bilateral trade, and the types of commodities etc., are analyzed for Burundi and Rwanda by using data obtained from COMTRADE (United Nations Commodity Trade Statistics Database). DRC is not included in the subject countries due to lack of information in such databases.

Table 4.1: Alternative Routes for Freight between Two Countries

Country	Export to/ Import from	Alternative Routes for Transportation		
Burundi	Rwanda	Land		
	Tanzania	Land	Water to Kigoma and Railway 2)	
	Kenya	Land		
	Uganda	Land		
	DRC	Land		
	Southern Africa	Water to Mpulungu and Land 1)		
	Other Countries	Land to Mombasa	Land to DSM	Water to Kigoma and Railway to DSM 2)
Rwanda	Burundi	Land		
	Tanzania	Land	Land to Bujumbura, Water to Kigoma and Railway 2)	
	Kenya	Land		
	Uganda	Land		
	DRC	Land		
	Southern Africa	Land to Bujumbura, Water to Mpulungu and Land 1)		
	Other Countries	Land to Mombasa	Land to DSM	Land to Bujumbura, Water to Kigoma and Railway to DSM 2)
DRC	Burundi	Land		
	Rwanda	Land		
	Tanzania	Land	Land to Bujumbura, Water to Kigoma and Railway 2)	
	Kenya	Land		
	Uganda	Land		
	Southern Africa	Land to Bujumbura, Water to Mpulungu and Land 1)		
	Other Countries	Land to Mombasa	Land to DSM	Land to Bujumbura, Water to Kigoma and Railway to DSM 2)

More than 70% of the freight of Burundi was handled at Bujumbura Port between 2001 and 2005. The amount of traffic gradually decreased after 2006, becoming very sparse in 2008. Figure 4.1 shows the import/export amount handled at Bujumbura Port. It should be noted that the amount handled at Bujumbura Port consists of the cargo transported both by truck and by ship.

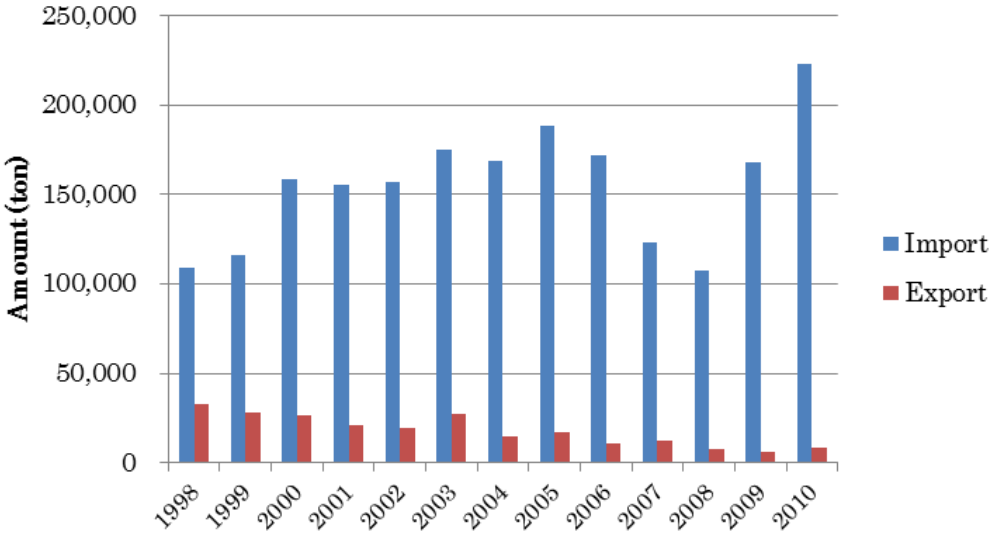


Figure 4.1: Amount of Traffic at Bujumbura Port

Figure 4.2 shows the amount of imports loaded from ship at Bujumbura Port during the years 1998 to 2009, sorted by the kind of commodities. The top two commodities are construction materials and food products. Major construction material and food product are cement and sugar respectively, both of which are mainly shipped from Zambia via Mpulungu Port.

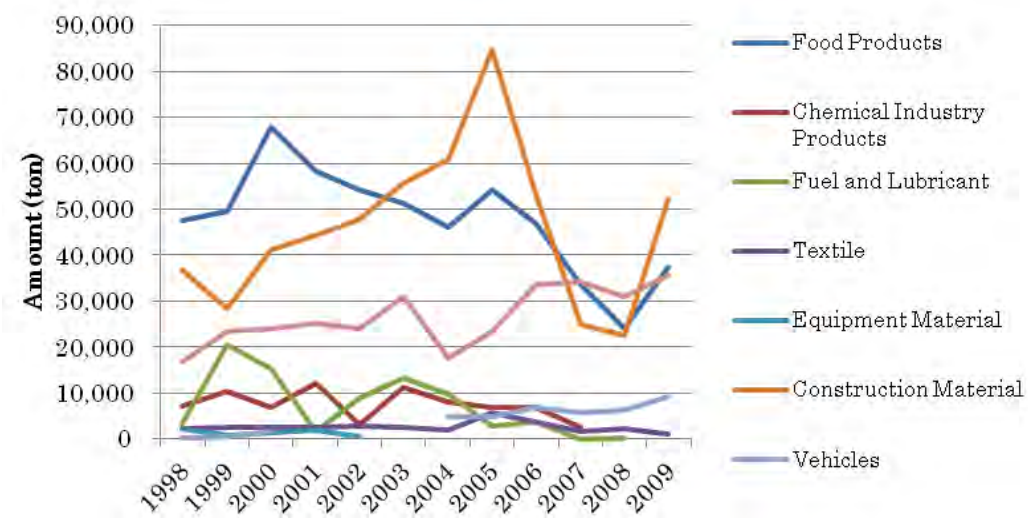


Figure 4.2: Amount of Imported Commodity at Bujumbura Port

Figure 4.3 shows the amount of exports loaded to ship at Bujumbura Port during the years 1998 to 2009, sorted by kind of commodities. The major export commodity is coffee. However, its amount has been declining over the years from 26,628 tons in 2000 to 5,275 tons in 2009. It is reported that no coffee was loaded to ship in 2010.

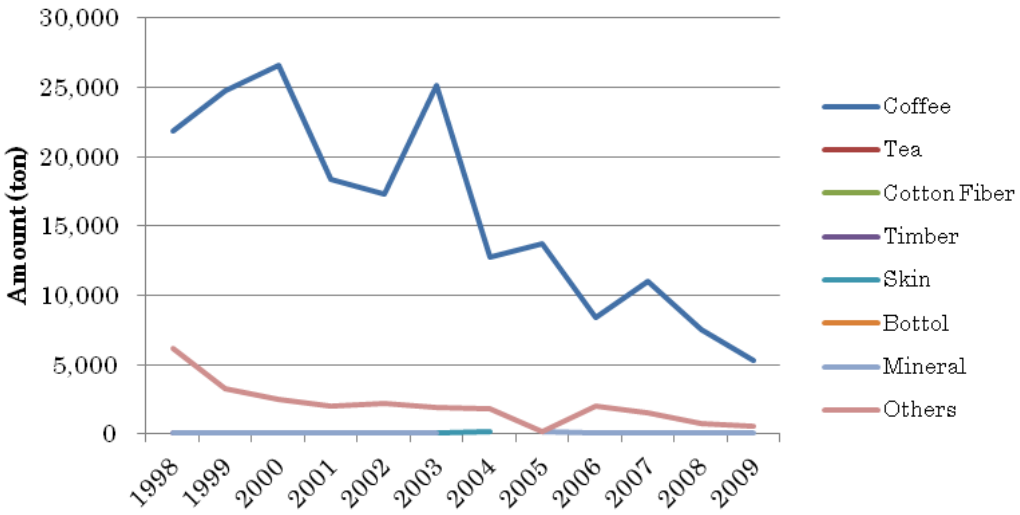


Figure 4.3: Amount of Exported Commodity at Bujumbura Port

The amount of traffic that was shipped during the past ten years from Kasanga and Kigoma ports (Tanzania), Mpulungu port (Zambia), and DRC port, are shown in Figure 4.4. The total amount of annual import from Tanzania, which stayed at around 80 thousand tons until 2005, started to plunge in 2006. By 2010, the amount had decreased to as low as one fourth of the amount in 2005. On the other hand, the amount of import cargo from Zambia, which stayed at around 50–60 thousand tons until 2006, increased rapidly in recent years to as high as 110 thousand tons in 2010.

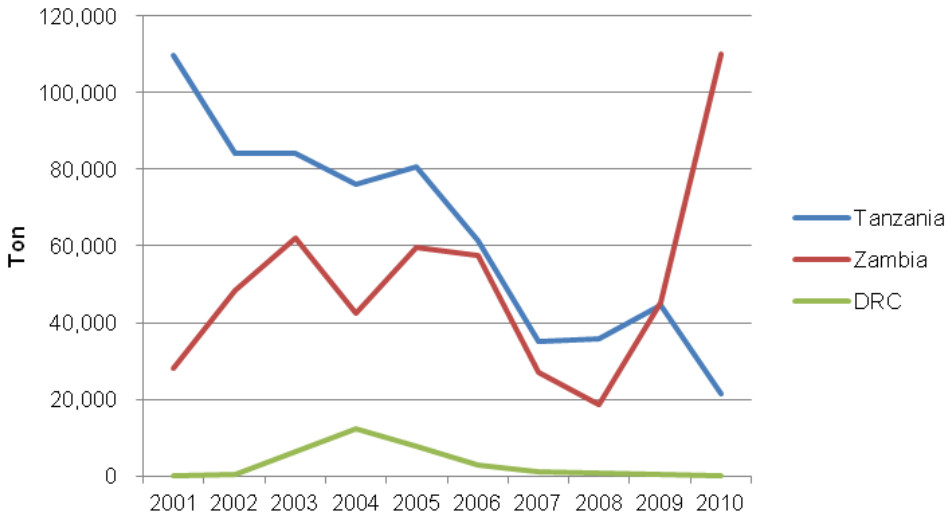


Figure 4.4: Amount of Import at Bujumbura Port from Each Lake Port

Various goods were imported from Kigoma port in 2001. However, after 2002, the traffic of cement and fertilizer decreased, and then, in 2007, the total traffic drastically decreased. Meanwhile, the import figures of Mpulungu Port are indicative of the fact that the port specializes in cement and sugar. Cement especially showed a radical growth of a threefold increase from the previous year in 2010. Sugar, on the other hand, has remained steady at around 10 thousand tons since 2001.

4.3 Estimates of Future Freight Demand

The annual trade amounts of Burundi and Rwanda are positively correlated with their GDP and population figures (the trade amounts of Burundi in 2008 and 2009 are excluded from the analysis because of their extreme drops compared to the average amounts in other years). By using the GDP and population figures as explanatory variables, a model for estimating the amount of future trade can be developed as follows:

$$y = a \cdot x_1 + b \cdot x_2 + c$$

Where y : Import and Export (USD million)
x_1 : GDP (USD billion)
x_2 : Population (million)
a, b, c : Parameters (the table below)

Table 4.2: Parameters of Model for Forecasting Amounts of Trade

Country/ Parameter	Object (million USD) (*y*)	GDP (National Currency 1) (*a*)	Population (million) (*b*)	Constant (*c*)	Correlation Coefficient r^2
Burundi	Import	2.15	135.3	−2,001.6	0.832
	Export	0.63	101.4	−996.1	0.923
Rwanda	Import	0.67	251.2	−2,505.3	0.970
	Export	0.23	73.6	−773.2	0.955

Note: 1) Burundi: billion BIF, Rwanda: billion RWF
Source: JICA Study Team

The future figures were assumed by adopting the outlook below.

- For GDP and population, IMF's estimates are directly employed until 2016.
- For the figures after 2016, it is assumed that GDP will grow at the rate of 4.5% while the population growth will be at the rate of 1.5%.

The estimated figure for future frames is 2.5 times higher for Burundi and 2.7 times higher for Rwanda compared to those in 2010, while the estimated population for both countries is 1.4 times more than that in 2010. The amounts of future trade were estimated by inputting the above future frames into the trade estimation model. In 2030, Burundi will experience more than a fourfold increase in the amount of trade compared to that of 2010.

On the assumption that the average share of partners and of commodities for Burundi's import/export trading from 2003 to 2010 will continue for the foreseeable future, the total import amount is multiplied by this share to obtain future import amounts by partner country and commodity. The same assumption is applied for Rwanda's import/export trading. Based on the estimated freight OD, the examination of whether cargos would be transported through Bujumbura Port or not is summarized in Table 4.3.

Table 4.3: Potential Freight Subjected to Further Examination, 2030

Unit: 1,000 tons

Country	Import/ Export	Partner Country/Area						
		Tanzania	Southern Africa	Other Africa	Asia	Middle East	Europe	Others
Burundi	Import	200.4	258.5	57.1	239.0	370.4	438.8	34.8
	Export	6.0	3.8	8.3	14.8	27.7	84.7	1.3
Rwanda	Import	136.8	109.0	68.4	382.1	466.3	444.1	118.8
	Export	8.4	26.6	10.2	51.9	7.0	150.3	14.8
Total		351.7	397.9	143.9	687.8	871.4	1,117.9	169.6

Source: JICA Study Team

Applying the idea of alternative transportation routes between two countries, the potential freight loads from/to Southern Africa, including Zambia, will be transported using waterways through Lake Tanganyika which connects Bujumbura Port and Mpulungu Port, whether in Burundi or in Rwanda. In consequence, the cargo amounting to 397.9 thousand tons is determined to be handled at Bujumbura port.

There are options for the cargos between Burundi, Rwanda, and Tanzania to be transported either by corridor/land or by water. Assuming that the share of Kigoma route will increase at about 12% according to the improvement of service level of TRL Kigoma line in 2030, the subject traffic will be 361.1 thousand tons. The result of the above estimation is shown in Table 4.4.

Table 4.4: Summary of Estimated Freight Volume Handled at Bujumbura Port in 2030

Case	Southern Africa	Others	Total
Base	397.9		397.9
Base + Kigoma	397.9	361.1	759.0

Source: JICA Study Team

The following tables show estimated freight volume to be handled at Bujumbura Port in 2020, calculated in the same manner as previously discussed.

Table 4.5: Summary of Estimated Freight Volume Handled at Bujumbura Port in 2020

Case	Southern Africa	Others	Total
Base	220.8		220.8
Base + Kigoma	220.8	164.1	384.9

Source: JICA Study Team

The freight volume by commodity can be estimated as summarized in Table 4.6 and Table 4.7, by distributing the total volume handled at Bujumbura Port shown in Table 4.4 and Table 4.5 respectively with the shares of commodities and partner countries as previously discussed.

Table 4.6: Estimated Freight Volume by Commodity Handled at Bujumbura Port in 2030

Unit: 1,000 tons

Commodity	Base	Base + Kigoma
Animal & Animal Products	0.6	1.1
Vegetable Products	14.8	59.7
Foodstuffs	70.5	72.8
Mineral Products	222.9	482.4
Mineral Fuel and Oil	19.1	31.7
Chemicals & Allied Industries	6.0	8.2
Plastics / Rubbers	2.5	3.1
Raw Hides, Skins, Leather, & Furs	12.0	23.62
Wood & Wood Products	4.5	8.1
Textiles	1.7	1.8
Footwear / Headgear	0.3	4.8
Stone / Glass	11.9	18.4
Metals	24.2	35.4
Machinery / Electrical	5.2	5.8
Transportation	1.7	2.1
Total	397.9	759.0

Source: JICA Study Team

Table 4.7: Estimated Freight Volume by Commodity Handled at Bujumbura Port in 2020

Unit: 1,000 tons

Commodity	Base	Base + Kigoma
Animal & Animal Products	0.4	0.6
Vegetable Products	8.7	29.1
Foodstuffs	41.1	42.1
Mineral Products	119.2	236.9
Mineral Fuel and Oil	11.4	17.1
Chemicals & Allied Industries	3.7	4.6
Plastics / Rubbers	1.5	1.8
Raw Hides, Skins, Leather, & Furs	6.3	11.6
Wood & Wood Products	2.7	4.6
Textiles	1.0	1.1
Footwear / Headgear	0.2	2.2
Stone / Glass	6.4	9.4
Metals	14.2	19.6
Machinery / Electrical	3.1	3.4
Transportation	1.0	1.2
Total	220.8	384.9

Source: JICA Study Team

5. Strategy of Port Sector Development

5.1 Development Strategy

Bujumbura Port is strategically located at the northern tip of Lake Tanganyika where all the cargo moving north and south find an economical pass, exploiting lake transport. The port shall be developed as a reliable transport node on this corridor.

The revival of the TRL railway of Tanzania will have a great impact on the lake transport between Kigoma Port and Bujumbura Port. As most of the cargos transported via Kigoma will

be international container cargos, both ports must be equipped with facilities and equipment to handle ocean going containers.

Once the road upgrading is completed from Tunduma to Kasanga Port in Tanzania, all the transit cargos to the areas on Lake Tanganyika can be transported by this route, as it is the shortest between Dar es Salaam and Lake Tanganyika. Kasanga Port is a potential counterpart port to Bujumbura Port on the East-west Corridor on Lake Tanganyika in case TRL railway is not vitalized.

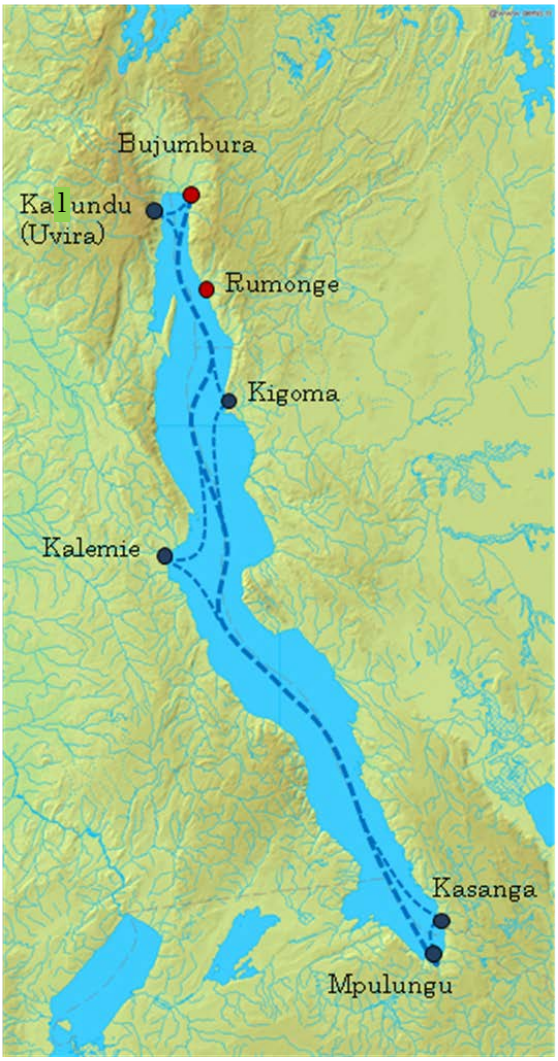


Figure 5.1: Main Ports on Lake Tanganyika

- Burundian government should have a development strategy incorporating the following aspects:
  - To make Bujumbura as a logistic hub in the inland region of East Africa consisting of Rwanda, North-eastern part of DRC, Uganda, Zambia and Burundi.
  - To make Bujumbura Port as a gateway of the inland region of East Africa taking advantages of the transport network developments of the counties on the coast of Indian Ocean consisting of Tanzania, Mozambique and South Africa.

- To materialize the abovementioned plan, the following measures should be implemented:
  - To consolidate the strength of Bujumbura Port as a node between lake transport and road transport on the North-South Corridor.
  - To exploit the transport network developments of the coastal countries to lower transport cost.
  - To enhance coastal shipping for short-distance lake transport.

Bujumbura Port should be capable of handling increasing cargo coming from the Southern part of Africa, including South Africa. The port should be efficient in handling transit cargo to/from Rwanda, north-eastern part of DRC, and Uganda. The port should lease out some areas within its premises for the convenience of the neighboring countries. In addition, Burundian government should request a proper development of Mpulungu Port to Zambian government for the benefit of both countries.

A dry port should separately be built at the suburb of Bujumbura City for the cargo coming from and going to the neighboring countries, crossing the border by road. For passengers coming from and going to the neighboring countries by road, an immigration office and international terminal may be built near the existing international airport.

5.2 Development of Bujumbura Port

As the operation of container block train will start in 2015 between Dar es Salaam and Kigoma, with the containerization starting at Mpulungu Port sooner or later, the development of the ports should focus on the container cargos to be handled.

There should be a ship repairing facility in Burundi to inspect and repair ships. As the most convenient location for the ship repairing facility is the present port basin of Bujumbura Port, where ships can be moored for fitting out, a slipway and workshop should be built at the port basin.

The expansion of the port premises should be considered. The port can be expanded to the north-west shore where the lake bed is getting shallow because of accretion caused by sandy soils debouched from the River Ntahangwa. The expansion should provide a sufficient water area for an oil berth for liquid bulk transport from Kigoma and Ro/Ro berth, which may be introduced for speedy transport of a relatively small quantity of cargo and 50 to 100 passengers.

5.3 Development of Rumonge Port

The objectives in developing Rumonge Port should be set to promote the coastal shipping for the people inhabiting the opposite shore in DRC and the eastern shore in Tanzania. The role as the lifeline for them will not cease even though the road between Makamba and Mugina, about 26 km to the Tanzanian border in Makamba Region, will be upgraded. Relatively big lots of cargos will continue to be transported by a ship capable of carrying cargo of about 150 tons, which is equivalent to 150 trucks, while small lots of cargos will be transported by road.

5.4 Demand Forecast of Bujumbura Port

The base-case considers the cargo moving between the Southern African region and the areas which can be considered the hinterland of Bujumbura Port, such as Burundi, Rwanda, and north-eastern part of DRC. The cargo is transported between Bujumbura Port and Mpulungu Port. As there is no alternative route for this cargo to move, this should be considered as the

base-case. The demand of the annual cargo volume is estimated to be 151,600 tons in 2015, 220,800 tons in 2020, 300,900 tons in 2025, and 397,900 tons in 2030.

Mpulungu Port has only a 20 m long berth and one crawler crane to load and unload cargo to/from ships. As the maximum capacity to handle the break bulk cargo is considered around 195,000 tons per year even if the berth is expanded to 60 m, the demand of break bulk cargo will exceed the capacity of Mpulungu Port. Therefore, sooner or later the cargo which can be containerized has to be containerized. Containerization at Mpulungu Port is assumed to start in 2020.

As the break bulk cargo and dry bulk cargo will be transported by transport means other than a container block train, the cargos destined to Bujumbura Port from Kigoma Port transported by ship are considered to be containers only.

The demand of Bujumbura Port is obtained by summing up t he cargos estimated for the base-case and the containers transported by the container block train(s). The results are shown in Table 5.1 and Figure 5.2.

Table 5.1: Cargo Demand of Bujumbura Port

1,000 ton

	2015	2020	2025	2030
Container from/to Kigoma	80.0	164.1	248.6	361.1
Container from/to Mpulungu	0.0	72.4	96.1	124.6
Break Bulk	141.1	133.4	184.6	246.8
Dry Bulk	4.0	6.0	8.3	11.1
Liquid Bulk	6.6	9.1	11.9	15.3
Total	231.6	384.9	549.5	759.0

Note: Mpulungu Port can handle containers in 2020 onwards.

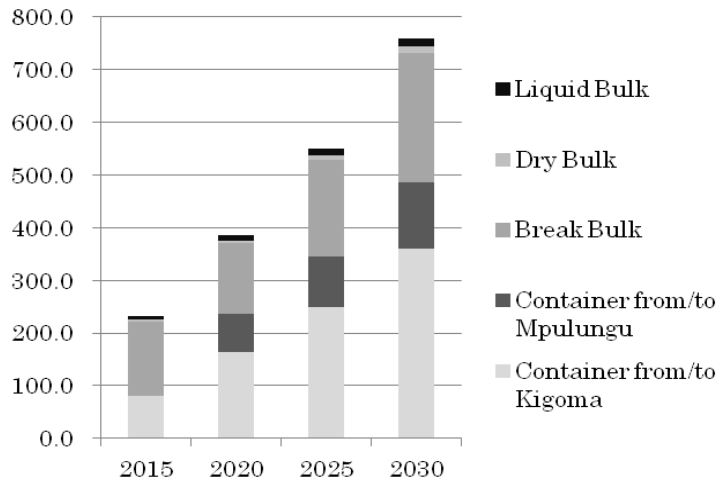


Figure 5.2: Cargo Demand of Bujumbura Port shown in Graph (ton)

5.5 Demand Forecast of Rumonge Port

Majority of the cargo handled at Rumonge is the imported ones, and the export cargo is seldom. Major inbound commodities are edible flour, dry fish, rattan for furniture, charcoal, and fuel oil.

Major outbound cargos are fruits and vegetables. It takes the cargo ships about 3 hours to cross the lake, about 35 km wide, to the opposite shore. Meanwhile, it takes about 8 hours for the cargo ships to go to Kigoma from Rumonge.

The current lake transport centered at Rumonge is to provide a lifeline to the people living on the opposite shore in DRC, where roads along the shore are yet to be built and no town of a significant scale exists. It also provides a lifeline to the people who are living at small villages dotted along the lake shore in Tanzania where no road access is available.

The annual cargo volume handled at Rumonge is estimated at about 25,000 tons (100 ton cargo ships × 10 ship calls per week × 25 weeks per year = 25,000 tons/year). This estimate is based on the information and discussion with an advisor of the Rumonge mayor and MTTPE official. As the population will not increase much in the remote small villages without access from the land, the cargo volume is considered to be the same in the future, i.e. 25,000 tons per year.

6. Development Master Plan of Burundian Ports

6.1 Development of Bujumbura Port

The berth lengths for the break bulk cargo required in 2015, 2020, 2025, and 2030, are estimated in the table below:

Table 6.1: Required Berth Length for Break Bulk Cargo

Year	Cargo (1000 ton/year)	Working Days per year	Ton/gang/day	Gang per vessel	Calling Vessels per day	Berth per Vessel (m)	Required Berth Length (m)
2015	141.4	300	250	1.6	2	80	160
2020	133.4	300	250	1.6	2	80	160
2025	184.6	300	250	1.6	2	80	160
2030	246.8	300	250	1.6	3	80	240

Currently Bujumbura Port has a 350 m long berth, which can be used to handle the demand of break bulk cargo estimated in 2030. However, in order to meet the large draft of the vessels and/or low water level in future, the quay wall should be rehabilitated in due course.

- The daily throughputs of containers at the quay wall is computed as shown below:

Table 6.2: Daily Container Throughput at Bujumbura Port

Year	2015	2020	2025	2030
From/to Kigoma Port (TEU/day)	31	65	99	144
From/to Mpulungu Port (TEU/day)	0	26	34	44

From 2020, 3 container ships of a 60 TEU capacity will be put into service and one of them will call Bujumbura Port every day up to the time when the daily container throughput reaches 120 TEU. In 2030, one additional container ship of a 60 TEU capacity will be required to transport containers once every 5 days.

For containers transported between Mpulungu Port and Bujumbura Port, it is also assumed a container ship having a 60 TEU capacity will be put into service. A container ship will need 5 days plying between Mpulungu Port and Bujumbura Port, half day for unloading/loading at each port, and 2 day navigation.

- As a result, the berth requirement for the container ships is estimated as shown below:

Table 6.3: Required Berth Length for Container Cargo

Year	2015	2020	2025	2030
Berth for Container Ships from/to Kigoma Port	0.5	1.0	1.0	1.2
Berth for Container Ships from/to Mpulungu Port	0.0	0.2	0.3	0.5
Total Berths	1.0	2.0	2.0	2.0
Berth Length (m)	80	160	160	160

Even though, in 2015 one berth will suffice the demand, two berths will soon be necessary in 2020. However, a phased construction of neighboring two berth of this size is not economical, as a certain extension of quay wall is required to retain the reclamation against the deep lakebed for safe berthing of ships. Two berths should be built from the beginning when financially possible.

The maximum volume of dry bulk will be about 1,000 tons per month, even in 2030. This volume of break bulk will be transported by a cargo or lighter vessel, both of which have a box type hull and wider hatches on the deck. They can be moored at the break bulk berth. The bulk barge will be unloaded by use of a wharf crane attached with a purpose-built bucket, shell type or peel type to fit the characteristics of the cargo.

The demand forecast predicts the liquid bulk to be transported in 2030 will increase from 6,600 tons in 2015 to 15,300 tons in 2030. It is likely that the oil barge owned by ARNOLAC, MT Cohoha, will be employed for the liquid bulk transport from Kigoma Port to Bujumbura Port. As its capacity is 335 DWT, one oil tanker berth is considered sufficient even in 2030.

Break bulk cargo like cement and sugar, major commodities handled at Bujumbura Port, have to be stored in the warehouses as practiced at present. The required number of warehouses, the dimensions of which are the same as the present ones, is estimated as shown in the table below:

Table 6.4: Required Number of Warehouses

Year	Cargo (1000 ton/year)	Dwelling Time (day)	Ton-day/year	Efficency (ton/m2/day)	Requied Area (m2)	Space of Warehouse (m2)	Required No. of Warehouses
2015	141.4	16	2,262,400	1.13	5,485	2,300	3
2020	133.4	16	2,134,400	1.13	5,175	2,300	3
2025	184.6	16	2,953,600	1.13	7,161	2,300	4
2030	246.8	16	3,948,800	1.13	9,574	2,300	5

Notes: 1) Cargo including dry bulk
2) Dwelling time assumed to be 16 days
3) Efficiency of storage assumed to be 1.13 ton/m^2 per day, 25 % increase from 0.9 ton/m^2 per year in 2010

From the table above, till 2025 no additional warehouse will be needed as there are 4 warehouses at present. However, later on, one additional warehouse has to be built to meet the demand in 2030. As the current workshop will be relocated well before 2030, to the northern side of the port basin where a slipway is to be built, a new warehouse can be built at the area where the workshop currently exists.

The number of the stuffed and empty containers from/to Kigoma Port and Mpulungu Port is computed as shown in the table below:

Table 6.5: Stuffed and Empty Containers to Be Handled at Bujumbura Port

Year	2015	2020	2025	2030
Stuffed Containers from/to Kigoma Port (TEU)	6,365	13,060	19,807	28,778
Stuffed Containers from/to Mpulungu Port (TEU)	0	5,135	6,801	8,794
Stuffed Conatiners in Total (TEU)	6,365	18,195	26,608	37,572
Empty Containers from/to Kigoma Port (TEU)	5,125	10,554	16,223	23,644
Empty Containers from/to Mpulungu Port (TEU)	0	4,433	5,901	7,662
Empty Conatiners in Total (TEU)	5,125	14,987	22,124	31,306
Total (TEU)	11,490	33,182	48,732	68,878

- The required stacking container area is estimated as shown in the table below:

Table 6.6: Required Area for Container Stacking Yard

Year	Containers per Year (TEU)		Capacity (TEU/m2*year)	Requied Area (m2)	Required Area in Total (m2)	Ditto, if square (m)
2015	Stuffed	6,365	0.745	8,544	12,673	113
	Empty	5,125	1.241	4,130		
2020	Stuffed	18,195	0.745	24,423	36,499	191
	Loaded	14,987	1.241	12,077		
2025	Stuffed	26,608	0.745	35,715	53,543	231
	Loaded	22,124	1.241	17,828		
2030	Stuffed	37,572	0.745	50,432	75,659	275
	Empty	31,306	1.241	25,226		

From the table above, the north-eastern area of the port has to be annexed and utilized as a container stacking yard. It is foreseen, however, that the area of the present port premises will be insufficient to stack containers in future. The port premises have to be expanded.

There are no ship-repairing facilities in Burundi. It is reasonable to have the ship repairing facilities within the Burundian territorial water. As it is most economical to build such facilities near or within the premises of the port, construction of a new slipway and workshop is taken into consideration in development of Bujumbura Port.

Workshop, lifting equipment, and other ancillary machinery are necessary for the ship repair facility. To increase the transport capacity of the Burundian fleet, the slipway can be used to refurbish the cargo barges which are currently idling and moored at the port basin into motorized cargo ships, when it becomes viable.

One Ro/Ro berth should be provided in future. When the cargo transport is more frequent between Bujumbura Port and the western coast of Lake Tanganyika of DRC, Ro/Ro ships will be employed by the private sector to materialize more frequent cargo and passenger transport. The Ro/Ro berth may be located as a horse hitch near the port entrance, as they frequently navigate between Bujumbura Port and other ports due to their mobility. Ro/Ro ships will transport loaded trucks and general cargo on palettes handled by a forklift.

- The master plan for the development of Bujumbura Port is worked out on the following principles:
  - To ensure sufficient port premises which can meet the future containerization of cargo to be transported on Lake Tanganyika, particularly those from/to Dar es Salaam via TRL railway and Kigoma Port

- To secure the shallow water area made with sand and boulders debouched from the River Ntahangwa, so that the port premises can be expanded to the area in future
- To build a container berth to meet the container demand to be generated by a TRL container block train and containerization of break bulk cargo
- To build a slipway accompanied by a workshop at the inner part of the port basin to repair and inspect the fleet of Burundian ships
- To secure the sufficient port basin for Ro/Ro berth and oil-tanker berth which will be required in future

Figure 6.1 and Figure 6.2 show the Master Plan Layout **Alternative (A)** and Master Plan **Alternative (B)**.

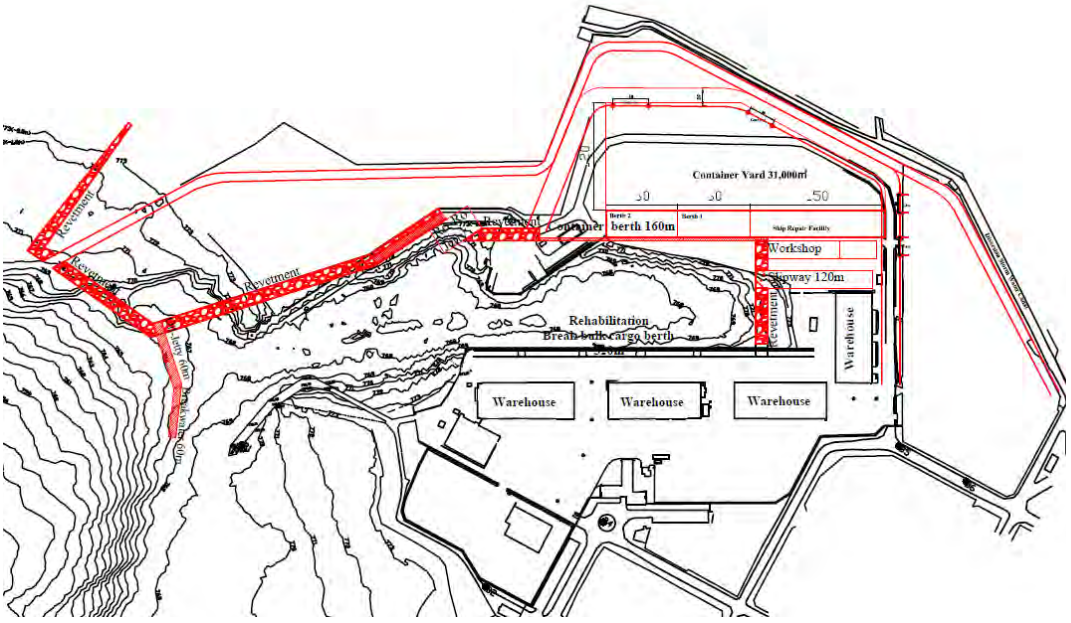


Figure 6.1: Master Plan Layout Alternative (A)

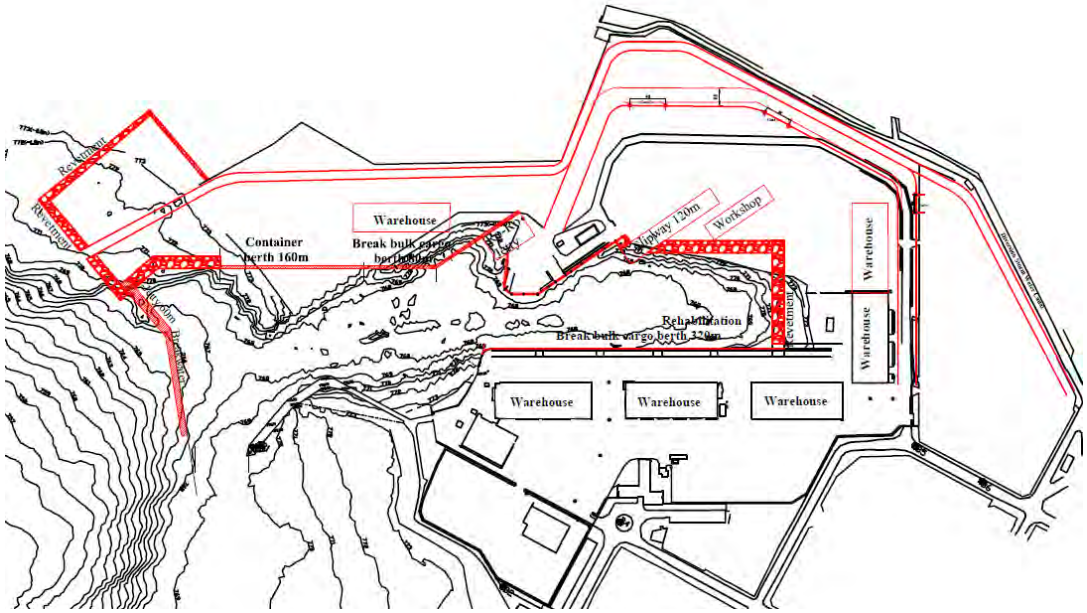


Figure 6.2: Master Plan Layout Alternative (B)

Based on the container transport by railway from Dar es Salaam Port to Kigoma Port envisaged by Tanzania Ports Authority, along with the results of physical survey and investigation, the conclusions, with respect to the development of Bujumbura Port, are summarized below:

1. New container berths have to be built to accommodate the container cargo.
2. A new break bulk berth is not necessary to be built, as the length of the existing general cargo berth is sufficiently long.
3. Master Plan Layout of Alternative (A) is better to meet the short-term and long-term demand of cargo.
4. A slipway can be built at the inner part of the port basin.

- The recommendations are as follows:
  1. The existing storm water cannel should be diverted to prevent the port basin from getting shallow.
  2. Container berths and container stacking yard should be built to meet the TRL railway revitalization.
  3. The ship repair facility consisting of a slipway and workshop, along with other ancillary facilities, should be built to inspect and repair the fleet of Burundian ships.

6.2 Development of Rumonge Port

The dimensions of the wooden cargo ships are considered to be 24 m long, 4.0 m wide, and 1.5 m deep in draft when fully loaded. Photo 8.1 shows two (2) wooden cargo ships from DRC beaching at the shore of Rumonge Port site.

Photo 6.1: Wooden Cargo Ships from DRC at Rumonge

When the regional economy grows to attract a large lot of cargo from Mpulungu Port, the port should be expanded for a large cargo ship to call at Rumonge Port.

In order to provide easier access from the berth to the deck of the ships, the jetty has to be of a floating type – a pontoon. For the stability of the pontoon against the waves, the minimum horizontal dimensions should be 30 m × 20 m.

An open air cargo stocking yard should be provided for the agricultural produce, imported mainly from the opposite shore of DRC, and cargo which can be wet when it rains. For the cargo which may stay at the port for some time for customs inspection and should not be wet

when it rains, a warehouse has to be provided. An open air storage yard should also be provided for the cargo which should not be wet when it rains but will not stay for a long time at the port. An administration building is to be built to provide offices for the port management/operation, customs, immigration control, quarantine, bank, forwarders, and shipping agents. A building for waiting passengers is to be provided out of the port premises.

The port layout is worked out as shown in Figure 6.3. MTTPE had the contract with a local contractor in Rumonge for construction of the gate, fence, and guard house which was completed in February 2012.

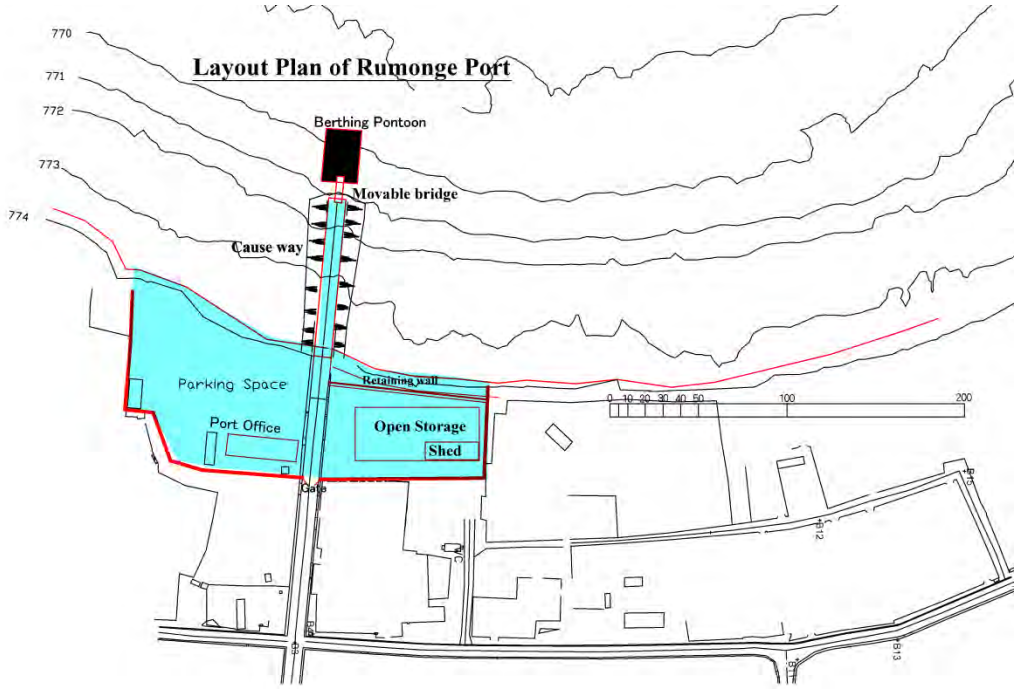


Figure 6.3: Master Plan Layout of Rumonge Port

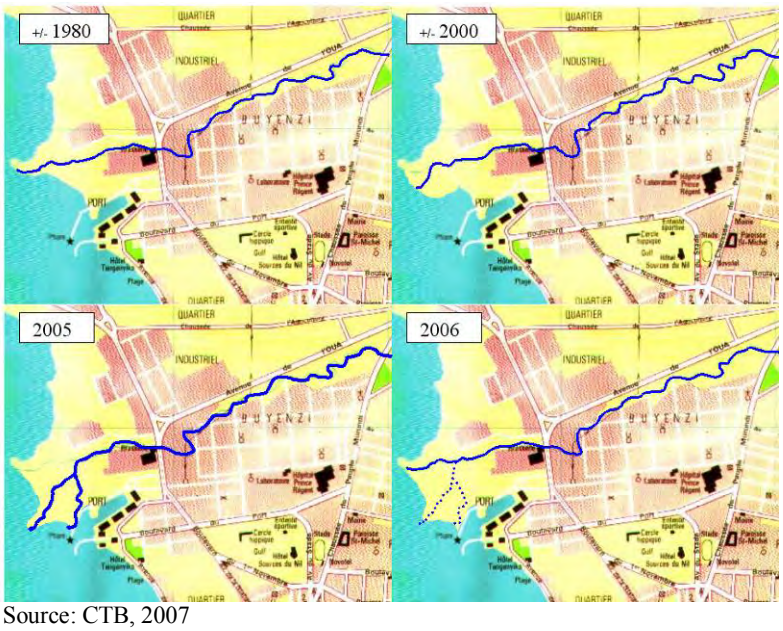
- Conclusions on the development of Rumonge Port are summarized as follows:
  1. The port is required to accommodate the small wooden cargo ships plying Lake Tanganyika, particularly between Rumonge and its opposite shore of DRC.
  2. The change of the elevation of the water surface is too large for the small wooden cargo ships to berth if the quay wall is made solid. A berthing facility of a floating type is preferable.

- The recommendations are as follows:
  1. To provide a pontoon of horizontal dimensions of 20 m × 30 m with freeboard of about 1.5 m to accommodate small wooden ships.
  2. To provide a movable ramp to connect the pontoon to the causeway.
  3. To provide an open storage at the elevation of 777 m.
  4. To build the warehouse, open shed, and administration building
  5. To provide offices in the administration building for international travel and trade

7. Environmental Considerations

Based on the baseline information collected within this study, it is found that several environmental factors would be critical for the implementation of proposed port improvement project of Port Bujumbura.

Most of the tributaries, reaching Lake Tanganyika, discharge turbid water containing silts and, sometimes, cause rapid local sedimentation at the downstream side (e.g., the river mouth regions around Bujumbura City) during every rainy season. Among them, the local geo-morphological condition of the Ntahangwa River, one of the major tributaries running through Bujumbura, is unstable (see Figure 7.1), at the downstream side in particular, while the mainstream around the river mouth region frequently changes its course and there have been incidents of this river sometimes flooding the nearby port facilities. It is noted that current port facilities exist in adjacent area of the sand bar created around this river mouth.



Source: CTB, 2007

Figure 7.1: Morphological Instability of the Ntahangwa River's River Mouth

It is very likely that some soils and/or sediments found inside of Bujumbura Port are contaminated by heavy metals such as PCB, arsenic, and other toxic substances. During the last dredging work of Port Bujumbura, it was found that several portions of the port sediment contained toxic heavy metal components such as Arsenic, PCB, Cadmium, and others therein. Some of those concentrations are exceeding the relevant environmental standards of EU, so a preliminary sediment analysis was conducted in 2007, prior to the dredging work.

It is reported that the following are three possibilities of where those toxic substances are coming from; (i) from the main body of Lake Tanganyika by the coastal current, (ii) some wastes discharged at the upstream side of Buyenzi Canal which accidentally contained those substances and reached the port, and (iii) from some of the port facilities, although there is no record of shipyard in the past. The exact origin of those hazardous substances found is still unknown.

The following two measures were taken in order to treat the removed sediments; i.e., (1) convey "safe" sediment to the discharge point, located within Lake Tanganyika, 300 meters away from the lake shoreline, and (2) store "harmful" sediment to the open-space land area, adjacent to the Port Bujumbura (i.e., Area B drawn in Figure 7.2), located within the port property. Water contained within those removed sludge was naturally drained and discharged through nearby channels back to the Port Bujumbura without any treatment.

Figure 7.2: High Risk Area of Heavy Metal Contamination around Port Bujumbura

It is highly likely that some parts of sediment inside of Port (Area A) contain toxic heavy metal components. Some sediments containing heavy metal were removed to Area B during the last dredging work conducted in 2008. No treatment such as the stabilization was taken so far.

Also, it was found that both the salvage work of wrecked vessels sunken in Port Bujumbura and UXO clearance around the jetty of Burundian Navy Base are not yet completed. It is reported that certain amounts of UXO, such as hand grenades, bullets (those lengths are varied between about 10 cm and 30 cm), and spent cartridges were retrieved from the bottom of the Bujumbura Port during the dredging work of Year 2008, particularly around the jetty of the Burundian naval base (i.e., Area C drawn in Figure 7.2). Photo 7.1 shows photo records of UXOs dredged from the port bottom. Accurately complied information for dredging points is not available. During the 2008 dredging work, full-scale mine clearance activities, such as reconnaissance and hazard assessment using electromagnetic metal detector, were not conducted prior to the dredging work. So, it can be concluded that some parts of Bujumbura Port are still contaminated with UXOs.

Hand Grenade

Bullet (1)

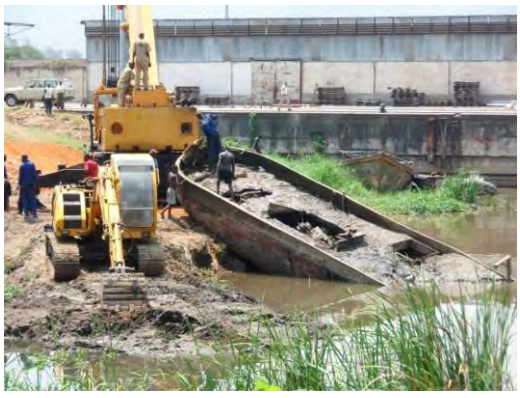
Spent Cartridge

Bullets and spent cartridges

Note that those remnants were retrieved during the dredging work of Year 2008.
[Courtesy of Clay Disposal, personal communication, 2011]

Photo 7.1: UXOs and Relevant Remnants Retrieved from Port Bujumbura

Several wrecked ships were salvaged during the last dredging work of 2008. Photo 7.2 shows the photo records of the salvage activities. Several ships are still wrecked inside of the Bujumbura Port and exact coordinates of those wrecked ship are unknown.



Note that several wrecked ships were salvaged during the dredging work of Year 2008.
[Courtesy of Clay Disposal, personal communication, 2011]

Photo 7.2: Ship Salvage at Bujumbura Port

8. Strategic Environmental Assessment

8.1 Alternative Evaluations

Strategic Environmental Assessment (SEA) studies are carried out for the developed port-sector master plan studies for Bujumbura and Rumonge. The alternative evaluations for the long-term master plan for Bujumbura and Rumonge Ports are conducted, based on both the engineering study results of this study and the current environmental and social conditions surrounding both ports. Table 8.1 and Table 8.2 summarize the alternative evaluation for the master plan layout of Bujumbura and Rumonge Ports, respectively.

Table 8.1: Alternative Evaluation for Bujumbura Port

	Alternative A	**Alternative B**	**Do-Nothing**
Social			
Local Traffic	Heavy traffic jam around the port.	Heavy traffic jam around the port.	Heavy traffic jam around the port.
More Employment Opportunities	High	High	N/A
Urban Planning	Easy to adapt for future growth of entire city (or would be key component for future regional infrastructure).	Easy to adapt for future growth of entire city (or would be key component for future regional infrastructure).	Not easy to adapt for future growth of entire city (or would be obstacle for future development).
Regional Growth	High potential to accelerate the growth of Bujumbura as the hub of regional transport and logistics system (note: need to establish integrated inter-state/or province transport system).	High potential to accelerate the growth of Bujumbura as the hub of regional transport and logistics system (note: need to establish integrated inter-state/or province transport system).	N/A
Regional Stability	High potential to lead regional stability, by improving regional infrastructure.	High potential to lead regional stability, by improving regional infrastructure.	N/A
Regional Economy			
Growth of International Trade	Accept more cargo ships, and then, lead to growth of cargo handling.	Accept more cargo ships, and then, lead to growth of cargo handling.	Existing port is narrow and would not match the growth of cargo handling.
Demolition of existing port facilities	Larger than Alternative B	Smaller than Alternative A	N/A
Possibility of Future Port Expansion	Partially limited.	Limited	N/A
Outside Investment	High potential to attract investment from outside.	High potential to attract investment from outside.	N/A
Environment			
Roadside Noise and Air Quality	Deterioration of roadside noise and air quality environment due to the circulation of future cargo trucks.	Deterioration of roadside noise and air quality environment due to the circulation of future cargo trucks.	Deterioration of roadside noise and air quality environment due to the circulation of future cargo trucks.
Soil Contamination	Risk of physical disturbance on deposits of dredged contaminated sediment due to the construction activity is high.	Risk of physical disturbance on deposits of dredged contaminated sediment due to the construction activities is high.	Risk of unexpected spreading of pollutants is high. Need treatment for dredged contaminated sediment.

	Alternative A	**Alternative B**	**Do-Nothing**
Sediment	Risk of physical disturbance on potentially contaminated sediment around the outlet of Buyenzi Canal is high.	Risk of physical disturbance on potentially contaminated sediment around the outlet of Buyenzi Canal is high.	Untreated city effluents is discharged directly to the port from Buyenzi Canal. Sometime, a lot of sediments are loaded into during flood events.
Water Quality	Temporal deterioration of port water quality due to construction.	Temporal deterioration of port water quality due to construction.	N/A
Overall Evaluation	Improvement of Bujumbura Port would be one of driving force to support regional development around Bujumbura. Proper EMP shall be established for the treatment of contaminated soils/sediments.		Existing port facilities will not match future growth of future cargo volume as well as the regional growth.

Source: This Study, 2012

Table 8.2: Alternative Evaluation for Rumonge Port

	Do Project	**Do-Nothing**
Social		
Local Traffic	Expect minor traffic jam around the port.	N/A
More Employment Opportunities	High	N/A
Regional Planning	Easy to adapt for future growth of entire region (or would be key component for future regional infrastructure).	Not easy to adapt for future growth of entire region (or would be obstacle for future development).
Regional Growth	High potential to accelerate the growth of Rumonge as the hub of regional transport and logistics system (note: need to establish integrated inter-state/or province transport system).	N/A
Regional Stability	High potential to lead regional stability, by improving regional infrastructure.	N/A
Regional Economy		
Growth of International Trade	International trade with Congo, Tanzania and Zambia may be improved.	N/A.
Outside Investment	High potential to attract investment from outside.	N/A
Environment		
Roadside Noise and Air Quality	Deterioration of roadside noise and air quality environment due to the circulation of trucks.	N/A
Water Quality	Temporal deterioration of port water quality due to construction.	N/A
Overall Evaluation	Port Rumonge Improvement Project would be one of driving forces to support future development of Rumonge Region.	Existing port condition will not match future growth of future regional growth.

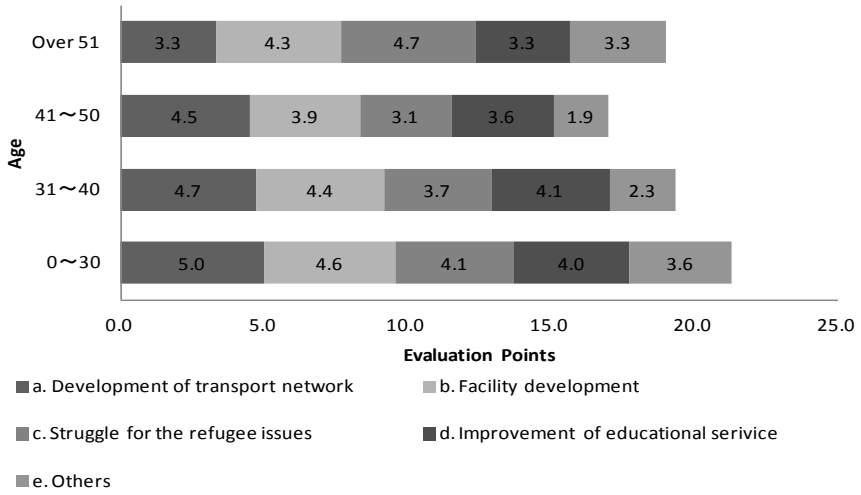
Source: This Study, 2012

Figure 8.1 shows the evaluation result of the sector-wide priority issues, obtained from this opinion survey, conducted at Rumonge region.

From this figure, it can be said that all generations evaluate that the priority of the development of the regional transportation network including the maritime transport and the improvement of social facilities, such as school, hospitals, are high.

Both ages under 30s and over 50s put more importance on the refugee-related issue, one of the critical regional issues with the DRC, compared with other generations. The younger generation seems to be concerned about the improvement of the educational service and, resultantly, gave more importance to them (4.1/5.0 for ages under 30s and 4.0/5.0 for those in their 30s).

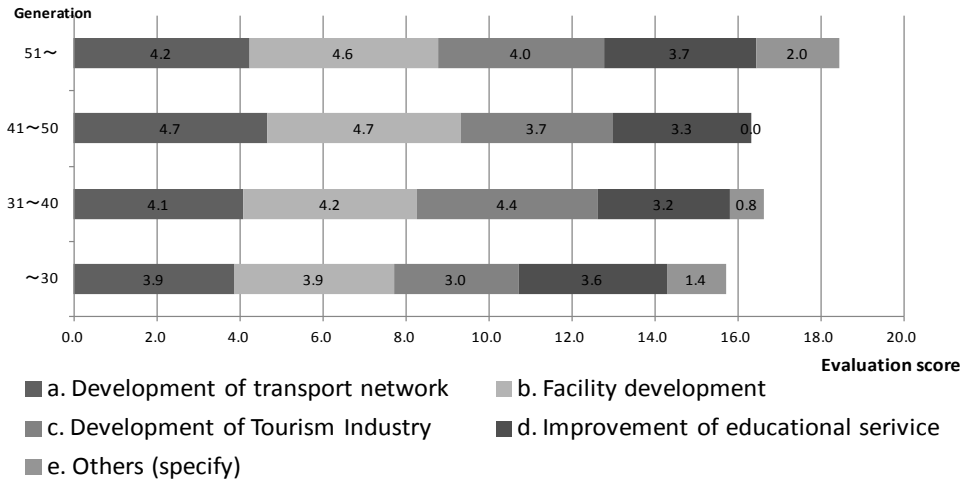
Also, from this study result, it can be said that the younger generation, under the age of 30, tends to feel the necessities for comprehensive regional development and/or improvement for Rumonge (the total evaluation score of each issue = 21.3/25.0) the most, followed by the generation of 30s and 50s (each total evaluation score of each issue are 19.2/25.0 and 18.9/25.0, respectively).



Note: total evaluation score by each generation are as follows, under 30s :21.3/25.0, 30s:19.2, 40s:17.0, over 50s: 18.9/25.0
Source: This Study, 2012

Figure 8.1: Priority Issue for Regional Improvement by Generation (Rumonge)

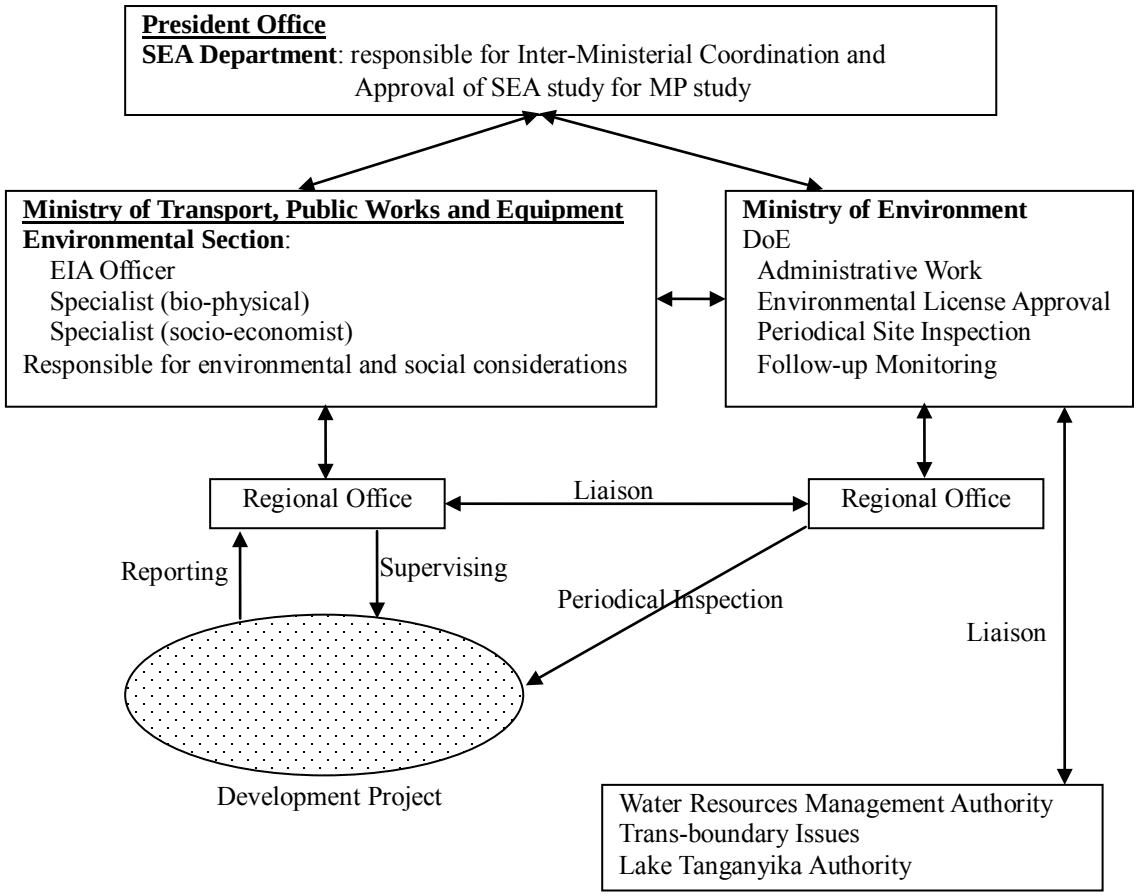
Figure 8.2 shows the evaluation result of this sector-wide priority issues obtained from this opinion survey conducted in Bujumbura. From this figure, it can be seen that the senior group (i.e., over 51) tends to show more comprehensive awareness to various issues (total evaluation score = 18.4/30) than the youngest group (total evaluation score = 15.8/30.0). Nonetheless, all generations show great concerns to the development of both transport network and public facilities.



Note: total evaluation score by each generation are as follows, Under 30: 15.8/30, 30s: 16.9/30, 40s: 16.3/30, over 50: 18.4/30
Source: JICA Study Team, 2012

Figure 8.2: Priority Issue to Be Improved in Bujumbura

Figure 8.3 shows the suggested environmental framework for the successful implementation of the proposed port improvement projects. The main role of the proposed SEA Section (depicted within this figure, not established within current governmental framework), belonging to the Presidential Office, is to arrange an inter-ministerial and sectoral coordination of a long-term, nationwide development policies/plans and/or program. All national master plans shall be developed and examined within this proposed SEA section, so more systematic and organized coordination among all master plans can be possible. Within this framework, competent ministries such as MoTPWE and MoE can work closely together while exchanging relevant information by establishing a good liaison between both ministries.



Source: This Study, 2012

Figure 8.3: Environmental Monitoring Framework for Development Project (Example)

9. Improvement of Maritime Transport on Lake Tanganyika

9.1 Improvement of Marine Transport

The current capacity of the Burundian fleet to transport break bulk cargo between Mpulungu Port and Bujumbura Port is estimated to be about 110,000 tons per year. The bottleneck of the transport capacity between the two ports is the limit of the loading capacity of cargo onto the ships at Mpulungu Port, as it only has a 20 m quay and, because of the narrow working space, only one gang of workers can be deployed.

Approximately 195,000 tons of the break bulk cargo per year can be transported by the current Burundian fleet. However, the demand of break bulk cargo will exceed this capacity in 2020, unless part of the break bulk cargo is containerized for loading efficiency. The containerization at Mpulungu Port needs one container berth and container handling equipment, like mobile container STS cranes and reach stackers. As a result, the Burundian fleet should put into service container ships plying between Bujumbura Port and Mpulungu Port as well as Kigoma Port .

- To promote lake transport, the port should consider the following for cargo handling equipment and facilities:
  - To install container STS cranes attached with a spreader and provide a container handling yard. Other ancillary equipment for container handling is to be provided.
  - To install slewing wharf cranes on break-bulk berth equipped with several types of buckets so that they can handle bulk cargo when necessary.
  - To provide finger-type forklifts to transport break bulk cargo, store them in the warehouses, and load/unload them onto/from trucks.
  - To further promote usage of pallets (except for cargo which is long in length or bulky) to augment the handling efficiency and reduce the damage to the cargo.

A modal shift among the lake, road, or railway transport has to be smoothly carried out. In particular, a modal shift between the ship and railway at Kigoma requires the operation timetables of both transport means to be adjusted and coordinated with each other to minimize the time loss in shifting the cargo. It is recommended to modernize the port facilities and cargo handling equipment for efficiency and introduce a computerized system to monitor the cargo movements.

9.2 Improvement of Marine Safety

The organization of BMPRA is not yet completed; as of August 2011 they had just begun to make a plan for marine safety. the BMPRA has many problems; there is not enough equipment to handle the BMPRA's duties and there is a lack of trained and organized staff. In actuality, the Navy vessels are mooring at Rumonge and Bujumbura in order to maintain safety.

In the territorial waters of Burundi, there have not been any serious accidents during the last 10 years. Serious accidents occurred in the territorial waters of DRC and they were caused by poor visibility, no visible navigation light, over-load, strong winds, dangerous cargo, etc. To avoid serious accident, a rescue system (organization, equipment, etc.) should be established. Suggestions are as follows:

- To build a safety communication system between navigating vessels and the BMPRA
- To enhance awareness of safety consciousness among the crew members of vessels
- To enhance awareness of the rescue work of BMPRA among the inhabitants on the Burundian shore
- To regularly conduct rescue trainings
- To possess a set of rescue gears

- Rescues shall be organized, reported and implemented as illustrated below:

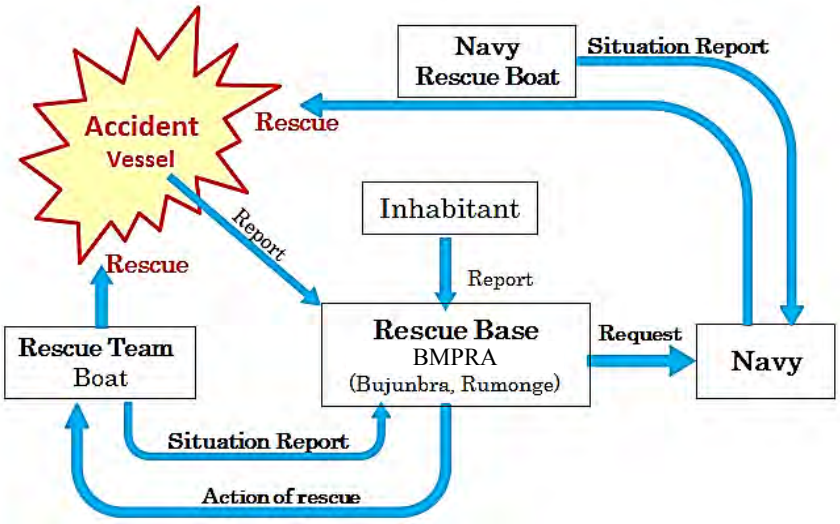


Figure 9.1: Rescue Flow

As the BMPRA has no rescue boats, they should acquire them as soon as possible. The required number of the rescue boats is three (3), one for Bujumbura Port, one for Rumonge Port, and the third one as a spare when the others boats are under maintenance or repair.

An investigation was conducted to check all lighthouses and beacon towers on the coast shoreline and it was determined that the existing beacons have become too old. The light is emitted by a non-LED bulb and the illumination "lux" has become dim. The existing beacons should be replaced by LED-lit higher towers. The results of investigation are as follows:

Table 9.1: Investigation Results

Location of Beacon	Description
Bujumbura (G reen) (Red)	• Green Beacon was broken and did not work. • Red Beacon is still working but the illumination lux is very low and very hard to see at night.
Magara (White)	• There is no beacon on top of the tower. It was stolen.
Rumonge (W hite)	• The beacon is working but the illumination lux is very low. • The beacon is positioned behind Rumonge Bay and not so high. Need to reconsider the positioning and elevation of the beacon light.
Nyanza-Lac (White)	• The beacon is still working but the illumination lux is very low. • The beacon is positioned on a cape but on private land. It should be built on government land. • High trees are blocking the beam of beacon's light.

10. Improvement of Cargo Handling

10.1 Bujumbura Port

The cargo handling equipment are well maintained and carefully operated even though they are aged and outdated. However, when their repairing becomes too costly or takes too long, they have to be replaced:

- Four shore cranes working at the general cargo berths should be gradually replaced with new cranes equipped with a shorter cargo boom and lower driver seat for easier

unloading operation. The new cranes should preferably be multipurpose for the convenience of the port operation as a whole.

- Five old 4.5 ton capacity forklifts, which were built in 1994 a nd 1995, should be replaced when its repair becomes too expensive.
- Shore crane for heavy cargo and containers, which was built in 1959 but now useless, should be also replaced.

It is necessary to rearrange the working area depending on the type of work. The dedicated area should be clearly marked by paint for appropriate management of the port area.

- Parking lot for trailers and trucks which are waiting for customs clearance should be provided.
- Working area for stuffing and un-stuffing work to/from containers should be provided around the warehouse and separated from other areas.
- Parking lot for a large passenger bus for immigration control should be provided at a distance from the cargo handling area. The parking area may be located at the eastern part of the port premises.

- Others to be improved are:
  - Waterproofing of roof and repair of doors
  - Storage management in warehouse
  - Safety training of laborers
  - Computerized inventory control

10.2 Cargo Handling at New Container Terminal

A mobile container STS crane should be employed to unload containers from the ship to the shore. Unloaded containers will be picked up by a reach stacker and placed onto chassis, which is pulled by a tractor head and moved to the designated slot of the stacking yard. Another reach stacker will off-load and stack containers at the stacking yard, as planned beforehand. Loading will be carried out in the same manner. One gang consists of the following equipment for one container ship:

- One mobile container STS crane
- Two reach stackers
- One tractor and chassis

To carry out proper stacking control and materialize accurate and agile response to consignee's tracing order of his containers, all the relevant information ranging from their unloading and loading to their gate-in and gate-out should be computerized. To acquire common information and data between the documentation team and operation team, LAN NET should be built.

Computerized storage control of containers is required at the container stacking yard, an operation system and data control should be computerized. Capacity building of the employees is also necessary.

10.3 Rumonge Port

Cooperation of the concerned agencies like local government, police, customs office, immigration control office, and quarantine office, etc. is indispensable. Prior to opening the port,

it is important to coordinate the procedures to investigate import and export cargo and control passengers to and from abroad.

- To meet the ship calls and cargo to handle, the port organization will consist of the following personnel:

Port master:	1
Document team:	2
Operation team:	1
Security man:	4
Total:	8

As arrival time and type and volume of cargo may not be obtained by use of telephone or internet, 4 security guards will ensure the security of cargo and ships of the port every day and night in 2 shifts. Working hours are limited from 08:00 to 17:00.

- The following charges can be considered as port tariff:
  - Harbor dues
  - Stevedoring charges
  - Open storage charges
  - Warehouse charges
  - Handling charges

11. Short-term Development Plan

11.1 Selection of Short-term Development Plan

- The following are selected as the short-term development projects:
  - Diversion of storm water canal
  - Construction of container terminal
  - Construction of ship repair facilities
  - Rehabilitation of the existing general cargo berth

(1) Diversion of Storm Water Canal

Unless diverted, 11.55 m^3/sec of storm water will run into the port basin and debouch sediments, sand, and debris. Maintenance dredging would have to be repeated to keep the port basin deep. In this regard, the storm water diversion, to prevent the port basin from getting shallow, is necessary.

(2) Construction of Container Terminal

TRL will start operation of one container block train between Dar es Salaam Port and Kigoma Port in 2015. It is estimated that transit containers will gradually increase to 361,000 tons in 2030 from 80,000 tons in 2015. This can be expressed in TEU as loaded transit containers will gradually increase to approx. 28,800 TEU in 2030 from approx. 6,400 TEU in 2015. To meet this demand, a container terminal should be built at Bujumbura Port.

(3) Ship Repair Facility

The slipway at Kigoma in Tanzania gives preference to Tanzanian fleet for repairing. The dry dock at Kalemie Port cannot be used by larger cargo ships of Burundian fleet because of its shallow navigation channel. At Bujumbura Port, there are 6 cargo ships, 4 tug lines, and one

tourism and research vessel each, totaling 10 ships, which are active and subject to annual inspection including underwater survey. In addition, there are 5 suspended cargo barges. It is necessary for the Burundian shipping industry to increase the lake transport capacity by deploying more ships in the future. The slipway is indispensable in order to inspect and repair these active ships. Additionally, it can be used to refurbish the suspended barges.

(4) Rehabilitation of General Cargo Berth

Regarding the exiting general cargo berths, deepening of the quay is required as the water depth is about 1.0 m shallower than its supposedly designed depth of 3.83 m. The difference is due to the discharged debris and soil from the storm water canal to the port basin. MV Teza, having maximum draft of 3.6 m at its fully loaded condition, cannot be accommodated at the berth with appropriate underkeel clearance. In addition, a proper fender system has to be installed to facilitate safe and faster berthing by the cargo ships, as all the fenders have been lost at the quay wall.

Installation of light beacons on the coast and procurement of rescue boats are considered necessary for safe navigation on Lake Tanganyika.

The general layout of the short term development plan in Bujumbura is shown in Figure 11.1.

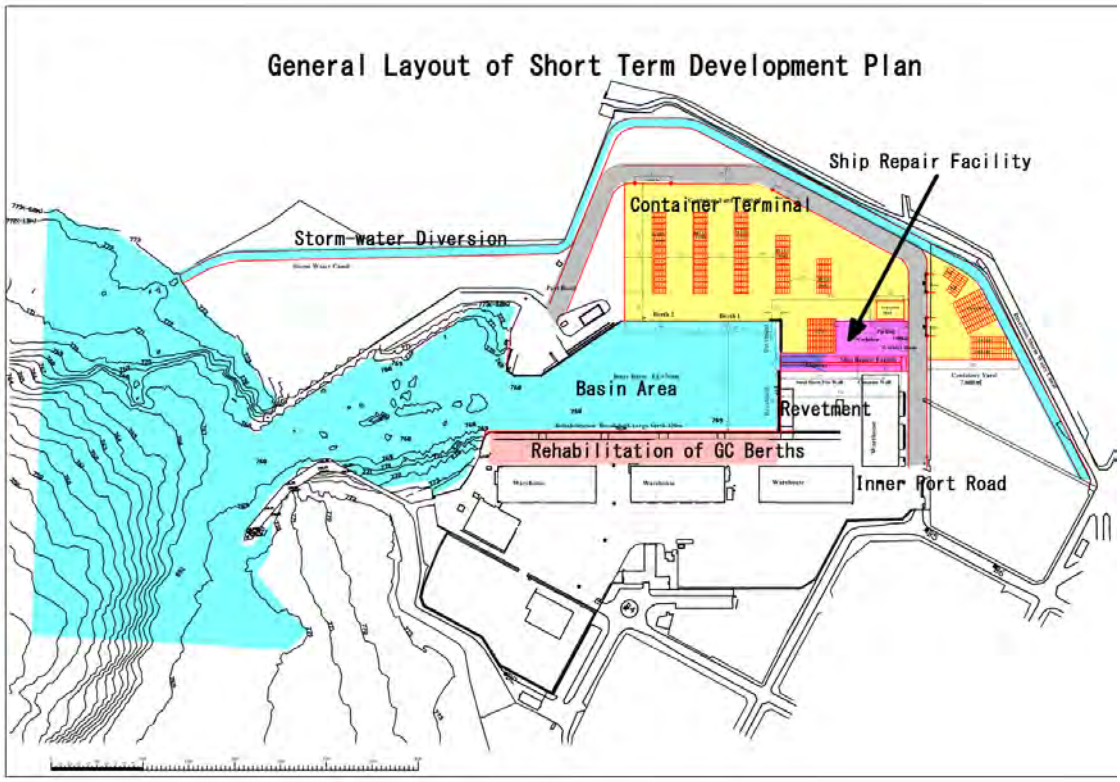


Figure 11.1: General Layout of Short Term Development Plan in Bujumbura

At Rumonge, the berthing facility is necessary to improve the cargo handling by providing an appropriate berthing facility for the small wooden cargo ships, so that effective cargo landing can be materialized and the workers' burden can be decreased. In addition, the facility can meet the possible increase of cargo. Layout of development plan in Rumonge is shown in Figure 11.2.

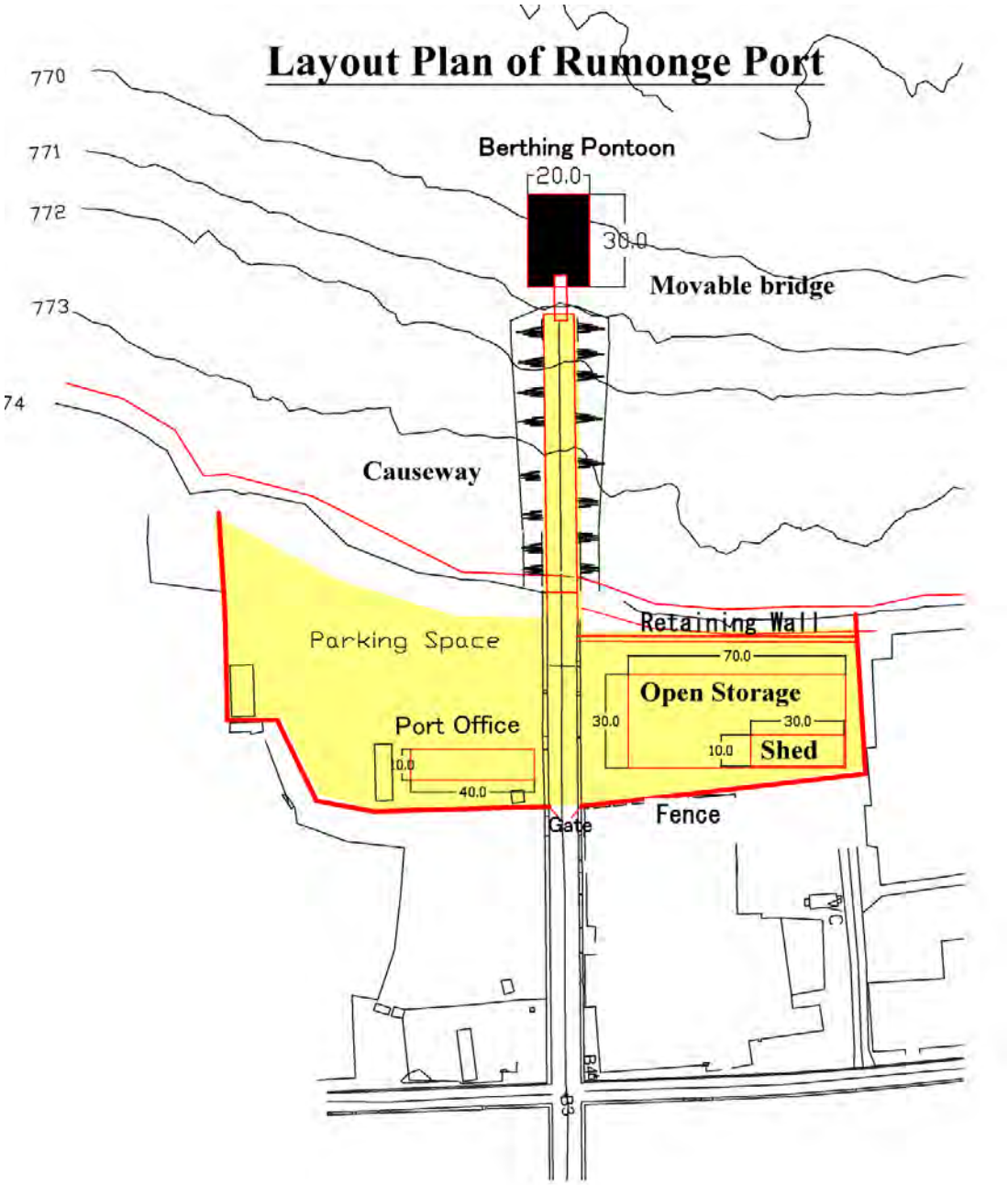


Figure 11.2: Development Plan in Rumonge

Preliminary design of the port facilities of Bujumbura Port and Rumonge Port are carried out and their main features are shown in Appendix.

11.2 Implementation Schedule

There will be three (3) project components to be completed until 2015, i.e., Diversion of Storm Water Canal, Construction of Container Terminal, and Construction of Ship Repair Facility. The construction schedule is worked out on the assumption that one contractor will carry out the works of all the project components. It is estimated that the construction works will need 17 months in total as shown in Figure 11.3:

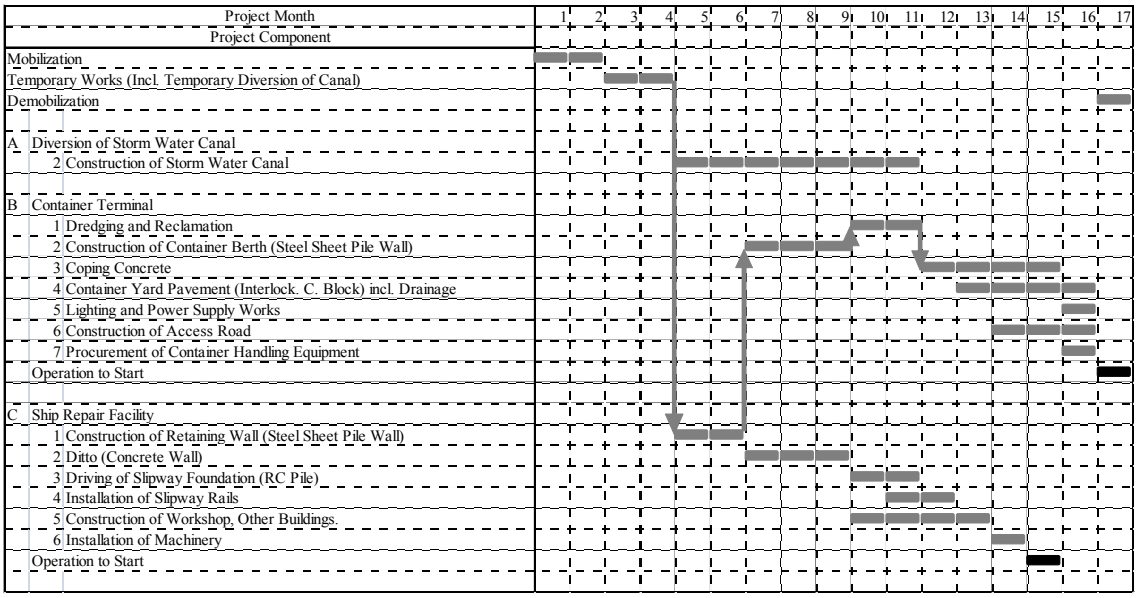


Figure 11.3: Construction Works Schedule

As the submission of the Final Report is scheduled in May 2012, the schedule for project implementation is worked out from this month.

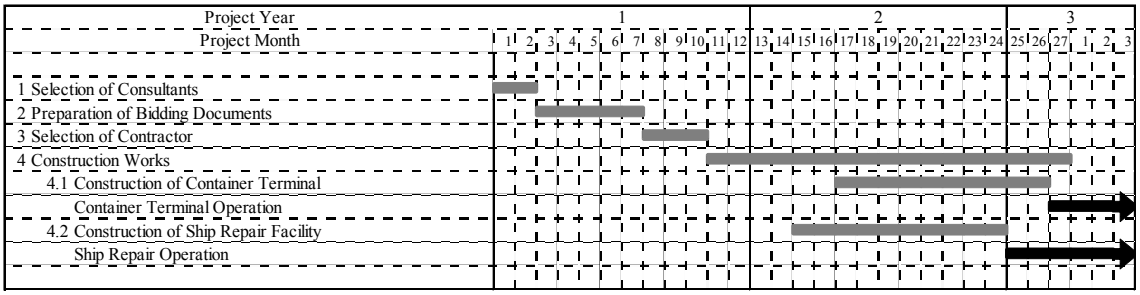


Figure 11.4: Project Implementation Schedule

11.3 Cost Estimation

Construction cost and equipment procurement cost are summarized in Table 11.1.

Table 11.1: Construction Costs at Bujumbura Port

		USD	Remarks
1	Diversion of Storm Water Canal	2,057,748	
	a. Earth Work	287,872	
	b. Culvert	1,295,011	
	c. General Expenses	474,865	30% x (a+b)
2	Dredging of Port Basin	974,688	
	a. Direct Cost	749,760	
	b. General Expenses	224,928	30% x (a)
3	Constructing of Container Terminal	18,139,340	
	3.1 Container Berths	6,240,000	
	a. Steel Sheet _Pile Wall	2,580,000	
	b. Coping Concrete	1,160,000	
	c. Bollards & Bits	80,000	
	d. Rubber Fenders	810,000	
	e. Back Filling	170,000	
	f. General Expenses	1,440,000	30% x (a. - e.)
	3.2 Apron	1,136,549	
	a. Sub grade works	34,744	
	b. Sub base course	67,950	
	c. Concrete pavement	733,605	
	d. Joint	37,970	
	e. General Expenses	262,280	
	3.3 Container Yard and Drainage	5,457,153	
	a. Container Yard	4,037,810	
	b. Drainage	160,000	
	c. General Expenses	1,259,343	30% x (a. - c.)
	3.4 Steel Sheet Pile Wall	4,290,000	
	a. Steel Sheet Pile Wall (1)	600,000	Temporary Coffer Dam
	b. Steel Sheet Pie Wall (2)	2,170,000	Slipway Wall
	c. Coping Concrete	380,000	
	d. Backfilling	150,000	
	e. General Expenses	990,000	30% x (a. - d.)
	3.5 Inner Port Road	1,015,638	
	a. Sub grade works	35,880	
	b. Sub base course	135,894	
	c. Asphalt pavement	609,140	
	d. General Expenses	234,724	30% x (a. - c.)
4	Ship Repair Facility	6,957,000	
	5.1 Civil Construction Works	1,547,000	
	a. Earth Works	120,000	
	b. Pre-cast RC Piles	570,000	
	c. R.C. Beams	230,000	
	d. Concrete Upright Wall	120,000	Retaking Wall
	e. Concrete Wall	70,000	Slipway Embankment
	f. Winch House	80,000	
	g. General Expenses	357,000	30% x (a. - f.)
	5.2 Slipway (Rail, Equipment)	5,410,000	
	a. Slipway Rail	1,433,000	
	b. Workshop	1,411,000	
	c. Machining Tools	597,000	

			USD	Remarks
		d. Cranes, Painting Tools, Spare Parts	926,000	
		e. Welders, Spare Parts, etc.	210,000	
		f. Supply, Consumables	833,000	
				Cost Total excl. VAT
a	**Construction Cost Total incl. VAT(18%)**		**28,128,776**	**23,837,946**
	breakdown			
b	1	Direct Cost	18,594,806	b=a-(c+d)
c	2	General Expenses	5,243,140	Σ(1-4)of General Expenses
d	3	VAT	4,290,830	(1-1/1.18)x a

Table 11.2: Procurement Cost of Container Handling Equipment

Equipment	Capacity	Unit	Price (USD)	Amount (USD)
Mobile Container STS Crane	35 ton at 19 m radius	2	3,000,000	6,000,000
Reach Stacker	35 ton, 3 tiers for loaded and 4 tiers for empty	2	950,000	1,900,000
Multi-purpose Forklift	3–5 ton	2	60,000	120,000
Tractor Head		5	140,000	700,000
Terminal Chassis		7	78,000	546,000
Total				9,266,000

Table 11.3: Construction Cost of Ship Repair Facility

Facility Name			
1. Slipway	**No.**	**USD**	**Note**
Rail	1	275,000	
Cradle with wooden bed	12	330,000	
Lifting Winch	1	344,000	
Wire (Lifting)	1	138,000	
Wire (Lowering)	1	28,000	
Sheave Block	2	55,000	
Chain/Stopper	8	110,000	
Lighting	1	25,000	*
Additional Spare Parts (3-years)	1	44,000	
Miscellaneous		84,000	
Sub Total		1,433,000	

2. Workshop	**No.**	**USD**	**Note**
Factory	1	1,000,000	*
Exhaust Fan/Duct	1	25,000	*
Office	1	63,000	*
Workers Room	1	63,000	*
Generator/Pump Room	1	13,000	*
Gas Bottle Room	1	13,000	*
Lighting	1	50,000	*
Additional Spare Parts (3-years)	1	61,000	*
Miscellaneous		123,000	
Sub Total		1,411,000	

3. Machining Tools	**No.**	**USD**	**Note**
Lathe	1	206,000	
Milling Machine	1	138,000	
Drilling Machine	2	55,000	
Grinder	1	14,000	
Pipe Bender	1	21,000	
Pipe Cutter	1	7,000	
Electric Saw	1	7,000	
High Pressure Cleaning Mach.	1	8,000	
Forklift	2	28,000	
Chain Block	4	28,000	
Hydro Oil Jack	2	6,000	
Measuring Equipment	1	14,000	
Additional Spare Parts (3-years)	1	23,000	
Miscellaneous		42,000	
Sub Total		597,000	

4. Crane etc.	**No.**	**USD**	**Note**
Jib Crane(Fixed)	1	550,000	
Crane Post	1	28,000	
Mobile (Truck) Crane	1	138,000	
Overhead Crane (work shop)	1	48,000	
Painting Tools	4	50,000	*spray, power tool
Additional Spare Parts (3-years)	1	38,000	
Miscellaneous		74,000	
Sub Total		926,000	

5. Welding	**No.**	**USD**	**Note**
Arc Welder	10	69,000	
Gas Welder	10	69,000	
Gas Cutting Machine	8	55,000	
Cable for Welder	20	14,000	
Additional Spare Parts (3-years)	1	1,000	
Miscellaneous		2,000	
Sub Total		210,000	

6. Supply/Consumables	**No.**	**USD**	**Note**
a. Electric			
Diesel Driven Generator	2	413,000	220ps, 160 kw × 2
Switch Board	1	28,000	
Transformer	1	69,000	
Cable	1	28,000	
Additional Spare Parts (3-years)	1	28,000	
Miscellaneous		33,000	
b. O2			
Bottle	30	38,000	*
Piping	1	25,000	*
c. Fresh Water			
Pump	2	28,000	1-pump stand

6. Supply/Consumables	No.	USD	Note by
Piping	1	13,000	*
d. Comp. Air			
Air Compressor	1	28,000	
Reservoir	1	25,000	
Piping	1	13,000	*
e. Gas			
Gas Bottle	30	38,000	*
Piping	1	13,000	*
Miscellaneous		13,000	
		833,000	

Total	**5,410,000**

Table 11.4: Rehabilitation Cost of General Cargo Berths

Rehabilitation of General Cargo Berths	UD$	Remarks
a. Fitting of Rubber Fenders	1,920,000	V- H250, L = 3.5 m
b. Fitting of Rubber Fenders	210,000	DD-300HW, L = 2.0 m
c. Reinstallation of Crane Rails	160,000	
d. Elavating of Apron	998,000	50 cm at Quay Face
Rehabilitation of G.B Berths Total	3,288,000	

Table 11.5: Construction Cost of Rumonge Port

No.	Item	Spec.	Unit	Quantity	Unit Price	Amount	Amount
					USD	USD	000 USD
	Rumonge Port Development						
1	**Earthwork**		Ls	1.0			232
1-1	Temporary Works		m^2	4,477.5	3.34		15
1-2	Filling Work		m^3	6,369.3	32.33		206
1-3	Open Storage & Gravel pavement Work		m^2	2,100.0	3.68		8
1-4	Earth retaining Work		M	33.0	95.57		3
2	**Retaining Wall**		Ls	1.0			158
2-1	Foundation works		M	90.0	599.67		54
2-2	Masonry retaining wall Work		M	90.0	379.70		34
2-3	Shore Protection work		m^2	315.0	222.48		70
3	**Causeway**		Ls	1.0			630
3-1	Mound foundation Works		m^3	2,900.7	78.81		229
3-2	Filling Work		m^3	1,504.3	97.15		146
3-3	Armor stone Work		m^2	1,101.3	170.71		188
3-4	Concrete pavement Work		m^2	960.0	69.93		67
4	**Berthing Pontoon**		Ls	1.0			3,128
4-1	Pontoon Production / Installation		Unit	48.0	46,000.00		2,208
4-2	Pontoon Transportation		f/t	1,170.0	700.00		819
4-3	Movable ramp		Ls	1.0	59,000.00		59
4-4	Ramp transportation		f/t	60.0	700.00		42
5	**Building Works**		Ls	1.0			550
5-1	Shed (Steel 1F)		m^2	300.0	533.58		160
5-2	Port Office (RC2F)		m^2	400.0	975.17		390
	SUB TOTAL	Σ (1–5)					4,698
	General Administration Expenses		%	30			1,409
	TOTAL						6,107
	VAT		%	18			932
	Total Cost without VAT						**5,176**

11.4 Financial Analysis

The following 6 Cases based on variations of funding source (ODA or the private investment) are analyzed.

Table 11.6: 6 Funding Source

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Container Terminal (Civil Works)	Private	✓	✓	✓	✓	✓
Container Terminal (Equipment)	Private	Private	Private	Private	✓	✓
Ship Repair Facility (Civil Works)	Private	✓	✓	None	✓	None
Ship Repair Facility (Equip. & Workshop)	Private	Private	✓	None	✓	None
Diversion of Storm Water Canal	Private	✓	✓	✓	✓	✓

Notes: 1) ✓ indicates finance is shouldered by public sector.
2) " Private" indicates a private finance.
3) " None" indicates project is not implemented.
4) Dredg ing works are not shown in the table, as it should accompany container terminal construction.
5) Operati on & maintenance is assumed to be done by a pri vate sector using its own financial resource

Total project cost (total capital expenses and operation expenses), total revenue and FIRR in each case are calculated and summarized in Table 11.7.

Table 11.7: Total Project Cost and IRR

Unit: BIF

	Total Capex (Public)	Total Capex (Private)	Total Opex (Private)	Total Revenue (Private)	Net Cash Flow (Private)	IRR (Private)
Case 1	0	60,766,848,895	146,608,328,194	177,335,065,520	▲ 30,040,111,569	*Negative (impossible calculation)*
Case 2	40,528,392,895	20,238,456,000	146,608,328,194	177,335,065,520	4,884,432,403	*1.91%*
Case 3	47,794,448,895	12,972,400,000	146,608,328,194	177,335,065,520	10,088,662,327	*5.37%*
Case 4	30,782,744,407	12,972,400,000	88,008,344,695	113,192,809,366	5,501,703,150	*4.07%*
Case 5	60,766,848,895	0	146,608,328,194	177,335,065,520	19,205,030,551	*Positive (impossible calculation)*
Case 6	43,755,144,407	0	88,008,344,695	113,192,809,366	14,834,972,750	*Positive (impossible calculation)*

Source: JICA Study Team

- Results of the financial analysis of each case are as follows:

  Case 1: This case could be not realistic. To secure decent financial return (FIRR 15%), tariff level should increase almost 5.3 times more than the current level.

  Case 2: Financial burden on the private sector is still significant. To secure decent financial return, tariff level should increase almost 2.2 times of the current level.

  Case 3: Total operation expenses are significant. To secure decent financial return tariff level should increase almost 1.6 times more than the current level.

  Case 4: This case does not generate the cash flow required to invest private portion. To secure decent financial return, tariff level should increase almost 1.6 times more than the current level.

  Case 5: Profitability of the project is quite high. Public will bear a large amount of financial provision for initial costs (capital expenses). Tariff level does not have to increase from the current level. Cash flow in private could get a margin to pay concession fee to public from the profit during the project period.

  Case 6: Profitability of the project is quite high. Public will have a moderate financial burden for initial costs (capital expenses). Tariff level does not

have to increase from the current level. Cash flow in the private sector could get a margin to pay concession fee to the public from the profit during the project period.

To satisfy financial requirements, grants from the donors could be possible options. In the decision making process for the provision of grants, the total project costs, including operational expenses which would be borne by the private sector, should be adequately taken into account.

Taking the current tariff levels (together with traffic volume risk) into account, it could not be expected that a large amount of investment from the private sector will be made easily. In other words, in only a case where concessionaires judge that certain traffic volume and proper tariff levels can be secured, they could make a decision for a capital investment upon counting future profits which would be generated from the later stage of cash flow.

In all cases which concessionaires expect to invest for infrastructure (Case 1, 2, 3 and 4), financial feasibility cannot be verified. This is largely due to the low level of the current tariff structure and traffic volumes. Therefore, either Case 5 or Case 6 is proposed in which all facilities are financed by grants, and the tariff should increase gradually, considering the current trend of inflation.

12. Selection of Urgent Projects

12.1 Candidate Projects

The container terminal should be built independent of the existing port facilities, as containers and break bulk cargo cannot be handled at the same handling yard.

The ship repairing facility is necessary to be built in, or before, 2015, as cargo ships and barges, 8 vessels in total, have to be in full operation to meet the cargo demand in 2015. Their annual inspection including underwater survey has to be timely conducted without interruption. Meanwhile, the slipway at Kigoma puts preference to the Tanzania fleet of vessels and the Kalemie Dry Dock has a navigation channel which is too shallow for the cargo ships of the Burundian fleet to navigate.

The diversion of the Buyenzi Canal is important to economically operate Bujumbura Port by reducing the maintenance cost. Without the diversion of this storm water canal, the quay wall of the container terminal will get shallower and the slipway of the ship repairing facility will get embedded in the sediments.

The rehabilitation of the general cargo berth is necessary to ensure the operation even at the time of the highest water recorded in 1964 and to avoid damages of ships when berthing.

As many fishing boats are utilized during night and early morning, light beacons with proper luminance should be installed. They would also enable Bujumbura Port to meet the cargo increase which may need night navigation.

It is necessary to keep one rescue boat each at Bujumbura and Rumonge and to cover the entire Burundian coast. Three boats are necessary which includes one spare boat.

The construction of a jetty consisting of a causeway and berthing pontoon at Rumonge Port is necessary to reduce burdens of workers currently carrying cargo on their shoulders and wading between the shore and ships.

The above-mentioned project accompanied with their completion year and procurement cost are summarized in Table 12.1:

Table 12.1: Candidate Projects with Cost and Target Year

Year	Urgent	2015	2020	2025	Remarks
Project Components					
1 Container Terminal					As a container block train will be operated from 2015, at least one container berth with a container stacking yard and container handling equipment has to be built on or before 2015. Container handling equipment should be purchased by the public sector for the concessionaire.
1.1 1st Berth including CY		✓			
(Cost, million US$)		6.8			
1.2 2nd Berth including CY			✓		
(Cost, million US$)			6.8		
1.3 Handling Equipment		✓			
(Cost, million US$)		9.3			
2 Storm Water Diversion		✓			Storm Water Diversion has to be built at the same time with container terminal construction.
(Cost, million US$)		1.7			
3 Ship Repair Facility					To meet container cargo demand from/to Kigoma Port, 3 container ships will be put into service in 2015. To ensure their regular service, Ship Repair Facility has to be built in 2015. Workshop quipped with machinery should be built by the pulic sector for teh concessionaire
3.1 Slipway		✓			
(Cost, million US$)		4.9			
3.2 Workshop with Equipment		✓			
(Cost, million US$)		5.1			
4 Rehabilitation of G. Cargo Berths				✓	Exiting general cargo berths can be rehabilitated after container berths fully be operated to reduce burden of break bulk cargo.
(Cost, million US$)				4.5	
5 Installation of Light Beacons	✓				This concerns navigation safety as well as the means to increase lake transport capacity by enabling night navigation.
(Cost, million US$)	1.3				
6 Procurement of Rescue Boats	✓				This is concerned with safety of navigation
(Cost, million US$)	0.2				
7 Development of Rumonge Port				✓	Development is intended to ease cargo handling between shore and small cargo ships.
(Cost, million US$)				5.2	
Total Cost (million US$)	1.5	27.8	6.8	9.7	

Notes: 1) Cost of 1st Berth and 2nd Berth are assumed 50% of total construction cost of container terminal.
2) Technically, construction of 2 berths by one contractor is more economical. In project implementation, therefore, 2 berths are assumed to be constructed under one project.

12.2 Environmental Scoping of Candidate Projects

The official EIA study to be required for the environmental license application is to be conducted by the Government of Burundi after the basic design of selected short-term projects are finalized. Meanwhile, some of the important environmental studies, summarized in Table 12.2, are conducted within this JICA Study.

Table 12.2: ToR of Environmental Study for Selected Short-term Projects

Factors	Evaluation	Topics	Methodology	Implementation
Air Quality	B/B	1. Baseline roadside A/Q 2. Impact Prediction during construction/operation phases	1. Baseline data collection 2. Field Survey. 3. Impact prediction	To be conducted within EIA Study.
Water Quality	A/B	1. Baseline W/Q 2. Impact Prediction during construction/operation phases	1. Baseline data collection. 2. Field Survey 3. Impact Prediction	Preliminary W/Q surveys is conducted within JICA Study.
Soil Contamination	A/D	1. Baseline soil and sediment contamination condition. 2. Collect past dredging and sediment treatment records. 3. Impact evaluation during construction/operation phases.	1. Baseline data collection. 2. Field Survey 3. Impact Prediction	Preliminary soil survey is conducted within JICA Study. Comprehensive Soil and Sediment surveys are to be conducted within EIA study.
Waste	A/D	1. Estimation of amount of construction wastes to be generated by earthwork of contaminated soil (e.g., Construction of Container Berth and Yard). 2. Selection of proper treatment of contaminated soil.	1. Estimate of Construction wastes, in particular, amount of construction wastes to be generated by earthwork of contaminated soil. 2. Treatment methods of Construction wastes in Burundi. 3. Selection of proper treatment of contaminated soil.	To be conducted within EIA Study after basic design of relevant facilities are finalized.
Noise/ Vibration	B/B	1. Baseline roadside noise/vibration 2. Impact Prediction during construction/operation phases	1. Baseline data collection. 2. Field Survey 3. Impact Prediction	To be conducted within EIA Study.
Accidents	B/B	1. Study future traffic accidents during operation phase	1. Establish traffic safety program for construction workers.	To be conducted within EIA Study.
Stakeholder Meeting		Conduct one stakeholder meeting at Bujumbura and Rumonge, respectively after selection of short-term projects.	Conduct stakeholder meetings at Bujumbura and Rumonge at late March and early April, 2012 after short-term development projects are selected.	To be conducted within JICA Study. Follow-up stakeholder meetings shall be conducted within EIA Study.

Note: A: significant, B: major, C: minor, D: less significant, U: Unknown, (Construction / Operation)
Source: JICA Study Team, 2012

No nickel, cadmium, chrome, arsenic, or mercury was detected within this study. Also, maximum values of zinc (Zn), copper (Cu), manganese (Mn), and lead (Pb) are 26.8, 5.65, 115.0, and 4.5 mg/kg, respectively. Compared with relevant environmental standard of soil, those values are smaller than those standards (e.g., environmental standard for lead is of 150 mg/kg). However, within this study, the soil parameter, PCB, and others conducted in past CTB study were not included due to the budget restriction.

The current water at Bujumbura and Rumonge Ports is of relatively good quality. It is noted that the water quality conditions around the outlet of Buyenzi Canal (B1), tend to be the worst due to the direct discharge of effluents of untreated sewerage, generated around the upstream side of this canal.

Based on post-meeting survey of the stakeholder meetings at Bujumbura and Rumonge, it was found that most of attendants showed positive attitudes to both port improvement projects. Also, it was found that they understood the concept of JICA Guideline for environmental and social considerations. Successive stakeholder meetings, in order to achieve more wide-spectral project consensus, are recommendable.

PCB, detected in previous CTB sediment survey, was not included due to the budget restriction. It would be essential to have more detailed soil survey, abiding by relevant anti-soil contamination laws and/or regulation such as that of Japan, and grasp the precise distribution of contaminated soils. It is very important to carry out more detailed sediment survey in order to check the existence of heavy metals that were detected in previous study.

It is essential to establish an environmental management program regarding the treatment of the contaminated soils, groundwater, and sediments after the basic design of both the container yard and diversion of the storm water canal are finalized in order to minimize the risk of the spreading of contaminated substances.

It is expected that the hippopotamus inhabiting in the area would relocate to nearby grassland area during and/after the implementation of the proposed port improvement project.

Monitoring frameworks for groundwater, water quality, and sediment shall be designed around the project site, in particular, the proposed dredging site of Bujumbura Port and water bodies such as tributaries and/or lake, located in adjacent area of both the future waste disposal site and reclaimed site. It is better to initiate relevant study after the basic design and the construction schedule of the entire port improvement project are delineated.

The risk of partial and/or complete closure of the outlet of the proposed storm water diversion outlet, due to the rapid sediments conveyed by the flood events of the Ntahangwa River, cannot be ignored. Comprehensive precautions as well as the periodical inspection of the diversion are essential for the smooth discharge of the storm water through the proposed diverted channel.

12.3 Conclusions and Recommendations

- Conclusions with respect to the port development in near future are as follows:
    1. The urgent projects are installation of light beacons and procurement of rescue boat for safe lake transport
    2. Container terminal has to be built to cope with the container transport on the lake in 2015, when a daily operation of a container block train between Dar es Salaam and Kigoma is commenced.
    3. Ship repairing facility has to be built to maintain the Burundian fleet of ships to cope with the cargo increase, particularly to maintain container ships which need daily operation.
    4. To materialize construction of the container terminal and ship repairing facility, it is necessary to divert the storm water canal currently flowing into the port basin.
    5. Rehabilitation of the existing general cargo berths is needed to cope with both the highest and the lowest water level of the lake. However, the rehabilitation can be carried out after the container terminal is completed.
    6. Execution of the Rumonge Port development mainly depends on political decisions. It should be carried out when sufficient funding is available.

- Recommendations for the development of the ports of Burundi are summarized below:
    1. To urgently install light beacons and procure rescue boats for safe navigation.
    2. To divert the storm water canal to construct container terminal and ship repair facility
    3. To construct the container terminal in, or before, 2015. To construct 1 b erth with minimum stacking yard only, if fund is not sufficient to complete 2 berths accompanied with their stacking yard,. It is recommendable that container handling equipment be procured by the public sector.
    4. To construct the ship repair facility in, or before, 2015. The public sector should build the slipway and workshop and procure necessary machinery and equipment.
    5. To rehabilitate the general cargo berths after the container terminal is completed.
    6. To develop Rumonge Port when the political decision is made and the fund becomes available.

13. Concession of Bujumbura Port

13.1 BMPRA (Burundi Maritime, Port and Railway Authority)

The Supervisory Board should be established without delay in BMPRA. Special attention should be given to the organization of the Port Authority. In the landlord port model, normally a distinction is made between two divisions in the Port Authority, namely the Nautical Division and the Operations-Finance division.

The nautical division takes care of the vessel management in the port and the access channels to the port. The objective of the nautical division is to guarantee efficient, secure, and safe handling of all ships (e.g. dangerous goods) in the port and in the access channels to the port. The Nautical Division is managed by the Harbour Master, who will be responsible for the port related nautical issues within the Maritime Authority.

There should be a clear regulation with regards to the position of the office responsible for the security of ports and nautical access. As BMPRA was established in January 2012, such office has not been clearly organized. BMPRA should organize the office responsible for the security under the mandate of the Harbour Master for the port related nautical issues.

The Finance and Operations divisions are responsible for all commercial, technical, operational, administrative, and financial aspects in the port. Currently, there is a separate unit in the BMPRA that is responsible for Administration and Finance; there is no need to have an Administration and Finance department in the Port Authority.

Three major skills are required namely commercial, technical, and operational skills. The commercial staff will be responsible for the commercial relations with the port users (vessel owners, shippers etc.) and the port operator. The technical skills will be very important specifically for the implementation of the Master Plan that will result in major nautical and infrastructure developments. These skills support the maintenance efforts within the port. The operational skills will support the commercial and technical skills. Within Finance and Administration additional, however limited, recruitment is required. The establishment of the Harbour Master's function within the Maritime Authority demands the development of the nautical skills.

The concession payments from the Port Operator should be collected by the BMPRA, who needs cash inflow to take care of its obligations as the Landlord of, namely, the nautical access and the infrastructure developments. The grants that potentially could be received from the donors for funding the development of the Master Plan should be transferred to the BMPRA as well. The Administration and Finance division should have the responsibility for allocating these funds properly.

The Management of the BMPRA has to develop a business plan for the next 10 to 20 years and a major component of the Business Plan is the Master Plan that supports the business plan. The Business Plan should also be in line with the mission statement and the respective roles and tasks of the organization as formulated in the Presidential Decree. The Business Plan should be supported by an implementation plan that also takes into consideration the recommendations as formulated in the to-be position.

13.2 Concessionaire

The new concession contract must be drafted according to the current international standards and must be consistent with (i) the objective of the Burundi's State, i.e., a logistic platform and (ii) the nature and level of investments to be made by the State of Burundi, in particular, on the basis of any grants and by the forthcoming investors/concessionaire.

The concession contract, which will have to be attached to the call for tenders, must be clear in all its aspects, especially in regard to investments, maintenance, status of the infrastructures, superstructures, assets and equipment to be operated, indemnification and compensation at the end of the concession or in case of early termination, royalties to be paid to the conceding party, and fixing of the tariffs.

Concerning the form of the new concession contracts, an option is offered to the Government: the first option consists of a sole and unique agreement containing both the specific and the general terms and conditions. The second option consists of considering the specific terms and conditions as the concession agreement, and the general terms and conditions as the exhibit to the specific terms and conditions. The general terms and conditions shall contain provisions that cannot be negotiable during the bidding process, whereas, the specific terms and conditions will be adjusted in order to take into account the winning bidder's offer.

The tender process and tender documents will be guided by the following three principles.

Operations: It is not acceptable that the operations be disrupted as result of the tender process. Continuation of the operation of the port should always be guaranteed.

Competition: The tender process should introduce competition allowing multiple potential operators to participate in the public tendering and provide competitive offers.

Landlord Port Model: Critical success factor for implementing a landlord model is the creation of a Port Authority which has been already achieved in Burundi. Landlord model specifies the obligation of the Port Authority to invest in maritime access and infrastructure (dredging, quay walls, internal roads, utilities, etc.) and the private operator to invest in superstructure (pavement, warehouses, etc.) and equipment.

Option 1 (Value Driven Deal) is driven by the potential decision by a potential donor to allow substantial grants for developing the port of Bujumbura. GOB can include in the bidding documents for concession, if such financial assistance is ensured, the condition that the projects shall be implemented by GOB by use of financial assistance committed by such donor. Option 2 (Transaction Driven Deal) is driven by transaction deal. It suggests that the public tender procedure should be started up without delay allowing getting the new concession contract to be signed in December 2012. With the objectives and guiding principles of the transaction taken into account, Option 1 is preferable, which allows incorporating the potential financial assistance from a potential donor based on the results of this Study.

The exit of the State of Burundi from the share capital of E.P.B., either through a sale of its shares to existing shareholders or the annulment of its shares, is recommendable. Whatever the option to the chosen for the transaction by the Government, the best and most acceptable scenario in a concession transaction is that the State should only be the conceding party, either directly or indirectly, through the Port Authority. Being the conceding party, the Government should not be a shareholder of the operator. Such situation will always result in conflict of interests.

Nevertheless, in many countries, the government has minor share of the capital of an operator to encourage the private sector to participate in port operation. In this regards, the Government of Burundi has decided to own 10 % of the share of a new operator to be selected.

Appendix: Preliminary Design of Port Facilities

(1) Facilities of Bujumbura Port

A.1 Diversion of Storm Water Canal

The volume of storm-water in the port from Bujumbura urban area is 11.55 m^3/sec, which is the design flood water amount at the point of entrance canal into the Port.

Design Flood Water mount	11.55 m^3 / sec.
Length of Canal in the Port	1,245 m
Bottom height at the entrance	EL+776.3 m
Bottom height at the outlet	EL+775.6 (=HWL)
Gradient of the Canal	0.056 %
Width of Canal	4.5 m as of assumption of 1.5 m water depth
Flow velocity	1.78 m/sec
Critical depth	0.88 m/sec
Normal depth	1.44 m/sec

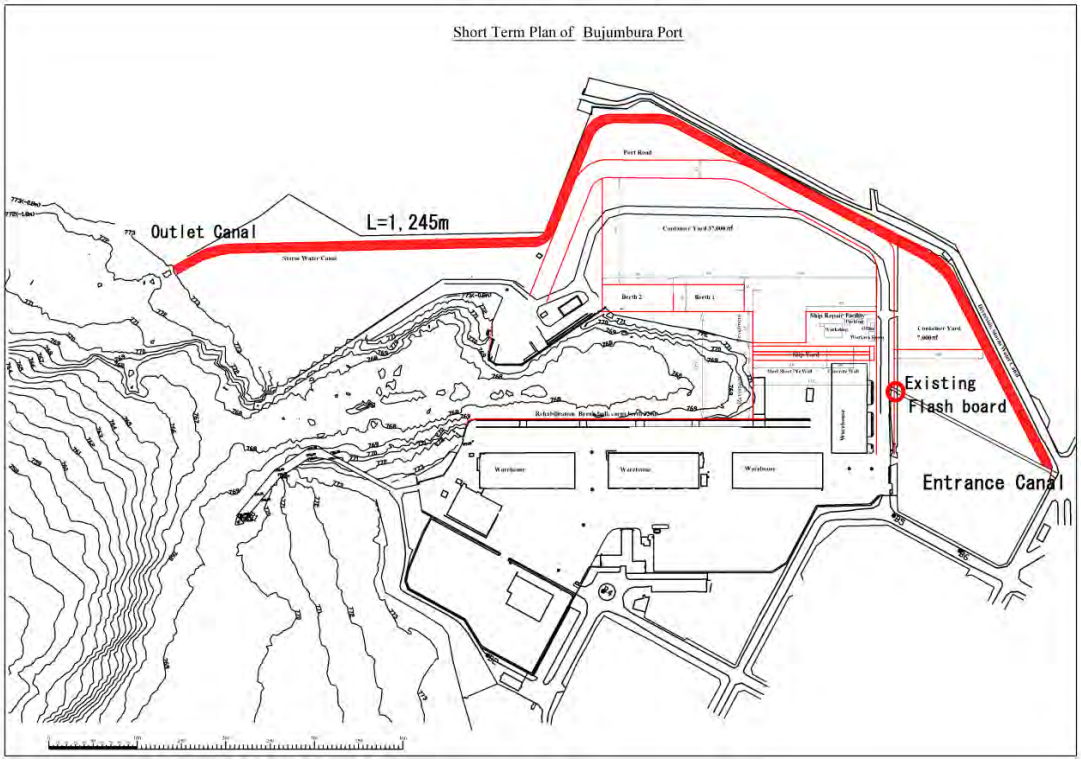


Figure A.1: Diversion of Storm Water Canal

A.2 Dredging of Port Basin

1) Design water depth

Full load draft of target ship:	3.8 m
Necessary clearance (15% of above):	0.6 m
Allowance considering sedimentation in future:	0.5 m
Design Low Water Level:	EL + 773.0 m
Calculated Level of Bottom:	EL + 768.1 m
Design Water Depth:	–5.0m = (EL + 768 m)

2) Basin area for Short term plan
Basin area = 120 m × 170 m = 20,400 m^2

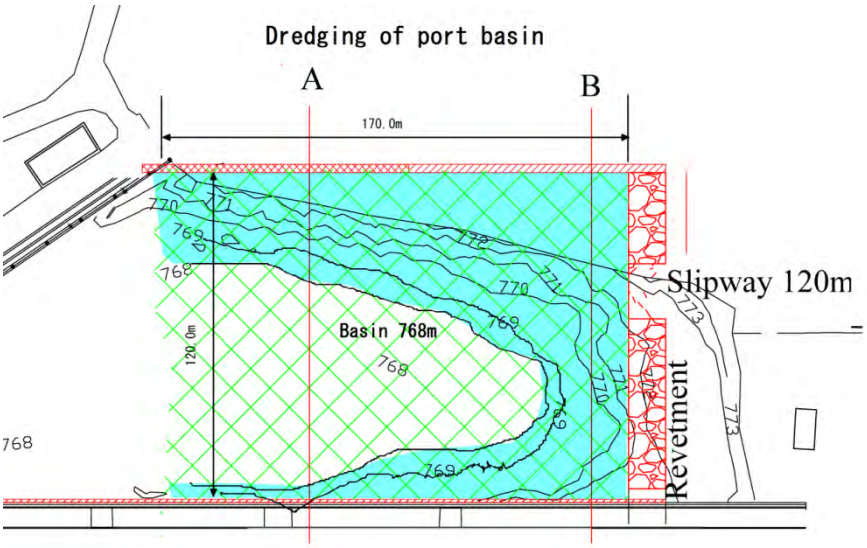


Figure A.2: Dredging Area of Port Basin

A.3 Container Terminal

The outline of the new container terminal is as follows:

Length of container berth:	80 m
Number of container berth (Quay wall)	2 berths
Water depth in front of the berth	5 m below LWL
Width of apron	30 m
Area of container stacking yard	44,000 m^2
Port road	20 m width

The new container terminal will be located as shown in Figure A.3.

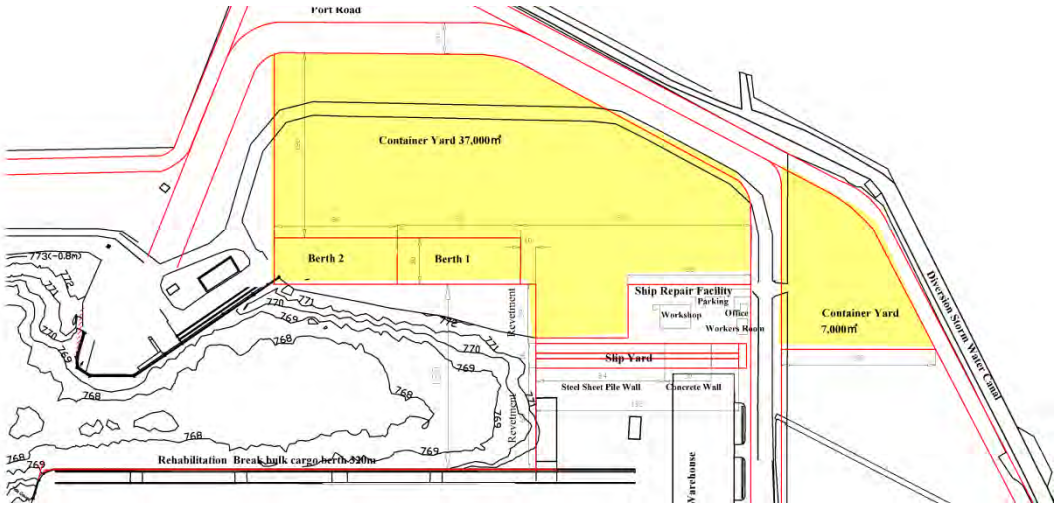


Figure A.3: Location of Container Terminal

Typical cross section of the container berth will be as shown in Figure A.4.

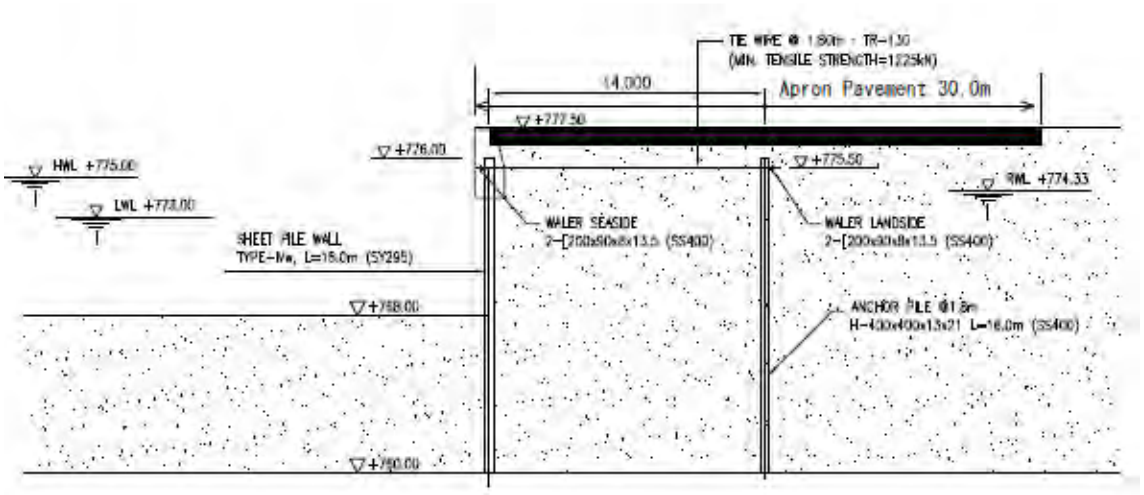


Figure A.4: Typical Cross-Section of Container Berth

A.4 Container Stacking Yard

On the assumption that mobile container STS cranes and reach stackers are employed for container handling, the container stacking yard is planned as shown in Figure A.5. Interlocking concrete block pavement is recommendable.

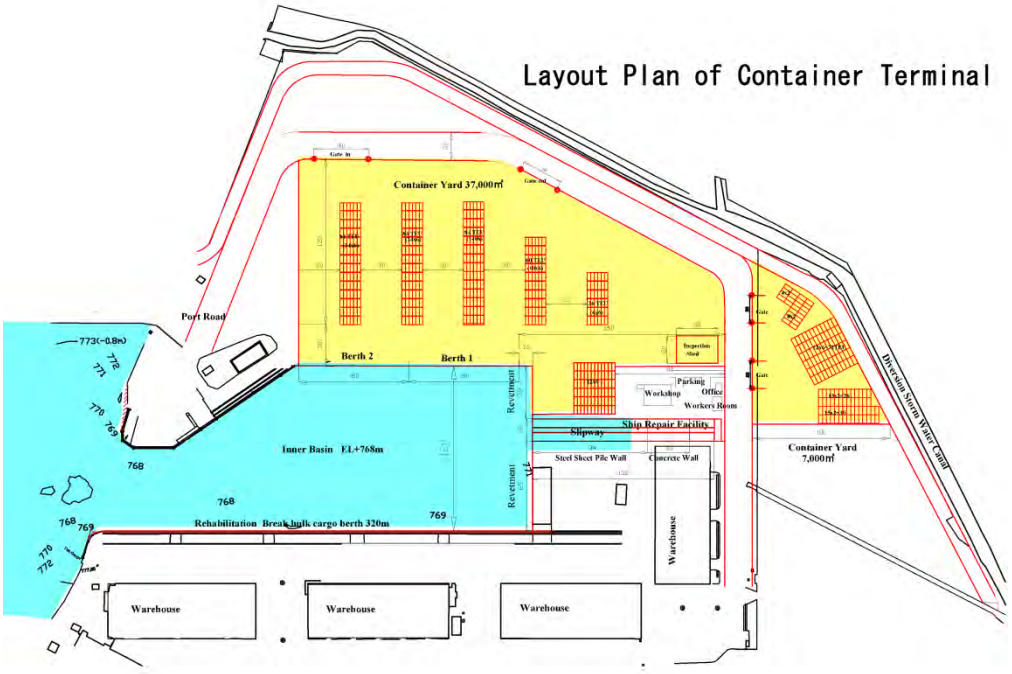
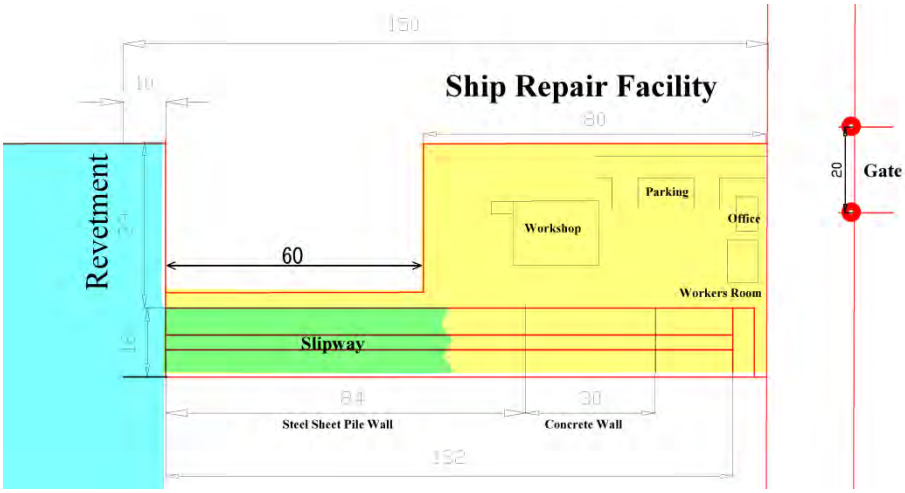


Figure A.5: Container Stacking Yard

A.5 Ship Repair Facility

Ship repair facility is located at the east end of the port basin of Bujumbura Port, having the area of over 6,000 square meters, and slipway, factory, office, and necessary machines and equipment. Inclination of slipway is designed as 1/12 (4.76 degrees), and the size of slipway is enough to accommodate the maximum dimension of ship (L = 60 m) in Burundi fleet. In order to keep a stable and safe supply of electric power, owning generating system driven by diesel engines is recommendable. The layout of ship repair facility is shown in Figure A.6 and FigureA.7.



FigureA.6: Layout of Ship Repair Facility (a)

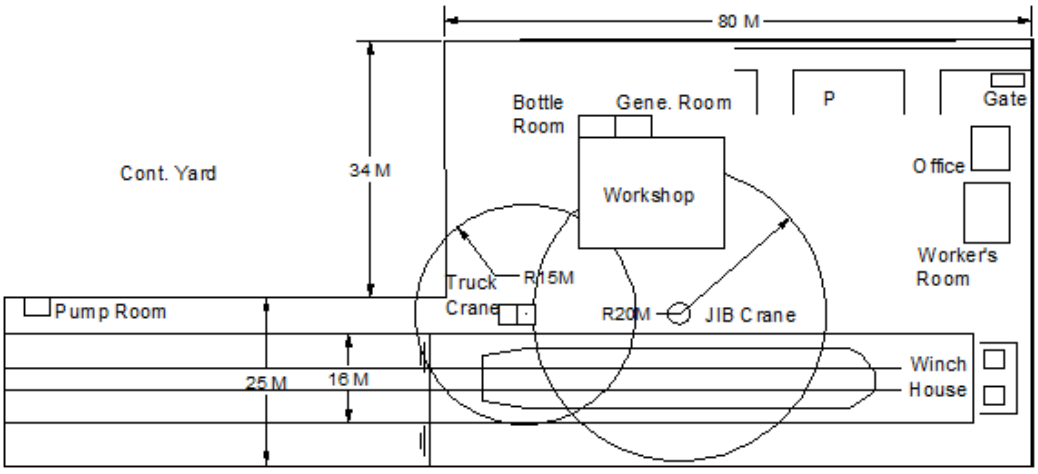


Figure A.7: Layout of Ship Repair Facility (b)

A.6 Rehabilitation of General Cargo Berth

Dredging of approximate 7,000 m^3 is required to dredge up to the level of EL + 768 m at the area in front of GC Berths. The dredged volume includes b) Dredging of Port Basin.

Rubber fenders will be installed on the quay wall and the apron will be elevated by 50 cm to E.L. + 777.5 m to avoid the inundation during the highest recorded water level.

Deepening of the port basin in front of the general cargo berths is illustrated in Figure A.8.

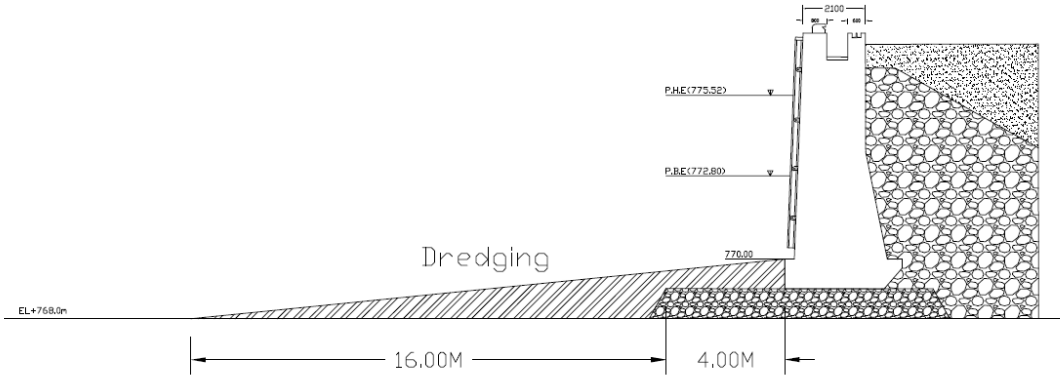


Figure A.8: Typical Section of Dredged Area in front of GC Berths

A.7 Inland Port Road

Inner Road Port will be constructed on the northern port premises as shown in Figure A.9.

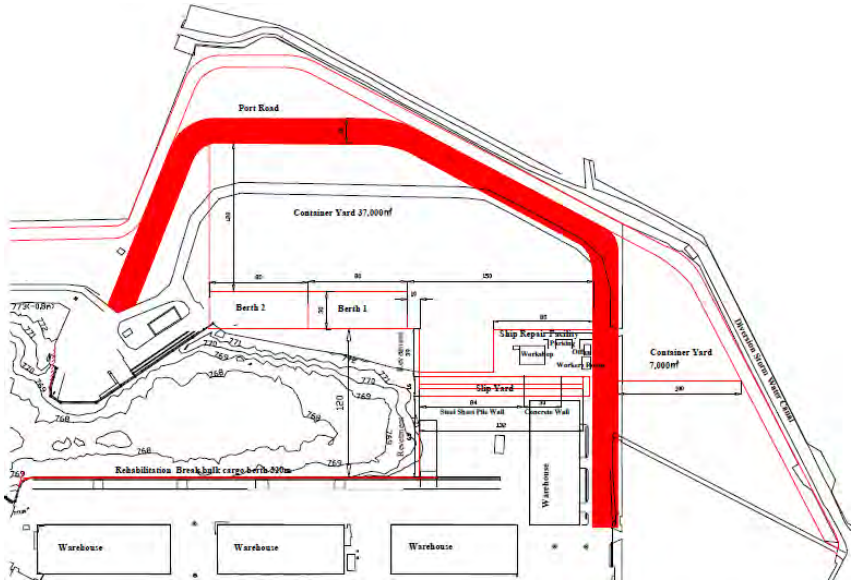


Figure A.9: Layout of Inner Port Road

A.8 Provision of Container Handling Equipment

In the Container Berths and the Yard, following equipments listed below table shall be provided for operating cargo handling.

Table A.1: Equipment List of Container Handling Equipment

Equipment	Capacity	Unit
Mobile Container STS Crane	35 ton at 19 m radius	2
Reach Stacker	35 ton, 3 tiers for loaded and 4 tiers for empty	2
Multi-purpose Forklift	3–5 ton	2
Tractor Head		5
Terminal Chassis		7

(2) Facilities of Rumonge Port

A.9 Facility Layout

Port facilities of Rumonge Port are composed of Berthing pontoon, Movable ramp, Causeway, Open storage and drainage, Warehouse, and Administration building as shown in Figure A.10.

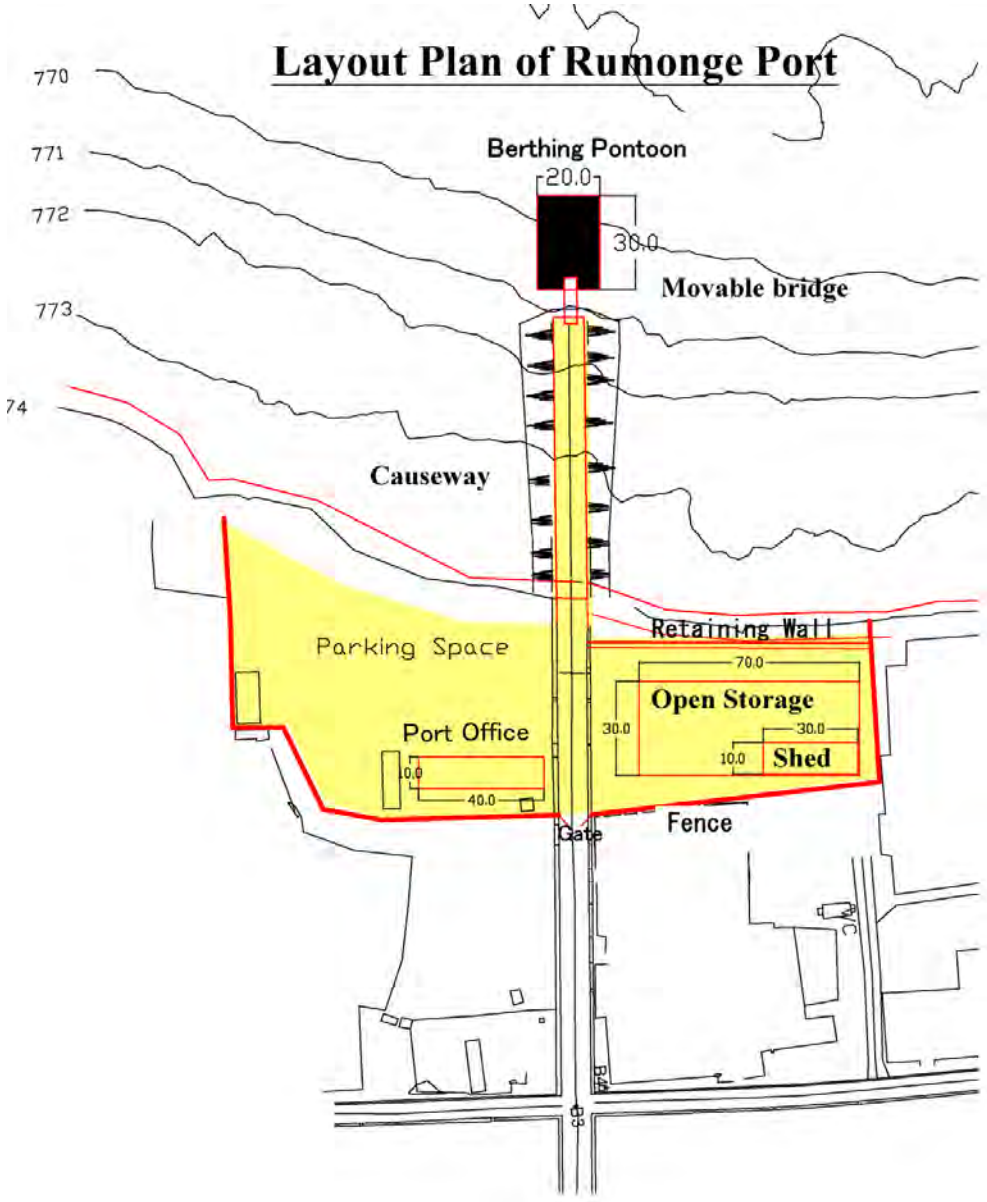


Figure A.10: Layout Plan of Rumonge Port

A.10 Berthing Pontoon

Module pontoon type was selected in the pontoon type because the module units are able to transport by container trailer.

Dimension of Berthing Pontoon:	W = 20 m × L = 30 m (600 m^2)
Number of module pontoon:	6 × 8 = 48 units
Dimension of module pontoon:	2.5 m × 5.0 m × 2.0 m (4 spuds equipped)
Movable bridge	2 m × 15 m

A.11 Causeway

Structural type of Causeway is selected to be a rubble mound with armor stone structure. Core stone of the mound is formed by rubble stones of 5 kg to 50 kg size. Surface of slopes are covered with armor stones.

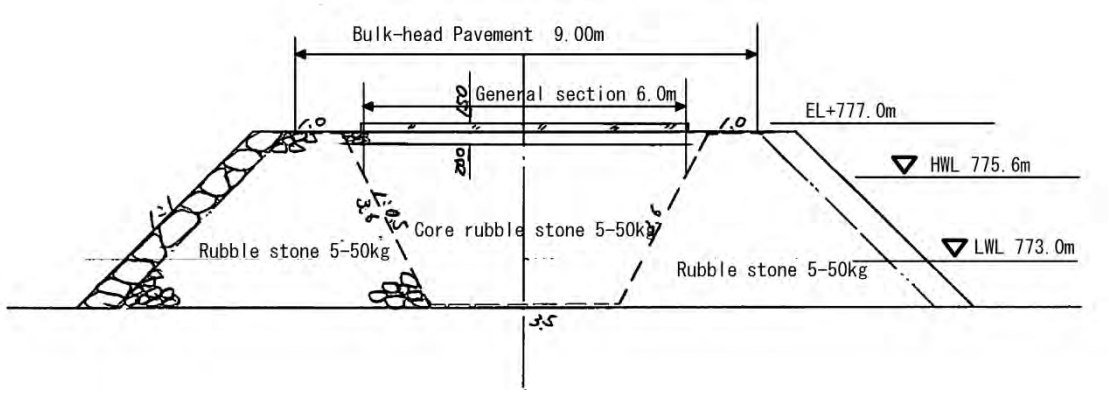


Figure A.11: Typical Section of Causeway

A.12 Coastal Revetment

Shoreline is shaped from a gentle graded sandy soil. A revetment paralleled to the shoreline is designed to keep an adequate area of a flat zone for the necessary port facilities, such as storage in the port area.