社会開発調査部報告書

...L COOPERATION AGENCY(JICA)
THE PORTS CORPORATION OF AQABA
THE HASHEMITE KINGDOM OF JORDAN

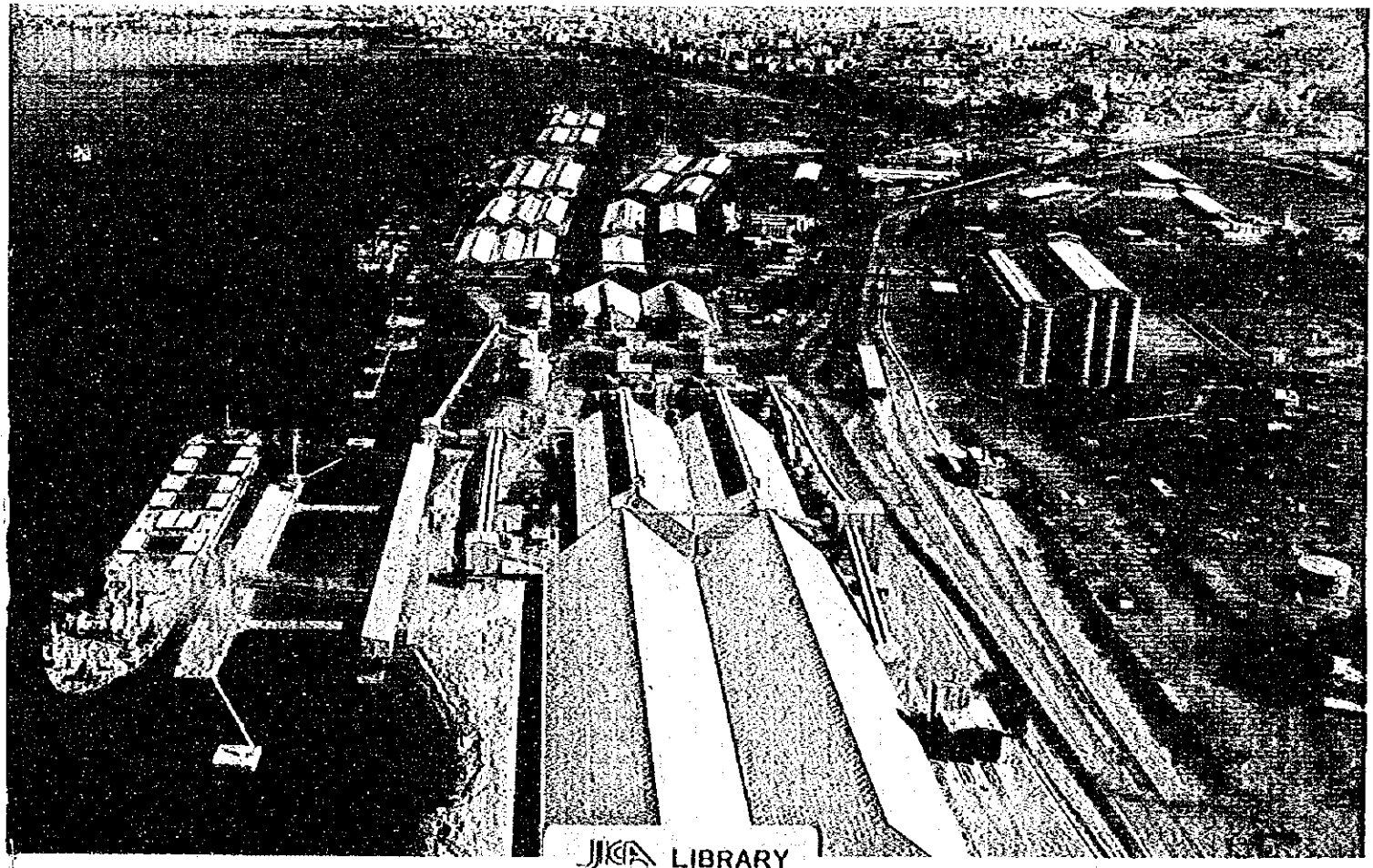
NO. 52

FINAL REPORT

THE STUDY ON THE IMPROVEMENT PLAN OF THE PORT OF AQABA IN THE HASHEMITE KINGDOM OF JORDAN

VOLUME (2)

FEBRUARY 1996



THE OVERSEAS COASTAL AREA DEVELOPMENT INSTITUTE OF JAPAN(OCDI)
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CURRENCY EXCHANGE RATE

1 US Dollar = 0.69 Jordan Dinar = 90 Japanese Yen

(As of March, 1995)

ABBREVIATIONS

APC	Arab Potash Company
ARA	Arab Region Authority
ARC	Arab Railway Corporation
BOT	Build, Operate and Transfer
B/L	Bill of Laden
CBR	Cost Benefit Ratio
CD	Chart Datum
CDL	Chart Datum Level
CFS	Container Freight Station
CIF	Cost, Insurance and Freight
CPU	Central Processing Unit
CY	Container Yard
CZMA	Coastal Zone Management Act
DAP	Di-Ammonium Phosphate
DG	Dangerous Goods
DO	Dissolved Oxygen
DOE	Department of Environment
DWT	Dead Weight Tonnage
EC	European Community
EIA	Environmental Impact Assessment
EIR	Equipment Interchange Receipt
EIRR	Economic Internal Rate of Return
EL	Elevation Level
ESCAP	Economic and Social Commission for Asia and the Pacific
ETA	Estimate Time of Arrival
ETD	Estimate Time of Departure
FEU	Forty-Foot Equivalent Units
F.C.	Factor Cost
FCL	Full Container Load Cargo
FIRR	Financial Internal Rate of Return
FOB	Free on Board
FTZ	Free Trade Zone
GAEAP	The Gulf of Aqaba Environmental Action Plan
GDP	Gross Domestic Products
GRT	Gross Registered Tonnage
GWh	Giga(one billion)-Watt hour
HP	Horse Power
IDECO	Irbid District Electricity Company
IEE	Initial Environmental Examination
IMF	The International Monetary Fund
ISO	International Standard Organization
JD	Jordan Dinar
JEA	Jordan Electricity Authority
JFI	Jordan Fertilizer Industry
JIEC	Jordan Industrial Estate Corporation
JPMC	Jordan Phosphate Mines Co. LTD.
JPRC	Jordan Petroleum Refinery Company
JTPI	Jordan Timber Products Industry

IMO	International Maritime Organization
LASH Ship	Lighter Aboard Ship
LCL	Less than Container Load
MARPOL	International Conference on Marine Pollution
MB	Mega Byte
MHZ	Mega Hertz
MMRAE	Ministry of Municipal and Rural Affairs and the Environment
MOF	Ministry of Finance
MOP	Ministry of Planning
MOP	Muriate of Potash
M.P.	Market Price
MOS	Ministry of Supply
MOT	Ministry of Transport
MPN	Most Probable Number
MSS	Marine Science Station
MT(M/T)	Metric Tons
NES	National Environment Strategy
NPK	Nitrogen(N)-Phosphatic(P)-Potassic(K) Fertilizer
NRT	Net Registered Tonnage
OC	Organic Substance
OECD	Organization for Economic Cooperation and Development
OECF	The Overseas Economic Corporation Fund
PC	The Ports Corporation
PLO	Palestine Liberation Organization
PSC	Port State Control
P.V.	Present Value
RO/RO Ship	Roll On / Roll Off Ship
RSS	Royal Scientific Society
SMB	The Sverdrup and Munk and Modified by Bretschneider
SS	Suspended Solid
T-H	Total Hydrocarbons
T-N	Total Nitrogen
T-P	Total Phosphate
TDS	Total Dissolved Salts
TEU	Twenty-foot Equivalent Unit
TS	Total Sulfide
TSS	Total Suspended Solids
UAE	United Arab Emirates
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
USA	United States of America

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4.1 Basic Concept of the Port Development

4.1.1 Background of the Port Development

As mentioned before, the port of Aqaba already has a lot of roles and functions. In addition, with the progress of the peace process in the Middle East, the port is to enjoy much prosperity. In this context, the port should play more important roles, because not only more goods and industrial materials will be supplied through the port but also more people will pass through freely.

This port has a number of problems to be solved, however, before more important roles and functions can be assumed. These are indicated in "2.7 Identification of Problems". Measures that the port is to undertake could be largely categorized into three phases. The first are measures to urgently be taken, which are proposed as "Urgent Improvement Measures". The second is to be coped with from the long term point of view. The third is the short-term measures in the framework of the long term point of view. Among others, the following are most important.

1) To cope with containerization

Containerization has made remarkable progress in maritime transport throughout the world. The same trend has begun to emerge at the port of Aqaba.

As the history of the port of Aqaba shows, substantial activity (export of phosphate rocks) started in 1959 when the Phosphate Exporting Berth (A), the first modern facility, opened. Since then, phosphate has been the number one exported cargo. Although it is thought that phosphate will continue to be one of the most important commodities, there is a noticeable decline in the cargo volume of phosphate rock during the past five years. In addition, it is said that export of raw materials, phosphate rocks, will be gradually replaced by products with added value, fertilizer etc.

On the other hand, in 1993, the port of Aqaba handled over 110,000 TEUs of container cargo throughput. Its present berth length seems sufficient for the time being. However, it will be indispensable to prepare for increasing container cargo from the long term point of view, considering the worldwide trend of maritime transportation and the expectative role of the port of Aqaba in future. It largely depends on how the port of Aqaba copes with worldwide containerization whether the port will take full advantage of its strategic location and prosper as the transit port in the Middle East. Therefore, coping with containerization should be granted priority in the formulation of the Master Plan. In this context, the trend of containerization throughout the world will be given attention.

Container traffic in the world has been constantly changing. During the last 15 years, Singapore, Hong Kong and Kaoshiung have marked rather higher growths in container handling throughput. In recent years Singapore and Hong Kong have alternated between the first and second ranked ports in terms of container handling throughput on the strength of the high economic growth of their hinterlands.

As to the fleet capacity, the growth rate of container ship for 1992 is 6.0% in number and 10.2% in TEU. That of interval of five years from 1988 up to 1992 has also shown a

steady increase, 4.5% in number and 9.7% in TEU while there has been an excess in terms of tonnage.

The above mentioned matters have brought the following changes to world container transportation:

a) Decreasing direct calls through restructuring in container network services
b) Restructuring feeder network service and assigning large/middle sized vessel to feeder ports

Ports are currently facing keen competition to survive as container ports. The following facilities and equipment are essentially required for container ports.

a) necessary berths for calling vessels
b) facilities and equipment to ensure efficient cargo handling
c) container yard with separate allotment and adequate layout

In addition, smooth operation should be ensured by introducing such systems and procedures as speedy customs clearance, computer and information network systems, reasonable and fast service and a safe working environment.

2) To prepare facilities and equipment necessary for increasing cargoes other than container cargo

Industrial products and materials are scheduled to increase in the near future. The port is expected to support the activities of major industries, namely, for export or import. Therefore, in correspondence with their product plan, additional port facilities and equipment should be planned.

3) To improve the environment around the port

Aqaba is a resort city as well as a port city. Many tourists come to spend time, staying at the beach, playing marine sports, watching coral reef by glass-bottomed boats etc. It is required that tourist attractions be kept in good condition.

Because of the topography, a part of the residential area is rather near from the port.

When southerly wind blows, dust generated by discharging or loading phosphate rocks raises an environmental issue. It is preferable to reduce dust through the introduction of necessary equipment or reallotment of the berths.

4.1.2 Basic Concept of the Port Development

In order to solve the issues mentioned in the section 4.1.1, the port development should be executed in the framework of the long-term viewpoint, that is to say, the master plan, because it takes a long time and a lot of investment to step forward into implementation. In line with this, the major objectives of the Master Plan for the port of Aqaba are thought to be as follows:

- To be a guideline for long-term investment and operational improvement scheme of the port

- To be a base for short-term development/improvement plan, the contents of which are required to be consistent with total development scheme

- To be a guideline of coordination and cooperation between various organizations or people concerned in the Gulf of Aqaba, where the port, tourism, marine recreation activities or protected area in terms of environment etc. are existing alongside the coastline of only 27 km, and to aim at sustainable development compatible with the environment

- To provide port users, investors and other business entities concerned with the prospect of a sound business environment and to serve as a guideline for the future development of those businesses

- To promote harmonized development of other infrastructures necessary to realize the proposed port development scheme

- To assist various financing agencies in their investment or financial assistance plans

On the basis of understanding of the master plan mentioned above together with the analysis of background of the port development and evaluation of present conditions related to the port, the basic concept of the port development for the Master Plan is proposed as follows:

1) The role and function as the gateway of Jordan

The port of Aqaba has carried out important roles and functions as the gateway for Jordan and the neighboring countries as well. As mentioned in "1.9 Transport", daily life of Jordanian people and major industrial activities depend upon the port. Moreover, a lot of goods and passengers have historically passed through Jordan due to its geographical location.

Today, with the beginning of the peace process, political and economic relations among the Middle East countries are entering a new stage. Progress of the peace process, that is to say, equilibrium in the region, will lead to an exchange of more commodities and people, both domestically and abroad. The port of Aqaba has to accommodate and deliver cargoes and passengers forecasted at the target year.

As a result, the port of Aqaba will contribute to promotion of the standard of living, development of industry, infrastructure etc. not only in Jordan but also in the Middle East.

On the other hand, such a process may likely cause changes in cargo and passenger flows to and from Jordan. This suggests that severe competition and cooperation in some cases among ports in the region may be brought about.

The port of Aqaba has the advantageous location of facing the Indian Ocean and the Far East which currently enjoys high economic growth. Therefore, the port of Aqaba has to make the best use of its advantage. The practical strategy is to aim at the first gateway to the East. As to traffic movement between the Middle East and the West, it is anticipated that severer competition among ports in the Mediterranean will arise. To cope with such a situation, it will be necessary for the port of Aqaba to ensure some significant functions as the gateway to the West through coordination and cooperation with port authorities

concerned.

2) Efficient and practical operation

Port activities are always changeable in an environment where socio-economic situation in the hinterland changes. In particular, the Middle East is thought to be a region which will experience the most drastic change. These changes will affect various aspects of port activities in Aqaba. One of the most likely scenarios is that the port of Aqaba will be involved in severe competition with neighboring ports.

Under such circumstances, it is most important to secure an efficient and practical operation and management system, provide good port services and flexibly deal with additional demands should they arise.

At present, the Ports Corporation has some issues to be solved as indicated before. Those which must be tackled immediately are proposed as "Urgent Improvement Measures". Others can be addressed in medium or long-term planning, such as increasing cargo handling productivity, providing better port services, introducing an adequate information system, review job descriptions and reforming the organizational structure.

3) The coordination with other activities in the Gulf of Aqaba including sufficient consideration of environment

The Gulf of Aqaba is blessed with a good natural environment; some portions of the coastline serve as resort or tourist areas. The tourist industry, which was second in earnings to other export inflows in Jordan, is very important for the region as well as port and industrial activities. The Government is also making great efforts to promote the tourist industry. Aqaba is one of the footholds.

Therefore, it should be taken into consideration that development and utilization of the port be harmonized with the other activities and environmental issues. In other words, the Master Plan of the port should correspond with the concept of sustainable development.

The impact on environment generated by port activities is classified into two phases: impact during construction works of port facilities and equipment and impact from operation.

This Study does not include detailed engineering design and its implementation program, so that detailed environmental impact assessment should be conducted at a later stage. However, efforts to minimize environmental impact even at the stage of preliminary design and implementation program will be made.

As to environmental issues accompanied with port operation, port operators should be responsible in principle. The Ports Corporation keep almost all jobs in the ports so that they should take measures necessary to deal with such issues, if any, together with other related companies or organizations. Furthermore, in advance, it is important to prepare contingency plans for oil spillage etc.

As a whole, the above mentioned matters will be taken into account in the formulation of the Master Plan.

4) Preparation for rational and economic design and its implementation stage

In order to step forward into implementation as soon as possible, it is preferable to minimize construction cost and the construction period.

Current port area has the topographical feature that the fronts of the berths sharply deepen while flat area of the back is narrow with large undulation. That suggests new development will result in rather higher cost, including new access road.

Therefore, an attempt will be made to make use of the existing facilities; in addition, the current berth assignment system will be maintained. Furthermore, consideration will be given to minimizing the influence to port activities as much as possible during the construction works.

4.1.3 Fundamental Condition for proposing the Master Plan

The Master Plan of the port of Aqaba will be proposed based on several conditions.

1) Following political and economic scenarios mentioned later, the port of Aqaba will be placed as a transit port in the Middle East. This means that future plans and projects (for example, Aqaba-Eilat Joint Project or Iraq Oil Pipeline Project), some of which were presented at recent economic meetings, will be implemented by each related organization (not always by the Ports Corporation).

2) Other than the above, projects related to development and utilization of the Gulf of Aqaba (for example, infrastructure investment such as roads and railway extension access to Aqaba from hinterland) will be implemented by individual agencies or organizations through foreign aid.

3) Another principal utilization in the Gulf of Aqaba, namely tourism development, will be steadily stepped forward so that more environmental consideration will be required.

4) It is assumed that relevant industries will increase production plans, making it necessary to expand and prepare storage space and to upgrade the transportation system between ports and facilities to ensure higher handling productivity.

5) Taking into consideration that the port of Aqaba will certainly face keen competition among neighboring ports, preconditions to cope with such a situation and to survive as the transit port should be introduced. To be concrete, efficient cargo handling productivity, competitive tariff rate, reasonable dwelling time of containers and economical calling vessel size etc. will be assumed in the formulation of the Master Plan.

6) On the recognition that space to be developed is strongly limited, it is desirable to minimize extension facilities. This means that much higher cargo handling productivity should be introduced.

7) Berths will be assigned, in principle, on the basis of the current way of use. Almost all berths are used for a specific use corresponding to kinds of commodities.

4.2 Space Utilization and Management Policy of Coastal Area

Coastal zone management programs are in place in some developed countries such as America, France and Australia. All of such programs in the above three countries are based on laws which were passed by the respective governments. When discussing the space utilization and management policy in the Gulf of Aqaba, examples of such legislation might prove useful.

Coastal Zone Management Act (CZMA) in America, which took effect in October 1972, is said to be one of the most typical. The following excerpt defines the policy of the Act;

Sec. 303. The Congress finds and declares that it is the national policy (a) to preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations, (b) to encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone giving full consideration to ecological, cultural, historic, and esthetic values as well as to needs for economic development, (c) for all Federal agencies engaged in programs affecting the coastal zone to cooperate and participate with state and local governments and regional agencies in effectuating the purposes of this title, and (d) to encourage the participation of the public, of Federal, state, and local governments and of regional agencies in the development of coastal zone management programs. With respect to implementation of such management programs, it is the national policy to encourage cooperation among the various state and regional agencies including establishment of inter-state and regional agreements, cooperative procedures, and joint particularly regarding environmental problems.

CZMA (Sec. 305.) requires that the management program shall include the following:

1) An identification of the boundaries of the coastal zone subject to the management program.

2) A definition of what shall constitute permissible land uses and water uses within the coastal zone which have a direct and significant impact on the coastal waters.

3) An inventory and designation of areas of particular concern within the coastal zone.

4) An identification of the means by which the state proposes to exert control over the land uses and water uses referred to in paragraph (2), including a listing of relevant constitutional provisions, laws, regulations, and judicial decisions.

5) Broad guidelines on priorities of uses in particular areas, including specifically those uses of lowest priority.

6) A description of the organizational structure proposed to implement such management programs, including the responsibilities and interrelationships of local, areawide, state, regional, and interstate agencies in the management process.

7) A definition of the term "beach" and a planning process for the protection of, and access to, public beaches and other public coastal areas of environmental, recreational, historical, esthetic, ecological, or cultural value.

8) A planning process for energy facilities likely to be located in, or which may significantly affect, the coastal zone, including, but not limited to, a process for anticipating and managing the impacts from such facilities.

9) A planning process for (A) assessing the effects of shoreline erosion (however caused), and (B) studying and evaluating ways to control, or lessen the impact of, such erosion, and to restore areas adversely affected by such erosion.

Although there are differences of politics, economy, administrative system, decision making mechanism and so on between Jordan and other countries, the above act suggests the significance, objectives, major items to be included, procedures to be followed, consideration to be taken and other important matters when making the coastal zone management program in the Gulf of Aqaba.

However, attention should also be given to the difference of background surrounding the area from that in developed countries. The OECD report (Coastal Zone Management, Integrated Policies) states: "The coastal zone in most OECD countries is under severe and increasing pressure from rapid urbanization, pollution, tourism development and continued development in hazard prone areas. Resource allocation conflicts are increasing."

On the contrary, there are not many such pressures and conflicts in Jordan and nor are they likely to arise, judging from its topographic features around the coastal zone, the present way of usage and the future possibility of utilization.

Taking into consideration various differences related to the utilization and management of the coastal area (roles of the coastal zone for the region and the country, various demands, available and suitable space to be developed, environmental situation, regional and nationwide policy etc.), a different coastal zone management program (different contents, planning process, effect etc.) is warranted. Therefore, before proposing the coastal zone policy in Jordan, the present situation and future trend of the area should be examined.

1) The Gulf of Aqaba constitutes a part of the great rift between Asia and Africa. The topography of the coastal area in Jordan is characterized by sudden increases in both sea depth and land elevation. The land area is almost entirely desert.

2) The coastal line of Jordan is only about 27 km long, though this coast extends about 180 km from the Red Sea. The territory of Jordan is located at the northern-eastern end of the Gulf of Aqaba. The remaining portion belongs to Egypt, Israel and Saudi Arabia.

3) Because of the limited coastal area, there is little diversity of use.

4) At present, the most active utilization of the coastal zone is port activities. The ports are separated into three areas. The offshore area sharply deepens and is used as an anchorage for large ships. There is almost no conflict with other activities because deep sea area is unsuitable for fishing activities and marine sports.

5) Aqaba town, port facilities (including small fishing boats basin), port related industries, resort hotels with private beach, the marina, the diving center, Marine Science Station etc. exist at the land area. Urban development including a

residential area and waste water treatment has been progressed following the urban planning. It should be noted that all areas and facilities mentioned above are strictly separated from one another, so there is little possibility for any problems to occur.

6) Fishing grounds in Jordan are found all along the coast of the Gulf. The other sea area is perhaps unsuitable for fishing because of its great depth. In addition, fishing activities may not inflict damage on coral reefs which exist at some parts of coast line. Commercial fishermen and fishing boats are on the decline. Small glass-bottomed boats allow tourists to view the coral reefs.

7) The season and area for tourism activities are also rather limited. Marine recreation activities (bathing, jet skiing, cruising, diving etc.) are done around and in front of the beach of the northern part of the Gulf and diving spots. High season is usually from May to August. These areas are separated from large commercial vessel calling area.

8) The land use plan named "Aqaba Town, Land Use and Transportation Context Plan" given by Aqaba Region Authority (ARA) is currently in effect. The original plan was made in 1986 and though it has been slightly revised several times, the basic conception remains the same. Although the jurisdiction area of ARA is said to cover 250 m beyond the coastline, the land use plan is literally a zoning plan with regard to land area and is not a coastal zone utilization plan in a strict sense. However, it can be used to identify the area use and the expected coastal zoning plan can be easily guessed. The zoning of land area use leads to the zoning of sea area use. Various activities and utilization related to the Gulf of Aqaba in Jordan including future development and investment plan of the coastal zone have been done on the basis of the land use plan for about 10 years. All public sectors such as authorities, organizations etc. and private sectors concerning the Gulf of Aqaba have been managing to keep the land use plan.

9) Some utilization plans and management plans, in particular, on environmental management plan, have been proposed. These proposals have not led to significant changes in the land use plan. There is a chance for some of them to be implemented in future through introduction of foreign aid.

10) To sum up the above, activities and utilization of the coastal area in Jordan are well organized and ordered. Serious problems have never occurred before. There is little variation in coastal activities and it is unlikely that any will be seen in future. This is largely owing to the land use plan by ARA. In terms of the coastal management, it is currently most important to harmonize port and tourist activities with the environment, taking into account the present situation around the coastal zone.

As a result, it is thought appropriate to base the space utilization and management policy on the existing land use plan. The land use plan has prevented disorderly development of the area. The present way of usage, in which each activity is physically separated from one another, should be basically continued, even though tourism and port activities would be expected to be activated. In other words, the basic concept of the land use plan should be kept as the space utilization and management policy of the coastal zone in the Gulf of Aqaba.

Assuming that the present land use plan will play an important role, there are some important points which should be added to the plan as the basis of the policy as follows:

1) With the progress being made in the peace process, the region will certainly undergo drastic changes. These changes may increase demand and impact upon the coastal area. Corresponding with such situations, relevant master plans concerning major uses, namely, on the subject of port activities and tourism, are currently being examined. Since the coastal zone plan is essentially made from the long-term perspective, it is, for the time being, thought appropriate to follow the present land use plan. After the relevant master plans are proposed, the land use plan should be revised, if necessary, after examination by the Board of Director of Aqaba Region Authority which includes the Director General of the Ports Corporation as one of its members. When revising the plan, it is desirable to clarify and indicate the sea use in the map, though major changes are not expected.

2) A more important matter to be taken into account is for all countries and agencies near the coastal zone to cooperate and coordinate with the utilization and management of the whole Gulf of Aqaba. This is strongly required from the viewpoint of environmental consideration in particular. As the Gulf of Aqaba is bordered by four countries, Egypt, Israel, Jordan and Saudi Arabia, and the portion of Jordan is very small, it is no use to discuss the environment only in the Jordanian portion of the Gulf. In this sense, Jordan should reveal its land use concept and seek the understanding and cooperation of other countries at the multi-lateral conference on environment in the Gulf of Aqaba.

3) In order to implement the coastal zone plan effectively, the plan should be well known not only by relevant organizations but also by the general public. The existing land use plan is not thoroughly understood by the general public. Cooperation can be expected when a broad understanding is reached.

4) As some relevant reports already recommended, more upgraded environmental consideration will require institutional and legal strengthening such as establishment of environmental impact assessment system and monitoring system. Closer communication between supervisory organization (for example, Aqaba Region Authority and Marine Science Station) and impact areas (for example, the port and beaches) is also required.

4.3 Alternative Sites for the Port Development

In order to determine the site for the port development, it is, in principle, necessary to examine various aspects regarding natural conditions, environmental conditions, socio-economic conditions, actual situation of land and sea use around the port and possible space to be developed from a long term point of view.

Concerning development site selection of the port of Aqaba, the space utilization policy of the coastal area was proposed in the previous section. The existing land use plan by Aqaba Region Authority should be the basis for port development. Existing port area is included in the industrial zone according to the land use plan. Most parts of assigned industrial areas alongside the coastline are already occupied by port facilities.

On the other hand, required space for the future port activities is determined through comprehensive analysis on the basis of the result of demand forecast, cargo handling or storing system, operation and management system, port-related industrial activities and so on. If required areas exceed the given zoning area, adjustment between the proposed port plan and the land use plan will be necessary. At this stage, the Study will be carried out on the assumption that planned port area will be within the framework of the given zoning area.

The development possibilities of the three port areas (the Main Port, the Container Port and the Industrial Port area) will be examined separately.

The Main Port area

The northern land area close to Main Port is assigned to the tourist zone by the land use plan, where water depth is rather shallow. There are several glass-bottomed boats from which tourists can view the coral reef.

The area on the southern side, which is basically a narrow road, has been allocated as the industrial zone.

Taking into account that water depth in front of the existing quay sharply increases while the quay's face line (from Berth No.2 to Berth No.6) extends straight, it is not desirable to propose a new quay whose face line is moved far offshore from the existing quay. Most of the land area between the quay and the road is already occupied by port facilities (storage, open yards, maintenance shop etc.), access to the hinterland (roads, railway) and administration offices and so on. It is too difficult to seek necessary space for expansion except for the area southward of the existing Phosphate Berth (B).

Major cargoes handled in the Main Port are currently phosphate rocks, grain and general cargoes. The loading of phosphate rocks brings about dust pollution, an issue that affects the residential and tourism area behind or around the port. Reallotment of the phosphate berths is requested from a long-term point of view. Moreover, it is likely that some general cargoes will be containerized sooner or later.

Therefore, since there is currently insufficient space around Main Port to go ahead with development, it is assumed that phosphate berths will be demolished or the general cargo handling berths will be converted to a container handling berth.

The Container Port area

The Container Port is comprised of container terminal, passenger terminal, cement and rice handling berths (Mo'ta and Mush). These facilities are scattered along a coastline of about two km. To be exact, the industrial zone, which is assigned by the land use plan, is connected by a road from Main Port to Container Port. Considering available land space behind berths and existing facilities or factory, there is no need to examine port development area around Mo'ta and Mush berths. It is thought appropriate that Mo'ta and Mush berths will keep their present function at their present location in future, too.

As to container terminal, it is likely that container handling throughput in the port of Aqaba will steadily increase in line with world trends. Current container terminal has many problems; for example, a road crosses the stacking yard and the container yards are not flat, and thus the container handling capacity has almost reached the limit. Container terminal requires a large area. Although there is open space around the existing terminal, operation system, container movement flow, kind of handling equipment, construction cost need to be studied in advance of proposal of development plan of this area. The problem regarding the road will be solved by an ongoing project in the near future. Therefore, it is thought that extension of the container terminal will be planned close to the existing quay.

Current passenger berth is over 540 m from the passenger terminal and those facilities are not so near to the central city. Taking the convenience of passengers into consideration, it may be worth thinking over the reallotment of those facilities in the long term. There is, reportedly, coral reef near the shore around the passenger berth. Therefore, reallotment or extension of passenger berth should be examined on the basis of demand forecast and environmental consideration.

The Industrial Port area

Cargo traffic volume handled in the Industrial Port mostly depends on products at the industrial activities just behind the port. In case that berth extension plan will be required following increased production plan, it is rational to plan cargo handling facilities and equipment as close to the factory as possible. Considering the present situation of this area, berth extension, if necessary, should be allotted around the existing facility concerned.

JFI. 1 Berth (the Timber Berth) is one of the general cargo berths. This berth mainly accommodates small livestock vessels because of its dimension and location. Largo livestock vessels presently call at the container berth, Moshtrak and Mo'ta berth. Livestock is one of the cargoes expected to increase. Due to environmental issues (odor and dung treatment) and sufficient area necessary for temporary storage and transshipment, JFI. 1 Berth is thought better to be assigned for handling all livestock after necessary rehabilitation or improvement.

In addition, in order to cope with the environmental problem of dust generated by loading phosphate rocks, it will be preferable for the existing phosphate berths to be moved from the Main Port to the Industrial Port in future. Relocation of the phosphate berths is deeply connected with the railway extension project. This is not to say that storage and loading facilities etc. of phosphate rocks also have to be moved, as costs would be astronomical. Accordingly, relocation plan of the phosphate berths should be determined, taking related projects into account.

Other possible area

From the long term viewpoint beyond the target year, 2010, attention should be paid to the Aqaba-Eilat joint project which was proposed at the peace talks between Jordan and Israel in October 1994. It has been a short time since negotiations commenced and it is premature to say with accuracy how things will develop. However, the area between Aqaba and Eilat has the potential to meet the demands arising from the above joint project. When the Aqaba-Eilat joint project is given shape to and there are any significant differences between the Master Plan and the joint project, adjustment will be required.

Incidentally, there is very little area available for development in Aqaba. The southern area of Wadi Araba is the only expansion site of Aqaba city not only for some Jordanian needs but also for some needs arising from the joint project. Therefore, it is recommended that the area should be reserved to meet the potential needs for urban development including light and assembly industry and related infrastructure.

As a result, alternative sites for the port development will be basically selected around the existing port facilities. However, there are little data and information on topography, soil condition, bathymetry, current, environmental condition etc. around sites. After the results of the site investigation, proposed plan may be slightly changed.

4.4 Political and Economic Scenarios in Jordan

4.4.1 Current Situation in the Middle East

The Madrid Peace Conference in October 1991 heralded the current Middle East peace process. Since then, there has been remarkable progress on the diplomatic front.

Israel and the Palestine Liberation Organization signed an interim agreement on self-rule in the Gaza Strip and the West Bank town of Jericho in September 1993 and negotiations are being conducted to implement the agreement.

Then, an historic peace treaty between Jordan and Israel was signed on 26th October 1994, ending 46 years of conflict. In the wake of this peace treaty, Jordan established diplomatic relations with Israel on 27th November 1994, becoming the second Arab state after Egypt to have a peace accord with Israel.

It's been officially announced that Syria is holding talks with Israel with the aim of paving the way for the resumption of direct bilateral peace negotiations, which were suspended in February 1994. Peace talks between Israel and Lebanon appear to be stalled while Lebanon waits for progres on the Israeli-Syrian track. Thus, Israel has signed peace treaties and agreements or holds official contacts with all its bordering countries.

During the month of January 1995, there were two summits between Jordan and Egypt in Aqaba and between Jordan and the PLO in Amman.

In the Aqaba summit both countries pledged to develop Jordanian-Egyptian ties and to work towards reconciliation among Arab states. It is understood that Jordanian-Egyptian relations will return to their previous level in terms of cooperation, coodination and joint action for the benefit of the Arab Nations.

In the Amman summit it was reported that a general agreement on political cooperation and seven other agreements related to specific sectors were signed by Jordan and the PLO. These involved economic cooperation, trade, transport, communications, education, information and banking and monetary affairs.

On the economic front too, there have been developments in line with the progress of the Middle East peace process.

In October 1994, the Middle East-North Africa economic summit was held in Casablanca, with the participation of representatives from some 60 countries and more than 1,000 businessmen.

It was reported that there were proposals from the participating countries, notably the creation of a Middle East development bank and joint development projects in the region.

Jordan presented 121 development projects valued at $18,000 million in such sectors as agriculture, energy, environment, health, human-resources, industry, transport, telecommunication, tourism and water. It is said that all the projects involve cooperation among two or more countries.

The Middle East's largest ever economic conference was held in Amman at the end of October 1995. Some 2,000 government officials, business executives and financiers from some 60 countries attended the three-day Middle East-North Africa Economic Summit. The Amman summit issued a declaration calling for the establishment of the regional development bank by the end of October 1997.

4.4.2 Future Situation in the Middle East

Forecasting or charting the future course of events, regardless of whether the matter is political, economic or social, is an arena where policy makers and economists have somewhat difficult tasks to envisage short-term, medium-term or long-term pictures. This is the case with future situation in the Middle East which has been rapidly changing as the days pass. What was considered as a remote possibility a few years ago has become a reality today. News of today quickly fades into the past.

The future situation in the Middle East will largely depend on the following elements.

- The Middle East peace process currently taking place.
- The U.N. sanctions against Iraq being enforced.
- Implementation of an interim agreement between Israel and the Palestinian Liberation organization on self-rule in the Gaza and the West Bank.
- Realization of joint development projects in the region.

Each of the above elements is described hereunder.

1) Weighing favorable and region and assessing pros and cons on the peace accords signed recently between the regional countries, one can at least agree that there will be no setbacks in the Middle East peace process and the region is moving steadily towards peace-seeking environments, though there have been sporadic acts of violence in some places.

   A peace treaty alone can not bring about the prosperity and improvement of living conditions of the people in the region concerned. Peace will have to yield its dividend which is made possible by means of economic developments in various fields.

   To this end there are and will be more national and regional economic development and cooperation in the Middle East countries.

   While there is little possibility of world-wide war, economic contests or so-called trade wars are emerging nowadays. In fact, many countries are seeking inter-economic blocks and trade alliances in order to cope with changes and to keep an advantageous position in today's world as observed by forming regional economic blocks such as European Union (EU), North African Free Trade Agreement (NAFTA) and, to a lesser degree, Asian Pacific Economic Conference (APEC) etc.

   Applying this trend to the Middle East region, the so-called "Mideastern Market" could possibly be formed by Jordan, Israel, Syria, Lebanon and Palestinians in the

initial stage and later expanded into a pan-Arab economic market through the inclusion other Arab states on a bigger scale once there is a comprehensive settlement in the Middle East peace process.

Such an economic block, however, may not bring about an increase in trade volume among the regional countries and is not beneficial to global trade if its economic activity is confined within its territory. Therefore, it is likely that any economic block would build bridges with other blocks to further increase the trade volume on a wider scale.

2) One must not forget the most important single commodity in world trade : oil. The Middle East is the largest oil producer, and as such is able to control the world market by limiting production.

Many industrialized countries continue to rely on oil supply from the Middle East, of which only Saudi Arabia and Iraq are thought to be capable of supplying much of the increase in demand. In future the demand for oil might increase as a result of the peace process.

The accompanying rise in oil prices would benefit not only oil producing countries, but the entire Middle East region, invigorating economic activities and creating an economic boom.

After the 1990 invasion of Kuwait, the U.N. Security Council imposed an oil embargo on Iraq which is still in force. Apart from the causes for the embargo, there has been a negative impact not only on Iraq and its people but on neighboring areas. When a relatively big economy like Iraq is banned from exporting oil and importing necessary products, international trade volumes decrease and nearby countries involved in the cargo traffic route are adversely affected.
Prior to the invasion, oil and cargo were imported and exported through the routes of Jordan, Syria or Turkey besides Iraq's own ports.

Sooner or later, however, the oil embargo will be lifted as a result of periodic reviews by the U.N. Security Council with Iraq fulfilling its obligations imposed in the previous resolutions and the world will see the resumption of oil flow from Iraqi oil fields.

3) Jordan is not indifferent to the progress of Israel-PLO negotiations on Palestinian self-rule, since they share a border, and have kept close relations in the moves of people, money, goods and services for a long time through cultural and religious ties.

In case there are disturbances and social unrest in the self-ruled territories due to the increased number of unemployed and delay in improving the infrastructure, Jordan is likely to be adversely affected.
There are massive human problems caused to both Jordan and Israel by the conflict in the Middle East. It is hoped the matter is eventually resolved by the parties concerned without causing a negative impact on Jordan.

The Palestinian authority was handed responsibility for further civil powers covering taxation and health on December 1, 1994 in addition to education, tourism and

social welfare, completing the process.

At the time of signing an interim agreement between Israel and the PLO in September 1993, internationl committee pledged financial aid to the Gaza and West Bank areas to boost the living standard of the Palestinian people and improve the infrastructure. Despite such pledges, it is said that actual disbursement of the aid funds has not fully arrived to the areas, presumably owing to the lack of proper accounting system for receiving aid funds on the part of the PLO.

Unless or until the Palestinians are relived from hardships and sufferings, the situation will not be improved. In this sense, the donors' financial assistance is needed quickly to bring stability and prosperity to the areas.

When political, economic or living surroundings change, people living therein may welcome the changes or reject them depending on the convenience and status quo of each people. This is the case of Palestinans who have been living under the Israel occupation for a long time and now facing new surroundings. It is natural that it may take some time for them to adapt themselves to the new environment.

4) Under the treaty of peace between the State of Israel and the Hashemite Kingdom of Jordan, both parties are to promote economic cooperation between them, as wel as within the framework of wider regional economic cooperation. Jordan agreed to enter into negotiations soon on arrangements that would enable the joint development of the towns of Aqaba and Eilat with regard to such matters as joint tourism development, joint customs posts, free trade zone, cooperation in aviation, prevention of pollution, maritime matter, police, customs and health cooperation.

   If these projects are implemented, the area will see more economic activities involving a large volume of cargo, goods and services, improve infrastructure and enhance the living standards of the people.

4.4.3 Political and Economic Scenarios in Jordan

This section is intended to focus on how future situation in the Middle East would affect the role and function of the port of Aqaba and the Jordanian economy as a whole.

In this connection, three (3) scenarios are formulated by as pre-conditions for the Master Plan selecting the Case 1, Case 5 and Case 9 from among the alternatives shown in the Table, which reflect the pictures of the possible future developments in the region resulting from the two main factors that will have an impact on the course of events in the future; the Middle East peace process and the U.N. sanctions on Iraq.

When looking at a situation or making a judgement, one tends to take either an optimistic view or pessimistic view. Results will lean to one side depending on the viewpoint. In the case of political and economic forecasts, this tendency may be even more pronounced. Most probably the answer or natural outcome lies in between. Bearing in mind this tendency, three scenarios are prepared as per attachments.

Case 1

Jordan has and will have a stable political situation in the years to come. Even if

disturbances or social unrest occur in the neighboring areas, Jordan will still be able to enjoy stability and prosperity through good leadership and sound economic policy. This entails investing in industry and infrastructure using its own funds or by obtaining financial assistance from foreign countries.

Under a peace treaty with Israel, Jordan is going to implement joint development projects, some of which are expected to contribute to the expansion of economic activities in the region. Economic cooperation between the two countries will be the model for other bilateral or regional cooperation and may possibly lead to the formation of Middle East economic block.

One might expect that the U.N. economic sanctions on Iraq would benefit the port of Aqaba, but the opposite seems to be the case. Because of the limited economic activities on the part of Iraq, overall volume in international trade has been decreased. The volume of cargo and goods in transit through the port of Aqaba has also been decreased as the figures show. When the Iraqi economy was in full swing, there was a larger volume of cargo and goods through the port of Aqaba. Therefore, it would be beneficial for the port of Aqaba to see the lifting of the U.N. sanctions against Iraq.

What makes the port of Aqaba so attractive for shipping companies and importers/exporters is its ideal location. It is thus in a position to compete with other ports on the Mediterranean and Red Sea coasts for the cargo and goods from the Indian Ocean basin and the Asian Pacific areas.

Competitiveness is not merely measured by overland distances between port and interior destinations. It depends on the operational efficiency of the port, lower port dues, cheaper labor costs, lower haul-costs and so on.

As long as the port of Aqaba takes advantages of these points, it will keep abreast of other neighboring ports and stay competitive even if other ports improve their facilities.

Case 5

Although there have been strains between Jordan and some Arab countries in the aftermath of the Gulf crisis, time has healed the differences and relations are back to normal levels. Jordan keeps friendly relations with all the Arab countries and will act as a pillar of stability in the Middle East.

Even though there are some voices of concern on the solutions of the Palestinian refugees and displaced and the status of Jerusalem as results of Middle East conflicts, the matters are expected to be peacefully settled by the parties concerned.

The Social and Economic Development Plan 1993-1997 prepared by the Jordanian government is a surprisingly candid report, describing shortcomings and problems which must be overcome to achieve the targets and objectives. But on the whole, the Plan is positive; it is clear that there is a determination to overcome the problems and achieve the objectives. If such determination holds, it will be possible that Jordan will realize steady economic growth, in which more of the national budget will be allocated to the improvement of social infrastructure as a peace dividend, with less spending on the military.

In bilateral relations, economic cooperation between Jordan and Israel and between Jordan and the PLO will be promoted in various sectors as agreed in the peace treaty and agreements. This kind of economic cooperation wil expand to regional ones in which two or more countries are involved in joint development projects.

With Jordan-Israel establishing an economic cooperation base, a regional economic block will evolve on a smaller scale in the initial stage, covering Jordan, Israel, Egypt, Syria, Lebanon and the PLO.

Among the joint development projects proposed by Jordan in the 1994 Casablanca Economic Summit, an Iraqi-Jordan crude oil pipeline seems feasible for planning and subsequent implementation. Once the sanctions on Iraq are eased, the project is expected to be planned.

Where there are a number of projects to be implemented as in the case of Jordan now, it will be necessary to identify the priority of the projects and put one or two into implementation at a time because any one of the projects require a huge sum of investment from the government and/or from the foreign countries.

Case 9

Despite recent reports that contacts are being made between Israel and Syria which will pave the way for the resumption of bilateral peace negotiations, this Israeli-Syrian track seems to be of an on-again off-again nature, while Israeli-Lebanon track appears to be waiting for progress of the former track.

While Syria is demanding the return of the Golan Heights, Israel is asking for security arrangements. How to break the stalemate is the crucial point, and a breakthrough has not yet been made.
Israeli-Palestinians track is making progress in some sectors, but it is frequently interrrupted by acts of violence.

Recent summit in Cairo by the leaders of Egypt, Jordan, Israel and the PLO is reported to have focused on Palestinian-Israeli peace process. Breaking the deadlock on such matters as Israeli withdrawal from the occupied areas, election of the Palestinian Council members, the expansion of self-rule areas, and ending settlement work in the occupied area was high on the agenda.

However, this will take time and a period of cold peace will remain for some time to come. Until the Israeli-Palestinian relations make headway, genuine peace may not be on the horizon of the Midddle East.

To help accelerate the Israeli-Palestinian track of the peace process, it will be indispensable to have aid funds from the donors' countries flow into the West Bank of Gaza area for improvement of social infrastructures and creation of jobs so as to enable the Palestinian people to enjoy fruits of the peace on their side.

Meanwhile, as long as the U.N. sanctions on Iraq remain unchanged, regional economy will continue to be stagnant and thereby bring about decrease in volume of cargo traffic for the port of Aqaba and of export of Jordanian products to Iraq. Under such cirsumstances, joint development projects will be implemented at a slow pace and be limited to the Aqaba/Eilat area.

Table 4.4.1 Alternatives leading to Scenarios

Middle East Peace Process / UN Sanctions on Iraq	•To reach a comprehensive settlement. •Attain political stability in region. •Peace treaty to be signed between Israel and neighboring nations. •Peaceful co-existence in region.	•To progress steadily. •Following Egypt and Jordan, peace treaty between Israel and Syria/Lebanon to be negotiated. •Palestinian self-rule to be extended to other areas.	•To make slow progress but no setback in peace process. •Diplomatic contacts to be underway between Israel and other Arab countries.
To be lifted completely	•Economic activities to be invigorated over entire region. •Jordan enjoys foreign investment to its industry and infrastructures. •Volume of cargo and goods traffic to be increased at Aqaba port. •Changes likely in cargo/ passenger flow to and from Jordan. Case 1	•Give favorable impact on Jordan economy. •Jordan to yield peace dividend from domestic economic achievement. •Port facilities at Aqaba to be improved. •Gradual changes likely in cargo/passenger flow to and from Jordan. Case 2	•Jordan-Iraq crude oil pipeline to be planned. •Amount of peace dividend differs by each nation's stability and economic development. •Port facilities at Aqaba to be improved. Case 3
To be eased or partially lifted	•Give a stimulus to Jordanian economy. •Export of mineral products and import of consumer goods to be increased through port of Aqaba. •Jordan-Iraq crude oil pipeline to be constructed. •Changes likely in cargo/ passenger flow to and from Jordan. Case 4	•Trade block to be formed on a smaller scale by Jordan, Syria, Lebanon, PLO and Israel. •More national budget to be allocated on improvement of infrastructure. •Jordan-Iraq crude oil pipeline to be planned Gradual changes likely in cargo / assenger flow to and from Jordan. Case 5	•Jordan-PLO economic coperation, trade, transport, communication and banking etc. to be observed. •Even limited oil export helps reactivate regional economy and has favorable impact on Jordan. Case 6
To remain status quo	•Limited volume of cargo/ good traffic between Jordan and Iraq through port of Aqaba. •Development of Aqaba/Eilat area to be implemented. •Construction of Jordan-Israel-Egypt highway to be executed. •Changes likely in cargo / passenger flow to and from Jordan. Case 7	•Economic relations between Jordan and Israel to be promoted. •Development of Aqaba / Eilat area to be planned and partly implemented. •Gradual changes likely in cargo / passenger flow to and from Jordan. Case 8	•Regional economy to remain stagnant. •Aqaba/Eilat cargo and passenger facilities to be constructed. •Oil refinery in Aqaba to be planned. Case 9

Table 4.4.2 Scenario : Case 1

	Up to Year 2000	Up to Year 2010
Middle East Peace Process	Peace treaty between Israel and Syria/Lebanon is signed. Implementation of agreement on Palestinian self-rule progresses toward full autonomy. Negotiations between Israel and other Arab countries are in progress.	A permanent settlement is achieved and peaceful co-existence is observed in the regior Middle East economic block is formed among regional countries to consolidate economic base and enter into mutual cooperation with other trade blocks.
U.N. Sanctions against Iraq	Oil embargo is lifted. Iraq returns to world oil market. Iraq emerges as large market for products. Volume of cargo traffic between Jordan and Iraq is increased for both ways.	Oil embargo is lifted. As a regional economic power with large market, Iraq's resumption of oil export brings about favorable impact on Jordan and entire regional economy.
Economic Develop-ment in Jordan	With political and social stability, Jordan enjoys foreign investment in its industry and infrastructure.	Privatization of industry produces some fruits. Export industries gain competitiveness Development of rural areas succeeds to a certain degree.
Implemen-tation of Joint Develop-ment Projects	Construction of a highway connecting Jordan with Israel and Egypt is in progress. Construction of Iraqi-Jordan crude oil pipeline is commenced.	Highway construction is completed. Development of Jordan Rift Valley is underway. Amman-Aqaba railway is under construction.
Roles and Functions of Port of Aqaba	To play a larger role both in regional and international trade for both ways as center port and distribution center in the whole North Red Sea area. Hinterland: Jordan, Israel, East Egypt, Northern Saudia Arabia, Palestine (W.B) and Iraq.	To assume an important role in international trade as Eastern gate and distribution center in the whole East Mediterranean economic block. Hinterland: Jordan, Israel, Egypt, Northern Saudi Arabia, Palestine, Iraq, Syria and Lebanon.

Table 4.4.3 Scenario : Case 5

	Up to Year 2000	Up to Year 2010
Middle East Peace Process	Direct or indirect contacts between Israel and Syria/Lebanon are continued. Palestinian National Authority's self-rule area is extended and receives aid funds from international donor countries.	Peace treaty between Israel and neighboring countries is signed or under negotiations. Inter-Arab relations return to their previous level in terms of cooperation and coordination.
U.N. Sanctions against Iraq	Oil embargo is partially lifted and Iraq resumes oil export to pay debts and import essential commodities/goods. The U.N. Security Council is to meet periodical to review the sanctions. (Latest was in April 95)	Oil embargo is lifted. Iraq is regaining an influential position in OPEC and invigorates wider economic activity in the region. Increase in regional and international trade is expected in terms of value and volume.
Economic Development in Jordan	The 1993-1997 economic and social development plan resulted in sustainable growth, higher productivity, social/economic and administrative reform. Steady flow of foreign investment is maintained.	More national budget is allocated to domestic development projects as peace dividend with less military spending. Economy is full-grown and ready to expand towards wider horizon.
Implementation of Joint Development Projects	A highway linking Jordan, Israel and Egypt is under planning and construction has partially commenced. An Iraqi-Jordanian crude oil pipeline is under study.	Some joint projects in Aqaba/Eilat area are initiated. The government identifies priority of projects and begins implementation accordingly.
Roles and Functions of Port of Aqaba	To play an increased role in international trade, serving not only Jordan but part of neighboring countries as transshipment and transit port. Hinterland: Jordan, Israel, East Egypt, Northern Saudi Arabia, Palestine (W.B) and Iraq.	To serve as center port and distribution center in the whole North Red Sea area. Hinterland: Jordan, Israel, East Egypt, Northern Saudi Arabia, Palestine (West Bank) and Iraq.

Table 4.4.4 Scenario : Case 9

	Up to Year 2000	Up to Year 2010
Middle East Peace Process	Peace treaty between Israel and Egypt (1979) and Jordan (1994) and interrim agreement on Palestinian self-rule between Israel and PLO (1993) are signed. Israel-Syria/Lebanon tracks make slow progress for bilateral peace talks.	Israel-Syria/Lebanon tracks make progress. No war but cold peace is observed in the region. Aid from donor countries helps improve infrastructure in West Bank and Gaza.
U.N. Sanctions against Iraq	Oil embargo is not lifted. Unless eased or partially lifted sanctions continue to have negative impact on Jordan and the region.	As long as oil embargo remains enforced, there is little posibility of invigorating the economic activity in the region. Jordan's exports to Iraq remain insignificant.
Economic Develop-ment in Jordan	With scarce natural resources, shortage of water and lack of investment fund in the country, Jordan faces difficulity in carrying out planned schemes unless a better climate for foreign investment emerges, or enhancement of technological skills for the people and improvement of products quality for export take place.	Government continues to make heavy investment in infrastructure sectors (electricity, drinking water, telephone, road, mineral resources, transport). Each sector overcomes problems and achieves objectives.
Implemen-tation of Joint Develop-ment Project	An oil refinery will be planned in Aqaba. Construction of Iraqi-Jordanian crude oil pipeline will be Considered, pending the resumption of Iraqi oil export. Palestine economic zone will be established with Jordan's support to the West Bank area.	Jordan-Israel joint investment will be partially executed. Aqaba-Eilat free economic area will be partially executed. Jordan-Israel-Egypt high way is under planning. Cargo/passenger facilities are constructed at Aqaba and Eilat.
Roles and Functions of Port of Aqaba	To play a relatively minor role in international trade, serving largely Jordan in its export and import. Hinterland : Jordan, Israel, Palestine (part of West Bank) and Iraq.	To act as a unique port in Jordan and as distribution center in limited North Red Sea area. Hinterland : Jordan,Israel, Northern Saudi Arabia, Palestine (West Bank) and Iraq.

4.5 Demand Forecast

4.5.1 Introduction

Demand forecast shall be carried out through a deep analysis of port activities. Generally speaking, there are two types of methods to estimate future port traffic: a macroscopic demand forecast and a microscopic demand forecast. In the former method, future traffic is estimated by using socio-economic indicators on the basis of correlation analysis. On the other hand, future traffic can be estimated by directly summarizing each future cargo volume respectively on the basis of future consumption.

In case of the port of Aqaba, the hinterland is not only limited to Jordan but also includes other Arab countries. Each country has a different indicator, so the demand forecast of the port of Aqaba is not easy.

Present political and economic situations of the Middle East Region are not stable. So the Study Team and the counterparts selected three scenarios (Case 1, 5 and 9) in order to adjust planning conditions of the port of Aqaba to the Jordanian situation in each stage.

The demand forecast is outlined in Figure 4.5.1.

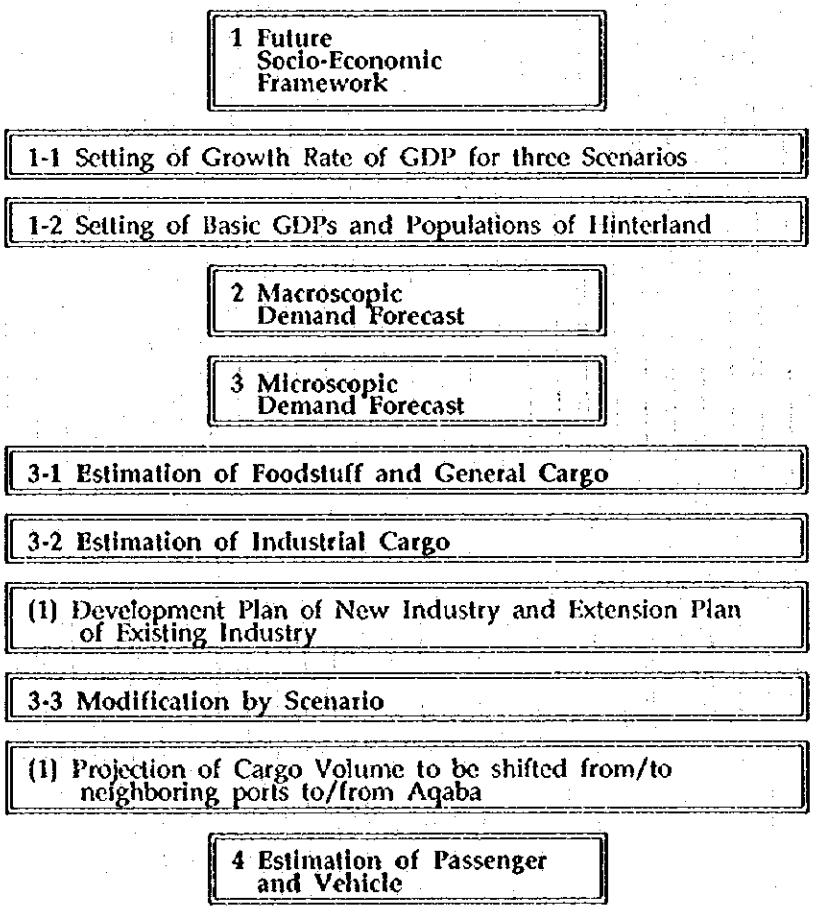

Figure 4.5.1 Flow of Demand Forecast

4.5.2 Future Socio-Economic Framework

Referring to "the Economic and Social Development Plan 1993-1997(by MOP)" (hereinafter referred to as "the Five Year Plan 1993-1997") and "Peace and the Jordanian Economy(by the World Bank)" (hereinafter referred to as "the World Bank's report"), two types of development plans were proposed, each with different GDP growth rates. The Five Year Plan 1993-1997 proposed a GDP growth rate of 6% per annum at 1991 prices. On the other hand, the World Bank's report expected an average GDP growth rate of 6.8% per annum during 1993-2003.

After these two reports had been authorized, the Peace Treaty between Jordan and Israel was signed and many projects entered the preliminary stage. On October 1994, Jordan submitted many projects at the Casablanca Economic Summit. The implementation of these projects would have various implications for Jordan and especially Aqaba. Jordanian projects consisted of 121 projects by 10 groups. Among the many proposed projects, 35 projects that influence port activities were also selected.

On the other hand, UN sanctions on Iraq are likely to be lifted sooner or later, which would have a huge impact on the Jordanian economy. So the Team and counterparts shall estimate higher growth rate of GDP than former two rates such as 8%, 9% or 10%. As of now the Study Team proposed Growth rates of GDP provisionally as follows:

Year	:	1993-2000	2001-2005	2006-2010
High Case	:	8.5 %	9.0 %	8.5 %
Middle Case	:	7.5 %	8.5 %	8.0 %
Low Case	:	6.0 %	6.0 %	6.0 %

Jordanian GDPs are estimated as follows(unit:million JDs):

Year	:	1993	2000	2005	2010	2010/1993
High Case	:	3,596	6,365	9,794	14,727	4.1
Middle Case	:	3,596	5,966	8,971	13,181	3.7
Low Case	:	3,596	5,407	7,236	9,683	2.7

Jordanian GDPs per capita are estimated as follows(unit:JDs):

Year	:	1993	2000	2005	2010
High Case	:	866	1,231	1,647	2,203
Middle Case	:	866	1,153	1,509	1,971
Low Case	:	866	1,045	1,217	1,448

The three scenarios have independent growth rate of GDP corresponding to economic activity in Jordan. The Israel-Jordan peace treaty has been signed and this will lead eventually to economic growth, but other peace treaties between Israel and other Arab countries will not have a huge effect on the Jordanian economy. Jordanian and Iraqi promote joint projects that have a large effect on Jordan economy, so the growth rate of Jordanian GDP will be affected when sanctions on Iraq are lifted. Corresponding to the level of Iraqi sanctions, growth rates of GDP of high, middle and low cases are applied to the previous three scenarios. Peace treaties between Israel and Arab countries have a large effect on shipping route of European-American cargoes, because free traffic access between Israel and Jordan is available only by peace of whole Mid-East Region. Relations between political and economic scenarios and Jordanian economy and port activity of Aqaba are shown in Table 4.5.1.

Table 4.5.1 Political Scenarios, Jordanian Economy and Port Activity

Iraq sanction \ Mid-East peace process	Comprehensive settlement	Steady progress	Slow progress
Total lifting of Iraq sanction	Case 1 Free traffic Access in Mid-East High growth rate of GDP	Case 2 Conditional Access in Mid-East High growth rate of GDP	Case 3 Restricted Access in Mid-East High growth rate of GDP
Partial lifting of Iraq sanction	Case 4 Free traffic Access in Mid-East Middle growth rate of GDP	Case 5 Conditional Access in Mid-East Middle growth rate of GDP	Case 6 Restricted Access in Mid-East Middle growth rate of GDP
Lifting of Iraq sanction in status quo	Case 7 Free traffic Access in Mid-East Low growth rate of GDP	Case 8 Conditional Access in Mid-East Low growth rate of GDP	Case 9 Restricted Access in Mid-East Low growth rate of GDP

4.5.3 Hinterland

Both the expansion and reduction of the hinterland can be considered. Namely, when large-sized container vessels call at Aqaba daily, Aqaba port is a hub port and hinterland expands not only to Arab countries but also to East Africa. On the other hand, from a pessimistic point of view, easy land access between Israel and Jordan-Iraq introduces expansion of hinterland of Israeli ports which are facing the Mediterranean Sea.

In this step, hinterland of the port of Aqaba is decided only by the distance between a port and users.

Population of Jordan, hinterland of Aqaba and that of Israeli Mediterranean ports are estimated as follows:

Year	1993	2000	2005	2010
Jordan	4,152,000	5,173,000	5,946,000	6,686,000
Hinterland of Aqaba (16%):	3,503,000	4,364,000	5,017,000	5,641,000
Hinterland of Mediterr. (84%):	649,000	809,000	929,000	1,045,000

Hinterland of Aqaba includes Aqaba, Ma'an, Tafiela, Karak and Balga. Northern governorate including Madaba and western governorate including Zarqa belong to hinterland of Israeli Mediterranean ports in case of western cargo.

4.5.4 Macroscopic Demand Forecast

In general, the cargo volume has a close relation with the social and economic indices of the country. The available social and economic indices in Jordan are population(1972-1993) and GDP(1983-1993). In 1980s the cargo volume indicates large fluctuation by Iraqi transit cargo. So long term data are effective for the study. Therefore, future cargo volume is estimated by utilizing population and Christian year.

1) Correlation between port cargo volume(V) and population(P)

$V = 5.052 \times P - 3387$ (R=0.646)
where, V : port cargo volume (thousand tons)
P : population (thousand)

2) Extrapolation of historical trend of cargo volume

$V = 444 \times Y - 870000$ (R=0.848)
where, V : port cargo volume (thousand tons)
Y : Christian year

The total cargo volume of the port of Aqaba in the future is estimated using the above equation in relation to population and Christian year. The results are shown in Figure 4.5.2, a summary of which is given below.

Table 4.5.2 Future Cargo Volume by Macroscopic Forecast

(unit:ton)

Year	by Population	by Christian year
1993	11,634,000	11,634,000
2000	22,745,000	17,516,000
2005	26,650,000	19,736,000
2010	30,388,000	21,956,000

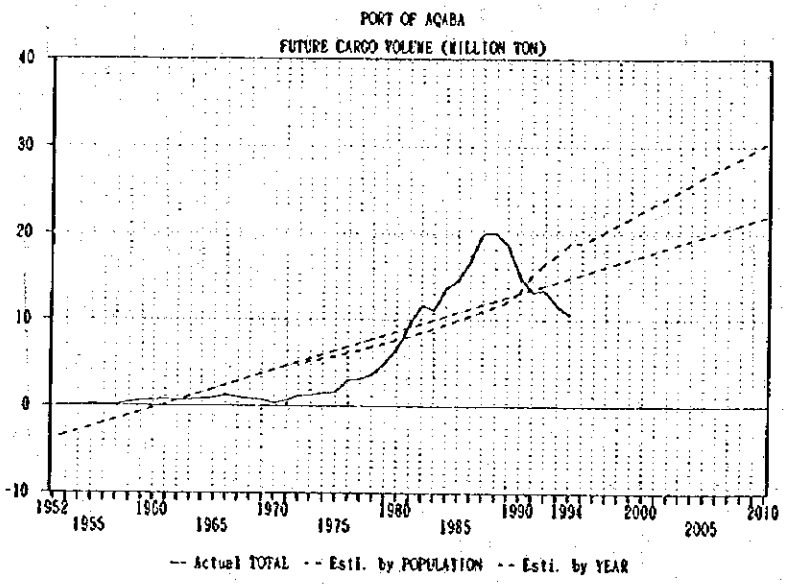

Figure 4.5.2 Future Cargo Volume by Microscopic Demand Forecast

4.5.5 Microscopic Demand Forecast

(1) General

1) Grouping of port cargo

There are 25 kinds of Jordanian imported cargoes, 8 kinds of imported transit cargoes and 9 kinds of exported cargoes in the statistics of PC. Considering the trend of cargo volume, several kinds of cargoes were selected as objects of projection. Names of projected cargo are listed in Table 4.5.3.

Table 4.5.3 Cargo List to be projected

Name	Import	Export
Local bulk	Grain	Phosphate
	Vegetable oil	Fertilizer
	Rice	Phosphoric Acid
	Livestock	Dead Sea Products
	Sulfur	Potash
	Liquid ammonia	Chemical oil
	Oil(thermal plant)	Cement
	Mineral/Chemical oil	
Local general cargo	Break bulk	Break bulk
	Container	Container
Transit	Rice	Rice
	Vegetable Oil	
	Livestock	
	Break bulk	Break bulk
	Container	Oil
Eilat transit		Phosphate
		Potash

2) Parameter of cargo forecast

Cargo volume will be estimated by GDP, population or industrial development plan. Usually foodstuff correlates to population and consumer goods are reflected in GDP. Generally speaking industrial products are also reflected in GDP but each industrial product is projected using production plan of its producer.

Port cargo by commodity is estimated by following index table.

Table 4.5.4 Port Cargo and its Index

Commodity	Index	Base data
Foodstuff 1 Grain Vegetable oil	Population	Average consumption per capita in previous 10 years
Foodstuff 2 Rice Livestock	Project Plan	
General cargo Break bulk Container	Population Growth rate of GDP	Average 10 years Average 5 years
Industrial cargo 1 Phosphate Sulfur Liquid ammonia Fertilizer Phosphoric Acid Potash Dead Sea products Oil (thermal plant) Cement	Project plan and world market	
Industrial cargo 2 Mineral/Chemical oil	GDP, Project Plan	Average 5 years
Transit Cargo 1 Rice Vegetable Oil Livestock	Project Plan and Regional market	
Transit Cargo 2 Break bulk Container Oil(Iraqi oil) Passenger on ferry Vehicle on ferry	GDPs of Arab countries Iraq sanction and Mid-East peace treaty	

(2) Future cargo volume

1) Foodstuff 1

Future cargo volume is estimated by average consumption volume per capita. In this study, average of ten years'(1984-1993) per capita consumption is checked for use as base data. But in 1988 characteristic of cargo volume is thought to be irregular, so base data are calculated except cargo volume in 1988. The same volume of cargo is applied to the three scenarios.

Table 4.5.5 Foodstuff in 2010

	Average cargo vol per capita	year 2010 population 6,686,000	
Grain	300 kg/capita	2,010,000	ton
Vegetable oil	25	170,000	

2) Foodstuff 2

Local consumption of Rice and Livestock is estimated by project plan of importers. Future volume of Rice is computed as bulk cargo at 115,000 tons, that is almost half of estimated import volume of Rice in 2010. Also, Livestock is forecasted from increasing of population and project plan of importers at 40,000 tons.

3) General cargo

General cargo usually consists of consumer goods and unspecified goods. This cargo is transported as break bulk, container and small bulk cargoes. This cargo includes sugar, frozen cargo, rice(in bag), forages, tea, cattle, sesame, coffee, potato, timber, tires, government goods, fertilizer, car, cement, cartridge, construction material, steel & iron and others.

Generally speaking, the ratio of container cargo to whole general cargo is growing as volume and value of cargo increase. Trend of containerization can be calculated by using logistic curve. Container cargo ratios of imported local cargoes at the port of Aqaba in 1980, 1985, 1990 and 1993 were 9%, 22%, 21% and 22% respectively. Ultimate container ratio of general cargo is calculated at 70%. The estimated future container cargo ratio is 59% in 2010.

Table 4.5.6 General Cargo in 2010 correlated to Population

	Average cargo vol per capita	year 2010 population 6,686,000
General cargo 1-Import(*1)	225 kg/capita	1,504,000 ton
General cargo 2-Import(*1) Sugar, Frozen cargo, Rice, Flour, Other 1	160 kg/capita	1,069,000 ton

Note: Other 1 includes Forages, Tea, Cattle, Sesame, Coffee, Potato.
(*1) means containerizable cargo (import).

Table 4.5.7 General Cargo in 2010 correlated to GDP

	Average cargo volume	year 2010 Case 1 (× 4.1)	Case 5 (× 3.7)	Case 9 (× 2.7)
General cargo 3-Import				
Steel&iron(*1)	332,000 ton	1,358,000	1,216,000	893,000
Other 2(*1)	91,100	373,000	334,000	245,000
Construction material etc.	3,560	15,000	13,000	10,000
General cargo 4-Export				
General cargo (112,000 × Multiplay F. × 0.9)	112,000	413,000	370,000	272,000

Note: Other 2 includes Timber, Tyres, Goverment goods, Fertilizer, Car, Cement, Cartridges.
(*1) means containerizable cargo (import).

Table 4.5.8 General Cargo in 2010 (Industrial Cargo)

	Average cargo vol	year 2010		
		Case 1	Case 5	Case 9
General cargo 5-Export Industrial and products (Dead Sea Products, Salt, others) (2300 × 0.9 × 0.15 × 0.9)	0	279,000	279,00	279,000

Some portions of container cargo shall be shifted from the port of Aqaba to Israeli Mediterranean port according to the progress of Mid-East peace treaty.

4) Industrial cargo

Industrial cargo is related to development plans of port users. PC suggested the study team future cargo volumes in Table 4.5.9. Future industrial cargo volume is evaluated with due consideration of world market condition and feasibility of the project.

Table 4.5.9 Future Port Cargo estimated by the Ports Corporation

Year	Import				Export			
	1993	1997	2000	2010	1993	1997	2000	2010
Total	5,253	11,580	13,011	17,010	6,381	15759	19,119	24,560
Grains	1,745	2,000	2,200	2,900	-	-	-	-
Rice	-	200	231	330	-	200	231	330
Bagged Cargo	639	700	770	1,000	-	-	-	-
JPMC & JFI	354	910	1,310	1,890	3,977	7,200	9,450	12,600
Phosphate	-	-	-	-	3,565	6,000	7,000	9,000
DAP	-	-	-	-	-	600	600	800
NPK	-	-	-	-	-	150	800	1,300
Sulfur	-	700	1,000	1,400	-	-	-	-
Liq. Ammonia	-	210	310	490	-	-	-	-
Phos. Acid					-	450	1,050	1,500
Arab Potash	-	-	-	-	1,452	3,900	4,200	4,500
Potash	-	-	-	-	1,452	2,200	2,200	2,200
Salt	-	-	-	-	-	1,000	1,000	1,000
Dead Sea products	-	-	-	-	-	500	800	1,000
Others	-	-	-	-	-	200	200	300
Power Station	-	720	720	720	-	-	-	-
Cement	-	-	-	-	695	1,343	1,629	2,500
Livestock	-	40	50	70	-	-	-	-
Steel/Iron	406	600	800	1,000	-	-	-	-
Car/Vehicle & Tire	65	100	130	200	-	-	-	-
Vegetable Oil	244	272	300	400	-	-	-	-
Chemical oil (Solvochem Holland)	-	263	300	500	-	100	150	250
Others	1,800	5,775	6,200	8,000	257	3,016	3,459	4,410
General Cargo	1,793	2,000	2,000	2,000	102	803	879	1,000
Transhipment	-	-	-	-	1	20	20	30
Transit	-	3,775	4,000	5,000	28	2,000	2,300	3,000
Re-Export	-	-	-	-	26	43	60	80
Others(Emp.Con.etc)	7	-	-	-	100	150	200	300

a) Phosphate

The export volume of phosphate has been rapidly decreasing since 1990 because of less consumption in East Europe and heightened competition. Phosphate consumption is, however, estimated to increase in response to world population growth.

Table 4.5.10 Future Demand of Phosphate

Year	1990	2010
World population	5,266,007,000	6,944,433,000
Phosphate(export)	4,874,000 ton	6,400,000 ton

b) Fertilizer

Export volume in 1993 was 410,000 tons. Future volume of signed projects is counted as additional volume in 2010. Total export volumes of DAP, NPK and phosphoric acid are estimated as 800,000, 1,300,000 and 1,500,000 tons respectively.

c) Potash

Future consumption is projected to increase in accordance with production schedule. Future export volume is estimated as 2,200,000 tons, which is in agreement with the PC projection.

d) Sulfur, liquid ammonia

Raw material of fertilizer, cargo volumes of sulfur and liquid ammonia are estimated at 1,400,000 and 490,000 tons.

e) Dead Sea Products

According to the project plan, port cargo volume is expected at 1,200,000 tons from production of industrial salt.

f) Oil (thermal plant)

Import of 720,000 tons of oil is planned for Aqaba thermal power plant.

g) Cement

Cement industry is an import substituted industry and is not an export oriented industry. So, the balance of domestic consumption in annual production volume (4 million tons) is to be exported. So, the exported volume is expected at 200,000 tons in Case 1, 700,000 tons in Case 5 and 1,200,000 tons in Case 9 respectively.

h) Mineral oil/Chemical oil

Mineral oil/chemical oil is expected using growth rate of GDP and project plan as following Table:

Year	1993	2010 Case 1	2010 Case 5	2010 Case 9
Mineral/Chemical oil(import)	240,000	1,000,000	890,000	650,000
Chemical oil(import)		500,000	500,000	500,000
Chemical oil(export)		250,000	250,000	250,000
Mineral oil(import)		500,000	390,000	150,000

Table 4.5.11 Future Industrial Cargo Volume

Industrial cargo	Estimated volume	
	Import	Export
Phosphate		6,400,000
Sulfur	1,400,000	
Liquid ammonia	490,000	
Fertilizer		2,100,000
Phosphoric acid		1,500,000
Potash		2,200,000
Dead Sea Products		1,200,000
Oil(thermal plant)	720,000	
Cement		200,000-700,000-1,200,000 (Case 1)(Case 5)(Case 9)

5) Transit Cargo 1 -Rice, Vegetable oil and Livestock

These commodities has no stable trend in Aqaba Port activity. Future volume is estimated by projects plan of importers. In case of Rice, cargo handling of import and export activities is executed by Aqaba Packing Co. and limited to Mo'ta floating berth. Other two commodities are imported by a few importers. So, considering their business plan and projected volume by PC, 630,000 tons of Rice, 230,000 tons of Vegetable Oil and 70,000 tons of Livestock are recognized as future cargo volume in 2010.

(3) Modifying cargo volume by Scenario

1) Israel-Jordan joint projects

Commencement of Israel-Jordan joint projects will result in a large demand for construction materials such as cement, steel & iron, and so on. Based on peak volumes in 1982, 1,000,000 tons of cement and 440,00 tons of steel & iron will be necessary to satisfy this demand for Case 1. Therefore, cement will decrease export volume and steel & iron will increase import volume. In cases of Case 5 and Case 9, 50% and 0% of volume of Case 1 are estimated respectively.

Table 4.5.12 Additional Consumption by Israel-Jordan Project

	Case 1	Case 5	Case 9
Additional consumption(cement)	1,000,000 ton	500,000 ton	0 ton
Additional consumption(steel&iron)	440,000 ton	220,000 ton	0 ton

2) Transit cargo 2

According to the statistics, in 1989 Iraqi transit import cargo reached 6,087,000 tons, equal to 333 kg/capita. In 1992, annual volume reached 1,959,000 tons, equal to 102 kg/capita. Historical transit cargo volumes of other countries are shown in Table 4.5.13.

Table 4.5.13 Transit Cargo Volume

Country	1978	1985	1989	1992	1994	2010 Case 1
cargo volume (ton)						
Iraq	17,901	3,969,212	3,087,125	1,959,465	193,891	1,720,000
Syria	508	n.a.	35	1,535	1,239	0
Saudi Arabia	78,012	24,358	34,798	77,69	136,473	210,000
Lebanon	14,659	428	232	4,512	6,100	0
Kuwait	620	6,770	19,647	29,867	31,625	50,000
Yemen	613	n.a.	2,171	3,441	455	0
U.A.E.	n.a.	4,375	7,860	13,011	16,444	20,000
Others	1,354	2,527	10,980	3,918	1,491	0
Total	133,667	4,007,670	6,162,848	2,093,544	387,668	2,000,000
per capita cargo volume	(kg)					
Iraq	1	250	333	102	9	53
Syria	0.1	0	0.0	0.1	0.1	0
Saudi Arabia	9	2	2	5	8	7
Lebanon	5	0.1	0.1	2	2	1
Kuwait	1	4	10	15	18	20
Yemen	0.1	0	0.2	0.3	0.0	0
U.A.E.	0	3	5	8	9	10

Transit cargo consists of container cargo and break bulk cargo. Considering historical trend of container cargo, a ratio of container cargo is set at 25%, 20% and 16% of whole transit import cargo by Case 1, Case 5 and Case 9 respectively. And Transit export cargo is set at 10% of whole import cargo.

Table 4.5.14 Transit Cargo by Type

	Case 1	Case 5	Case 9
Transit container(import)($1)	500,000 tons	200,000 tons	80,000 tons
Transit break bulk(import)	1,500,000	800,000	420,000
Transit break bulk(export)	200,000	100,000	50,000

Note: ($1) is referred in estimation of Empty container.

3) Aqaba-Eilat Free Trade Zone(AEFTZ)

Aqaba-Eilat Free Trade Zone (AEFTZ) is assumed to be established on Israel-Jordan border. Number of employees is expected to be 5,000, that is just half of the existing Amman Industrial Estate. Total cargo volume is assumed to be 10,000 TEU in Case 1. Cargo volumes of Case 5 and Case 9 are assumed to be 50% and 0% of Case 1 respectively. Two thirds of cargo are imported, and one third of cargo is exported. If cargo weight of TEU is assumed as 11 tons, cargo volume is estimated as follows:

Table 4.5.15 Aqaba-Eilat FTZ

	Case 1	Case 5	Case 9
Import container	70,000 ton	40,000 ton	0 ton
Export container	40,000	20,000	0

4) Iraqi oil export

Implementation of Iraqi oil export project is expected in accordance with lifting of Iraqi sanctions. Maximum exporting volume is projected at 1 million barrels per day. In this study, working ratio is assumed as 0.65 and total annual volume is set at 34,000,000 tons($0.160*10^6 m^3$/day*0.9tons/m^3*360days*0.65). In cases of Case 5 and Case 9, this project is thought to be postponed.

5) Shifting import container cargo

According to Figure 2.4.6, share of western container cargo to whole container cargo is about 50%. Considering population of hinterland(refer to 4.5.3 Hinterland) and economic potential, 80% of western cargo is projected to have a benefit through Israeli Mediterranean port instead of the port of Aqaba. Therefore 40% of computed container cargo shall be shifted from Aqaba to Mediterranean ports in Case 1. In case of Case 9, this kind of economic benefit is not considered, and no container cargo shall be shifted. In case of Case 5, 20% of computed container cargo is thought to be shifted.

Table 4.5.16 Shifting Container Cargo (Import)

	Case 1	Case 5	Case 9
Total break bulk cargo(#1) (refer to Tables 4.5.6, 4.5.7 & 4.5.20 break bulk)	4,745,000	4,343,000	3,711,000
Container cargo(#2) (0.59 × (#1))	2,800,000	2,563,000	2,190,000
Shifted container(#3) (0.4 or 0.2 × #2)	1,120,000	510,000	0
Remained container(#4) (#2 - #3)	1,680,000	2,050,000	2,190,000
Container cargo(#5) (Aqaba-Eilat FTZ)	70,000	40,000	0
Total container(import)(#6) (#4 + #5)	1,750,000	2,090,000	2,190,000

6) Shifting of export bulk cargo

Along the Israeli-Jordanian border, industrial railway will carry phosphate, potash and dead sea products. Starting point of railway is the Dead Sea and arriving point is Aqaba. Both Israeli and Jordanian products will be transported. In cases of Case 1 and Case 5, this project will be carried out. Export volumes of Israeli phosphate and potash are estimated using data obtained at the port of Eilat and the same multiplying factor(=1.52) of Jordanian potash.

Table 4.5.17 Industrial Cargo shifted from Eilat

Year	1993	2010		
		Case 1	Case 5	Case 9
Israeli phosphate	640,000	970,000	970,000	0
Israeli potash	650,000	990,000	990,000	0

7) Volume of empty container

Current export container is almost empty. In the future, loaded container is expected to increase in volume depend on growth of GDP. Number of empty container can be obtained by computing the difference between import and export as shown in following Table.

Table 4.5.18 Empty Container

	Case 1	Case 5	Case 9
Import container($1+#6) (refer to Tables 4.5.14 & 4.5.16)	2,250,000	2,290,000	2,270,000
Export container (10% of General cargo)	70,000	70,000	60,000
Export container (refer to Table 4.5.15)	40,000	20,000	0
Difference of volume(@1)	2,140,000	2,200,000	2,210,000
Empty container (@1/11 × 2)	390,000	400,000	400,000

8) Results of modification by scenario

Final estimated cargo volume in 2010 is shown on Table 4.5.19.

Table 4.5.19 Results of Modification by Scenario

	Case 1	Case 5	Case 9
Israel-Jordan joint project			
Cement(export)	1,500,000	2,000,000	2,500,000
Steel&iron(import)	1,798,000	1,436,000	893,000
Transit cargo(total)	2,200,000	1,100,000	550,000
Container(import)	500,000	200,000	80,000
Break bulk(import)	1,500,000	800,000	420,000
Break bulk(export)	200,000	100,000	50,000
Aqaba-Eilat Free Trade Zone			
Container(import)	70,000	40,000	0
Container(export)	40,000	20,000	0
Iraqi oil export			
Oil(import)	0	720,000	720,000
Oil(export)	34,000,000	0	0
Modified container cargo			
Loaded(import)	17,500,000	2,090,000	2,190,000
Volume of empty container			
Empty(export)	390,000	400,000	400,000

9) Future cargo volumes in 2010 and 2000

Future cargo volume in 2010 is summarized in Tables 4.5.20, 4.5.21, 4.5.22 by trade.

Table 4.5.20 Future Port Cargo in 2010 - Import

(unit : thousand tons)

	AQABA / Year	Import 1993 Modified	2010 CASE-1	2010 CASE-5	2010 CASE-9
LOCAL	BULK				
	GRAIN	1,300	2,010	2,010	2,010
	RICE(50%ofWhole)	104	115	115	115
	VEGETABLE OIL	174	170	170	170
	LIVESTOCK	25	40	40	40
	PHOSPHATE				
	SULFER	210	1,400	1,400	1,400
	LIQ.AMMONIA	130	490	490	490
	FERTILIZER(SOLID)				
	PHOSPHORIC ACID(LIQUID)				
	POTASH				
	DEAD SEA PRODUCTS				
	OIL(CRUDE OIL, FUEL OIL)		0	720	720
	MINERAL/CHEMICAL OIL	240 (AVE89-93)	1,000	890	650
	CEMENT				
	SUB TOTAL	2,183	5,225	5,835	5,595
	GENERAL CARGO				
	BREAK BULK	1,580	1,950	1,780	1,520
	CONTAINER	570	1,750	2,090	2,190
	LOCAL LOADED CONTAINER		1,680	2,050	2,190
	AQABA FREE ZONE		70	40	0
	OTHERS(EMPTY C.etc.)				
	SUB TOTAL	2,150	3,700	3,870	3,710
TRANSIT	RICE(in BULK)		330	330	330
	VEGETABLE OIL		230	230	230
	LIVESTOCK		70	70	70
	BREAK BULK	1,260	1,500	800	420
	CONTAINER	20	500	200	80
	OIL(CRUDE OIL, FUEL OIL)				
	SUB TOTAL	1,280	2,630	1,630	1,130
EILAT	BULK				
	PHOSPHATE				
	POTASH				
	SUB TOTAL				
	GRAND TOTAL	5,613	11,555	11,335	10,435

NOTE1:GENERAL CARGO includes following cargoes;
(SUGAR) (FROZEN CARGO) (RICE)
(FORAGES, TEA, CATTLE, SESAME, COFFEE, POTATO)
(TIMBER, TYRES, GOV.GOODS, FERTILIZER, CAR, CEMENT, CARTRIDGE)
(CONST.MAT.) (STEEL&IRON) (OTHERS)

NOTE2:Cargo volumes of TRNSIT RICE, VEGETABLE OIL and LIVESTOCK in 1993 are not available.

Table 4.5.21 Future Port Cargo in 2010 - Export

(unit : thousand tons)

	AQABA	Export			
	Year	1993	2010	2010	2010
		Modified	CASE-1	CASE-5	CASE-9
LOCAL	BULK				
	GRAIN				
	RICE				
	VEGETABLE OIL				
	LIVESTOCK				
	PHOSPHATE	3,570	6,400	6,400	6,400
	SULFER				
	LIQ. AMMONIA				
	FERTILIZER(SOLID)	410	2,100	2,100	2,100
	PHOSPHORIC ACID(LIQUID)		1,500	1,500	1,500
	POTASH	1,450	2,200	2,200	2,200
	DEAD SEA PRODUCTS		1,200	1,200	1,200
	OIL(CRUDE OIL, FUEL OIL)				
	MINERAL/CHEMICAL OIL		250	250	250
	CEMENT	700	200	700	1,200
	SUB TOTAL	6,130	13,850	14,350	14,850
	GENERAL CARGO				
	BREAK BULK	160	690	650	550
	CONTAINER	100	500	490	460
	LOCAL LOADED CONTAINER		70	70	60
	AQABA FREE ZONE		40	20	0
	OTHERS(EMPTY C. etc.)		390	400	400
	SUB TOTAL	260	1,190	1,140	1,010
TRANSIT	RICE(in BULK)		300	300	300
	VEGETABLE OIL				
	LIVESTOCK				
	BREAK BULK		200	100	50
	CONTAINER				
	OIL(CRUDE OIL, FUEL OIL)		34,000		
	SUB TOTAL	0	34,500	400	350
EILAT	BULK				
	PHOSPHATE		970	970	
	POTASH		990	990	
	SUB TOTAL		1,960	1,960	
	GRAND TOTAL	6,390	51,500	17,850	16,210

NOTE1:GENERAL CARGO includes following cargoes;
(SUGAR) (FROZEN CARGO) (RICE)
(FORAGES, TEA, CATTLE, SESAME, COFFEE, POTATO)
(TIMBER, TYRES, GOV. GOODS, FERTILIZER, CAR, CEMENT, CARTRIDGE)
(CONST. MAT.) (STEEL&IRON) (OTHERS)

NOTE2:Cargo volumes of TRNSIT RICE, VEGETABLE OIL and LIVESTOCK in 1993 are not available.

Table 4.5.22 Future Port Cargo in 2010 - Total

(unit : thousand tons)

	AQABA Year	Total			
		1993	2010	2010	2010
		Modified	CASE-1	CASE-5	CASE-9
L	BULK				
O	GRAIN	1,300	2,010	2,010	2,010
C	RICE	104	115	115	115
A	VEGETABLE OIL	174	170	170	170
L	LIVESTOCK	25	40	40	40
	PHOSPHATE	3,570	6,400	6,400	6,400
	SULFER	210	1,400	1,400	1,400
	LIQ.AMMONIA	130	490	490	490
	FERTILIZER(SOLID)	410	2,100	2,100	2,100
	PHOSPHORIC ACID(LIQUID)		1,500	1,500	1,500
	POTASH	1,450	2,200	2,200	2,200
	DEAD SEA PRODUCTS		1,200	1,200	1,200
	OIL(CRUDE OIL, FUEL OIL)			720	720
	MINERAL/CHEMICAL OIL	240	1,250	1,140	900
	CEMENT	700	200	700	1,200
	SUB TOTAL	8,313	19,075	20,185	20,445
	GENERAL CARGO				
	BREAK BULK	1,740	2,640	2,430	2,070
	CONTAINER	670	2,250	2,580	2,650
	LOCAL LOADED CONTAINER		1,750	2,120	2,250
	AQABA FREE ZONE		110	60	
	OTHERS(EMPTY C. etc.)		390	400	400
	SUB TOTAL	2,410	4,890	5,010	4,720
T	RICE(in BULK)		630	630	630
R	VEGETABLE OIL		230	230	230
A	LIVESTOCK		70	70	70
N	BREAK BULK	1,260	1,700	900	470
S	CONTAINER	20	500	200	80
I	OIL(CRUDE OIL, FUEL OIL)		34,000		
T	SUB TOTAL	1,280	37,130	2,030	1,480
E	BULK				
I	PHOSPHATE		970	970	
L	POTASH		990	990	
A	SUB TOTAL		1,960	1,960	
T	GRAND TOTAL	12,003	63,055	29,185	26,645

NOTE1:GENERAL CARGO includes following cargoes;
(SUGAR) (FROZEN CARGO) (RICE)
(FORAGES, TEA, CATTLE, SESAME, COFFEE, POTATO)
(TIMBER, TYRES, GOV.GOODS, FERTILIZER, CAR, CEMENT, CARTRIDGE)
(CONST.MAT.) (STEEL&IRON) (OTHERS)

NOTE2:Cargo volumes of TRNSIT RICE, VEGETABLE OIL and LIVESTOCK in 1993 are not available.

4.5.6 Passenger and Vehicle Forecast

The completion of the Jordan-Israel-Egypt coastal highway will have either a positive or negative impact on vehicle and passenger traffic of the port of Aqaba depending on one's viewpoint. This highway may result in less passengers and less trucks because they can use the highway from Aqaba to Nuweiba in half the time by ferry. However, the number of trucks may remain the same as at present because ferry trip gives drivers a short rest during long distance transport or saves tax-charge by Israeli customs. Also the Israeli government does not appreciate many passengers passing Eilat without staying.

In this study, buses registered with the Israeli government are assumed to have permission to pass Eilat with ease in Case 1.

Regarding foreign tourists, a foreign passenger ship will call at Eilat because of a basic agreement between Jordan and Israel.

Future passenger and vehicle are estimated using GDP of hinterland. Growth rate of GDP of Mid-East is projected at 4.5% because the World Bank Report forecasts that the growth rate of GDP of this area is 4.5% during 1992-2002(refer to "Global Economic Prospects and the Developing Countries").

Number of Egyptian workers in East Arab countries is estimated in the following table(Table 4.5.24).

Table 4.5.23 Passenger and Vehicle Traffic in 2010

Year	1993	2010
Passenger	1,247,167	2,600,000
Vehicle	113,462	240,000

Table 4.5.24 Egyptian Workers in East Arab Countries

	1993 estimated	2010 estimated		
		Case 1	Case 5	Case 9
Iraq	500,000	3,250,000	2,125,000	500,000
Other Arab Countries	3,400,000	3,250,000	3,250,000	3,250,000
Total	3,900,000	6,500,000	5,375,000	3,750,000
Ferry passenger(30% of workers)	1,170,00			
Ferry passenger(40% of workers)		Base (2,600,000) Actual 960,000	2,150,000	1,500,000
No. of vehicle	113,462	240,000	200,000	140,000

1) Case-1

Most Egyptians travel by land. Only 240,000 vehicles were carried on ferry. Total ferry passenger equals 960,000 (4 persons per vehicle).

2) Case-5

Most Egyptian tourists use ferry boat. Basic number of passenger and vehicle shall be modified according to the scenario. In cases of Case 5 and Case 9, unemployment in Iraq is pronounced due to sanctions. Number of vehicle is in proportion to number of passenger.

4.6 Required Port Facilities and Equipment

Required port facilities and equipment for the Master Plans are determined in accordance with the selected scenarios (Case 1, 5 and 9).

4.6.1 Functional Allotment of Port Activities

The port of Aqaba currently handles many kind of cargoes and already has a lot of port facilities and equipment. Before examining required port facilities and equipment at the target year, 2010, allotment and capacity of the existing port facilities and equipment should be evaluated. In this section, existing functional allotment will be reviewed first and then the conceptualization of the Master Plans will be examined. Evaluation of port capacity will be made later.

Main Port: Phosphate, Grain, Break bulk cargoes (General cargoes) are major cargoes to be handled. Almost all administrative departments including marine control center are located here. There is also a water basin for tug boats and barges to be moored and maintenance or repair shops for small working crafts or cargo handling equipment.

Container Port: Four separate port facilities exist: Container/Ro-Ro berth, passenger berth (Yarmouk), floating berth for rice (Mo'ta) and dolphin berth for cement (Mosh). The latter two berths are used exclusively by companies which have their own factory or storage area at the land side behind the berth.

Industrial Port: Three separate port facilities exist: dolphin berth for fertilizer products, materials and potash, tanker berth for oil and chemical product and small quay for livestock mainly to be unloaded. Each berth, in particular, dolphin berth (JFI.E and JFI.W) and tanker berth (Oil Jetty), is used exclusively. Small quay for livestock is officially named JFI.1 but goes by the name of "Timber Berth" because it was related to the timber processing product project. There is a warehouse for timber at the land area just behind the JFI.1 berth. JFI.E and JFI.W are owned by The Ports Corporation but operated by a private company named Jordan Phosphate Mine Co. A project to increase fertilizer production is presently ongoing while another similar project is being discussed by organizations concerned.

Major problems related to the existing functional allotment of port activities are as follows;

1) Dust pollution caused by handling phosphate needs to be minimized to preserve the environment of the urban area near the port and to allow for tourism development of the Gulf of Aqaba. The best solution is to relocate phosphate handling facilities. From a practical viewpoint, however, this might prove difficult. The Ports Corporation has already set up the choke feeders at the outlet of the cargo loading equipment into ships at the Phosphate B berth so as to prevent dust diffusion during discharging. In addition, efforts to further reduce dust are being made. If phosphate is exported at another place (the industrial port is the most proper site), a large amount of money would be required to replace and renew the berth, storage and cargo handling system. Considering the budgetary constraint, relevant organizations will have to depend upon foreign aid in order to acquire the necessary funds. In a practical sense, then, it is thought that replacement of phosphate berth together with related facilities and equipment will not be completed by the target year, 2010.

2) It is sometimes said that the location of the passenger terminal is inconvenient for movement to and from the central city of Aqaba. In particular, when many tourists stay at hotels and then use ferry boats to move between Aqaba and Nuweiba, it may be better for the passenger terminal to be located closer to the city. Almost all passengers, however, are migrants, of which about 90 % are presently Egyptian. They are transit passengers. Their origin or destination place usually differs from Aqaba city so that they seldom stay in Aqaba. This type of passenger movement through the port of Aqaba will not change in future because the steamship route offers cheap fares. In this context, the present location of the existing passenger terminal can be justified by the following reasons:

a) Passenger terminal does not necessarily need to be located near the central city because passengers rarely enter the city for extended periods. Most of them move through Aqaba city as quickly as possible before or after boarding ferry boats. Sometimes they do not enter the city at all.

b) Procedures necessary to cross borders such as customs require space. Offices related to these procedures usually require isolated areas due to their jobs. Taking into account that most users are foreign migrants, it is understandable to place those offices apart from the central city.

c) A large number of vehicles are carried together with passengers. In order to smoothly handle many cars, large parking areas are required. Considering the topography in Aqaba, it is difficult to secure appropriate places near the city where movement of vehicles would not negatively influence the city's environment.

Taking the above into consideration, it is better to retain the existing passenger terminal. This helps to minimize construction cost for implementation of the Master Plan by making the best use of two modern passenger halls which were erected just over ten years ago, in 1983.

It is said that there is another problem in terms of the passenger terminal layout. The distance between the passenger halls and the berths is over 540 m, rather long, so that it is tiresome for passengers to move to/from the halls, in particular, during the hot season. This problem will be examined later in the section "Proposed Master Plan".

There are no other serious problems. All other port facilities are located at the most convenient site near storage or factories. Taking some typical examples, JFI.E, JFI.W, Mo'ta and Mosh berth with related factories and storage are found just behind the port facilities. Such a location is the most reasonable for their activities. In other words, it can be recognized that those port facilities constitute parts of their factory. Therefore, those port facilities should be retained as far as the production activities will be continued as they are or they are to be increased.

As a result, the functional allotment at the target year, 2010, is basically thought to be the same as the existing one.

In the next section, capacity of individual port facilities will be evaluated, referring to the allotment of port activities mentioned here.

4.6.2 Methods of Capacity Evaluation

Evaluation of Present Capacity

As mentioned in the above 4.6.1, the Port of Aqaba consists of Main port, Container Port and Industrial Port. Each port is currently operating smoothly by using its equipment and facilities to accommodate various kinds of calling vessels and cargoes.

It is necessary to review the present port capacity due to increased number of vessels and cargo volume expected on route to the target year.

What follows is an evaluation of present port capacity.

(1) Main Port

This port is currently dealing with general cargo, grain, phosphate, vegetable oil and bunkering.

1) Berths

Acceptable maximum draft of calling vessels in Berth No.1 to 7 is now 13.0 meters at Berth No.3, otherwise it is 14.4 meters at Phosphate Berth B. Nowadays many Panamax bulk carriers with draft more than 13 meters are calling at this port to discharge grain and go alongside at Berth No.3 about one meter apart from berth by inlaying Yokohama fenders in between berth front and vessel side in order to gain increased depth. Some of such vessels are obliged to shift from Berth No.3 to Berth No.1 after decreasing their draft by discharging parts of grain, because Berth No.1 is specified for MOS (Ministry of Supply) grain vessels and can accept vessels with maximum draft 10.8 meters.

In view of efficient port management, these operations are unpractical. Berth assigned for Panamax carrier such as grain carrier should be deepened up to minus 14 meters to ensure available draft of 13 meters at all times without shifting.

In the target year, 2010, size of calling vessels will become undoubtedly larger than at present to meet the increased cargo volume.

2) Storage Facilities

There is a paved storage area of 281,000 square meters which consists of the closed storage of 40,000 m^2 including one cold store of 500 m^2, the hunger storage of 34,000 m^2 and the open storage of 207,000 m^2. As far as capacity is concerned, there may be sufficient storage space for general cargoes.

Cargo storage capacity in the Main Port through the year is 6.84 million MT, assuming cargo dwelling time in the port area is 15 days.

Cargo occupancy of storage	; 50 %
Height of stored cargo	; 2 meters
Storage factor	; 1 MT/m^2
Cargo dwelling time	; 15 days (Figures in 1994)
Capacity through the year	; 6,840 thousands MT

Meanwhile, some kinds of cargoes are delivered directly on trucks without storage in the port which makes further additional capacity.

Provided that cargo dwelling time could be shorted by one day, overall capacity could be increased by 7 percent. This is the most important element for the increase of cargo storage capacity for the future.

Regarding Phosphate Berths, Berth B is presently acceptable for large vessels with draft up to 14.4 meters as mentioned above and Berth A for tanker of vegetable oil with draft up to 11.0 meters.

Phosphate Berth A and B might have sufficient capacity even in the target year.

(2) Container Port

This port is currently dealing with mainly container ships, ferry boats, bulk cement ships and bulk rice ships.

< Container Terminal >

There are three container berths with 540 meters in length, which can accommodate calling vessels with up to 14.0 meters draft. Two gantry cranes are available.

Main specifications of the above two gantry cranes;- (The third generation)

Type of crane; Rope trolley, hinged boom type gantry crane
Rate load; 40 tons under spreader
Rail span; 18 meters

Trolley travel;	Outreach	;	37.250 meters
	Backreach	;	16.0 meters
	Total length of trolley	;	71.25 meters
	Lift above rail	;	27 meters
	Lift under rail	;	15 meters
Speed;	Main hoist (Rated load)	;	35 meters / min
	Main hoist (Spreader only)	;	75 meters / min
	Cross traverse (All loads)	;	140 meters / min
	Boom hoist	;	5 meters / min
	Long travel (All loads)	;	140 meters / min

The capacity of container yard through a year is calculated as follows; -

1) Present available ground slots;

Yard 1 / 2 - 3,000 TEUs, Yard 3 - 705 TEUs, Yard 4 - 800 TEUs, Free Zone - 312 TEUs Total available ground slots - 4,817 TEUs (Remark; Yard 4 was reviewed)

2) The conditions of study;

a) Usable slots

- In Yard 1 / 2: available slots for full containers with two tiers are 6,000 TEUs.
- In Yard 3: available slots for empty containers with three tiers are 2,115 TEUs.
- In Yard 4: available slots for empty containers with three tiers are 2,400 TEUs.

- In Free zone: available slots for full containers with two tiers are 624 TEUs.

Total usable slots in Container Terminal are 11,139 TEUs.

b) Container Dwelling Days in the terminal

- In Case-1: 21 days for full containers (almost all import)
  22 days for empty containers (almost all export)
  (Based on 1994 statistics)

- In Case-2: 10 days for full containers
  7 days for empty containers
  (Expected figures in the target year)

3) The capacity of container storage through the year calculated using the above conditions

- In Case-1: 104,000 TEUs for Yard 1 / 2
  34,990 TEUs for Yard 3
  39,700 TEUs for Yard 4
  10,810 TEUs for Free Zone

Total available capacity for the year 189,500 TEUs

- In Case-2: 218,400 TEUs for Yard 1 / 2
  109,980 TEUs for Yard 3
  124,800 TEUs for Yard 4
  22,710 TEUs for Free Zone

Total capacity for the year 475,890 TEUs

As a result of the above study, the capacity of the present container yard in the terminal is sufficient even in the target year, provided that container dwelling time could be improved in Case-2.

Table 4.6.1 Present Capacity of Container Storage in Container Terminal

Area	Present Ground Slots in TEU	Container Mode	Tiers	Available slots in TEU	Case-1 (Container Dwelling Days: Full=21 Empty=22)	Case-2 (Container Dwelling Days: Full=10 Empty=7)
Yard 1/2	3,000	Full Container	2	6,000	104,000	218,400
Yard 3	705	Empty Container	3	2,115	34,993	109,980
Yard 4	800	Empty Container	3	2,400	39,709	124,800
Free Zone	312	Full Container	2	624	10,816	22,713
Total TEUs	4,817			11,139	189,518	475,893

* Number of days per year is 364 days according to PC Calculation Sheet of Container Duration Average.

But from an operational point of view, there are two serious problems in this terminal at the present time. One is the interruption by the existing main road passing through between Yard 1 / 4 and Yard 2 / 3 and the other is the difficulty of container movement due to different height (about 10-20 meters) between Yard 1 / 4 and Yard 2 / 3.

Prior to the target year, 2010, these problems must be solved.

< Ferry Boat Berths (Passenger floating Berth) >
< Bulk cement Berth (Mushtarak Berth) >
< Bulk Rice Berth (Mo'ta floating Berth) >

These three kinds of berths will function without major investment even in the target year as far as the size of berths concerned. Berthing capacity will be mentioned later.

(3) Industrial Port

This port consists of Industrial Berths, Oil Jetty and Timber Berth.

< Industrial Berths (JFI West and East) >

There are two berths which consist of JFI West and East nearby southern border of Jordan with Saudi Arabia. JFI East Berth handles Potash, DAP and Phosphoric Acid to be loaded and, Liquid Ammonia and Fuel to be discharged. JFI West Berth handles Potash and DAP in bulk to be loaded and Sulfur in bulk to be discharged. PC owns these berths including port facility connected with the industrial factories (JPMC and APC) up to Tower 3 and JPMC are currently in charge of cargo handling operation in these berths.

According to the JPMC information, the designed capacity of cargo handling equipment for each cargo is as follows ;

For Potash and DAP	;	1,500 tons / H
For Sulfur	;	500 tons / H
For Liquid Ammonia	;	680 tons / H
For Phosphoric Acid	;	560 tons / H

Currently the productivity of cargo handling operation in these berths is seriously low, especially sulfur operation. First of all, these operations must be improved for the future increment of cargo volume.

< Oil Jetty >

Currently small amounts of chemical oil and mineral oil are handled for Solvochem Holland B.V.

If the resumption of Iraqi oil export into this country through pipe line has a favorable impact after oil embargo is lifted, it will be definitely required to construct a big oil tanker terminal.

< Timber Berth >

JFI 1 Berth is known as the Timber Berth. In 1994, more than 250 livestock vessels called at this berth. This berth is suitable for such vessels as well as small conventional vessels due to shallow depth (vessel available draft up to 6.8 meters).

By the target year, 2010, it will be required to enlarge this berth because large sized vessels of live stock and general cargo shall be assigned here.

Method of Future Capacity Evaluation

In order to ascertain the maximum possible capacity in the target year, 2010, for the Port of Aqaba, the following various conditions specified in this port will be considered.

- Generally, berth productivity depends on commodities to be handled, size and type of vessel to berth, cargo handling equipment to be used, cargo handling system to be applied and working conditions.

- Cargo working days per year is assumed to be 351 days excluding two national holidays and one day per month for the maintenance of cargo equipment and facilities.

- Cargo working hours per day is assumed to be 18 hours including 16 hours for day and night shifts and two hours overtime, and 24 hours at specialized berths like phosphate Berth, Oil Tanker Berth Industrial Berths and so on.

- Maximum berth occupancy is assumed to be 70 %.

Studies have been conducted on following major kinds of cargo, considering the above conditions.

(1) Phosphate

1) Size and cargo volume per vessel to be loaded

Assuming the export volume of phosphate will be greatly increased in future, the size and cargo volume to be loaded per vessel would become larger than at present. It is therefore expected that calling vessels in the target year will load average 55,000 tons of phosphate rock per shipment, while currently larger average volume is around 40,000 tons.

The type of such vessels will become mostly Panamax size or more larger.

2) Handling cargo productivity per day

The following formula is generally adopted.

Qa = Qn x En
Qa ; Actual handling capacity per hour (tons / hour)
Qn ; Normal or designed capacity per hour (tons / hour)
En ; Handling efficiency (normally 0.7)

Bp = Qa x Ng
Bp ; Berth productivity (actual handling capacity) per hour (tons / hour)
Ng ; * Number of handling equipment (exclusive berth)
* Number of available gangs (non-exclusive berth)

Qd = Bp x Hd x Ew
Qd ; Berth productivity (actual handling capacity) per day (tons / day)
Hd ; Working hours per day
Ew ; Working time efficiency (normally 0.8)

By = Qd x Dy x Bo
By ; Berth productivity (capacity) per year (tons / year)
Dy ; Working days per year
Bo ; Berth occupancy (0.7)

Two phosphate loaders with choke feeder are installed in Berth B and the loading capacity of each loader is 2,000 tons per hour. Though loading productivity by these loaders depends on the size and type of vessels and conditions of phosphate stock pile, it will be estimated as 2,500-3,000 tons per hour with two loaders. As this berth provides 24 hour operation, loading productivity per day would be anticipated to be at least 40,000 tons.

Qa = 2,000 tons x 0.7
= 1,400 tons
Bp = 1,400 tons x 2 loaders
= 2,800 tons
Qd = 2,800 tons x 24 hours x 0.8
= 53,760 tons / day

3) Necessary berthing hours other than cargo operation

Required hours other than cargo operation during vessel berthing are composed of the time for vessel mooring / unmooring and preparation for commencing cargo work / vessels sailing after completion of the work. It also includes the time required for clearing the documentation of cargoes and vessels entry / leaving.

In the case of phosphate Berth B, the above required time should be maximum 3 to 4 hours because of the berth being opened to vessel road and two same type loaders being easily handled.

The required number of berths for exporting phosphate is determined by the above three factors, 1), 2) and 3) and examined in the next section, 4.6.3.

4) Berth productivity per year

Bp = Qd x Dy x Bo
= 53,760 tons x 351 days x 0.7
= 13.2 million tons / year

As a result, the berth productivity of Phosphate Berth B is 13.2 million tons per year.

As the forecast cargo volume in the target year is 7.37 million tons in Case 1 & 5 and 6.4 million tons in Case 9, there will be sufficient capacity for exporting phosphate rock as far as the berth facility is concerned.

(2) Vegetable Oil in bulk

Chemical tankers currently use Phosphate Berth " A " to discharge vegetable oil such as palm, corn, tallow and so on and 12 small stowage tanks (11,500 tons) are located near by the berth.

Size of calling chemical tankers is presently from 7,000 DWT to 40,000 DWT. Average productivity to discharge vegetable oil might be 336 tons per hour due to pipe line capacity. Assuming working hours will be 24 hours per day, handling productivity per day is 6,450 tons.

Forecast cargo volume in the target year is 170,000 tons, the same as at present. But vessel size will be expected to become larger than at present from the viewpoint of cost efficiency. The enlargement of shore facilities such as storage tanks connected the berth with pipe line will be considered in order to improve the productivity in future.

(3) Grain

As grain is one of the most important cargoes to be imported to this country and cargo volume is forecasted to greatly increase in 2010 (2.01 million tons), it is indispensable to improve productivity. In this connection, grain berth should be deepened up to minus 14 meters and exclusively used for large grain vessels like Panamax size to come alongside the berth any time with full load.

On the assumption that grain berth would be deepened to minus 14.0 meters, berth capacity is evaluated as follows;-

1) Average cargo volume per vessel

As cargo volume is increased, size of calling vessels will become larger and larger. Although number of Panamax sized bulkers with full load of nearly 60,000 tons is possibly increased, average cargo volume per vessel will be still around 40,000 tons, as there will also be small sized vessels.

2) Handling cargo productivity per day

Total capacity of three existing unloaders installed on Berth 1 is 980 tons per hour while that of two pneumatic unloaders is 240 tons each and of one mechanical unloader is 500 tons.

Actual productivity of equipment is generally said to be about 70 % of the capacity. Provided grain unloading operation would be done by using three unloaders, anticipated productivity per hour is 680 tons.

According to MOS (Ministry of Supply), Berth No.1 productivity is currently restricted by belt conveyor to silos, of which capacity is 720 tons, thus anticipated productivity per hour is about 500 tons. As MOS provides 24 hour operation, handling productivity per day is 9,600 tons.

On the other hand, in case of using seven evacuators exclusively on the vessel with seven hatches such as Panamax bulker, anticipated productivity is 490 tons per hour. Provided working hours is 18 per day, handling productivity per day is about 7,000 tons.

Qa1 = 720 tons x 0.7
= 500 tons for three unloaders (Grain Berth)
Qa2 = 100 tons x 0.7
= 70 tons for one evacuator (other than Grain Berth)
Bp1 = Qa1
= 500 tons per hour (Grain Berth)
Bp2 = Qa2 x 7 units
= 490 tons per hour (other than Grain Berth)

Qd1 = 500 tons x 24 x 0.8
= 9,600 tons per day (Grain Berth)
Qd2 = 490 tons x 18 x 0.8
= 7,056 tons per day (other than Grain Berth)

3) Necessary berthing hours other than cargo handling operation

Preparation for commencing cargo work by using evacuators will take considerable number of hours because they must be placed on the deck of grain vessel by mobile crane and later removed when cargo handling is complected.

Therefore berthing time required other than cargo operation will take 4 to 5 hours, but in case of using pneumatic and mechanical unloaders, it will take less than the above.

4) Berth productivity per year

By1 = Qd1 x By x Bo
= 9,600 tons x 351 days x 0.7
= 2,358 thousand tons

By2 = Qd2 x Dy x Bo
= 7,056 tons x 351 days x 0.7
= 1.734 million tons

5) Capacity evaluation

Taking the forecast cargo volume into consideration, one specialized grain berth will be sufficient for grain operation. While the grain berth is congested, another suitable berth should be assigned for the vessel to unload grain by evacuators.

It is necessary to raise cargo handling productivity by improving present grain unloading operation.

(4) General cargo (Break bulk Cargo)

General cargo in this port is mainly categorized into bagged cargoes, steel products, cars / vehicles, livestock and other general cargo. Bagged cargoes consist of sugar, rice, bean, coffee, tea, potato and so on. Other general cargo includes frozen cargo, forages, timber, construction materials and so on.

Almost all these cargoes are currently handled in the Main Port, otherwise at suitable berths in the Container Port and the Industrial Port.

1) Average cargo volume per vessel

Although it is very difficult to forecast average cargo volume per vessel in the target year due to the various kinds of cargoes, it is possible that it will become larger than at present. Present average cargo volume from conventional vessel calling at the Main Port is more than 2,500 tons (unloaded and loaded).

In future, general cargoes are expected to be containerized except bagged cargoes, steel products, cars / vehicles and live stocks. Therefore, in the target year general cargo will mainly consist of bagged cargoes and steel products. Even though containerization will progress in the future, general cargo volume in the target year is forecasted to increase up to 4.35 million tons in Case 1, 3.34 million in Case 5 and 2.55 million in Case 9.

Considering the above future situation, average cargo volume per vessel is expected to be about 3,000 - 3,500 tons, depending on the size and type of calling vessels. Otherwise, size of general cargo vessels will not change too much compared with the present size, which is average 10,000 DWT, because the cargo volume per vessel is not expected to change.

2) Handling cargo productivity per day

Handling productivity of bagged cargo and steel products is determined using the following formula;-

$$Qd = W \times Np \times 60/Cy \times Ng \times Hd \times Ew$$

Qd ; Handling productivity per day (tons / day)
W ; Unit weight of bag (50 kgs)
Np ; Number of bags per lift (36 bags)
Cy ; Average time per cycle (2 minutes)
Ng ; Number of gangs (4 gangs)
Hd ; Working hours per day (18 hours)
Ew ; Working efficiency (0.8)

* In case of bagged cargo, handling productivity per day is as follows ;

Qd = 0.05 tons x 36 bags x 60/2 cycles x 4 gangs x 18 hours x 0.8
= 3,110 tons per day

* In case of steel products, handling productivity per day is as follows ;

Assuming average weight per lift is 5 tons, Cy is 5 minutes and Ng is 4 gangs.

Qd = 5 tons x 60/5 cycles x 4 gangs x 18 hours x 0.8
= 3,456 tons per day

Based on the above, possible handling productivity per day will be more than 3,000 tons.

3) Necessary berthing hours other than cargo handling operation

Required berthing hours other than cargo operation for the conventional vessels should be not more than 3 hours because they usually equip their own derricks or cranes and

ships crew will serve the arrangement of their equipment for cargo operation, while shore gangs must prepare necessary cargo gears and machines such as slings, forklifts and so on before vessel berthing.

4) Capacity of storage facility

As described in the above (1), storage capacity in the Main Port may be sufficient even in the target year.

The following formula is used to determined storage capacity ;

$$Mb = (Ab \times Rt \times W \times r) / P$$

Mb ; Capacity of storage facilities per year (tons / year)
Ab ; Area of storage facilities (m^2)
Rt ; Turnover ratio (365 / cargo dwelling days) (times / year)
W ; Cargo volume per unit area (tons / m^2)
r ; Utilization ratio
P ; Peak ratio

$$Mb = (281{,}000 \times 365/15 \times 2 \text{ tons} \times 0.5) / 1.3$$
$$= 5.26 \text{ million tons per year}$$

As a result, storage capacity in the Main Port is sufficient for general cargo, even in Case 1 which has the largest cargo volume forecast in all cases.

(5) Industrial products and raw materials

Industrial products and raw materials handled in JFI West and East Berths consist of Fertilizer, Potash, Sulfur and Liquid Ammonia.

The designed capacity of existing cargo handling facilities in these berths is as described in the above Item (3).

1) Average cargo volume per vessel

In 1994, average cargo volume per vessel was 13,830 tons for fertilizer, 13,350 tons for potash, 13,800 tons for sulfur and 14,000 tons for liquid ammonia, according to JPMC report.

In the target year, 2010, as a huge increase of cargo volume is forecasted due to industrial development in this country, average cargo volume per shipment will be certainly increased. Taking the size of berths and kinds of calling vessels into consideration, average cargo volume per vessel is expected to be 20,000 tons for all cargoes.

Although size of calling vessels depends on cargo volume and kinds of vessels such as bulker, tanker and conventional ship, their average size will be 30,000 - 35,000 DWT for Fertilizer and Potash and 20,000 - 25,000 DWT for Sulfur and Liquid Ammonia.

2) Necessary berthing hours other than cargo handling operation

As far as cargo equipment and facilities are maintained in good order and communication between berth operators and related factory is made smoothly, required berthing hours other than cargo handling operation will be within three hours.

3) Cargo handling productivity per day

In these berths, 24 hours are available for cargo operation according to JPMC. Assuming the productivity of existing loaders and unloaders will be able to be improved up to 70 % of their designed capacities, the following cargo handling productivity will be anticipated by using the above formula.

a) Fertilizer and Potash

Qd = 1,500 tons x 0.7 x 1 unit x 24 hours x 0.8
= 20,160 tons / day

b) Sulfur

Qd = 500 tons x 0.7 x 1 unit x 24 hours x 0.8
= 6,720 tons / day

c) Liquid Ammonia

Qd = 680 tons x 0.7 x 1 unit x 24 hours x 0.8
= 9,139 tons / day

d) Phosphoric Acid

Qd = 560 tons x 0.7 x 1 unit x 24 hours x 0.8
= 7,526 tons / day

As a result, the cargo handling equipment and facilities for Sulfur should be enlarged to raise productivity prior to the target year, because sulfur cargo volume in 2010 is forecasted more than 6 times compared with that in 1993.

4) Berth productivity per year

This is calculated by the above formula.

a) Fertilizer and Potash

By = 1,500 tons x 0.7 x 351 days x 0.7 x 24 hours x 0.8
= 4.9 million tons per year

b) Sulfur

By = 500 tons x 0.7 x 351 days x 0.7 x 24 hours x 0.8
= 1.65 million tons per year

c) Liquid Ammonia

By = 680 tons x 0.7 x 351 days x 0.7 x 24 hours x 0.8
= 2.24 million tons per year

d) Phosphoric Aicd

By = 560 tons x 0.7 x 351 days x 0.7 x 24 hours x 0.8
= 1.85 million tons per year

As a result, it is considered that in the target year Sulfur and Liquid Ammonia vessels should be exclusively assigned for existing JFI West and East Berths, and Fertilizer and Potash vessels for these two berths and one additional berth which must be constructed near the berths. Otherwise, the capacity of equipment and facilities for Sulfur must be enlarged prior to the target year. On the other hand, cargo volume of phosphoric acid will be increased, though it is currently very low and it is desirable that liquid cargoes such as Liquid Ammonia and Phosphoric Acid be handled in JFI East Berth even in the target year, because this berth is equipped with the required cargo handling equipment. Therefore an additional loader for phosphoric Acid will be required in JFI East Berth by the target year to raise the handling capacity to the necessary level. Loading of salt, Magnesium Oxide, NPK in bulk and Dead Sea products for export will start by the year 2000 in addition to the present handling cargoes. Therefore further improvement of equipment and facilities shall be required. Consequently, it will be proposed to improve following equipment and facilities by the target year, taking increased cargo volume into consideration.

- To construct an additional industrial berth (JFI North) in the north existing JFI West and East Berths including one loader with the capacity of 1,500 tons per hour to handle DAP, Potash, NPK, Magnesium Oxide, Salt and so on.

- To install an additional unloader for Sulfur with the capacity of 500 tons per hour in JFI West Berth.

In this regard, out existing mechanical unloader for sulfur is chain bucket elevation system and is frequently out of order which results in low productivity. As a complex unloader equipped with many spare parts is not suitable for this kind of cargo which corrodes metals, an additional unloader to be supplied by 2010 must be of simple structure. It is recommended that grab system handled by gantry crane be adopted for the new sulfur unloader because it is easier to maintain and more productive than existing mechanical unloader.

- To install an additional loader for phosphoric Acid with the capacity of 560 tons per hour in JFI East Berth.

Further details of these cargoes are described in Chapter 5.4.

(6) Oil

Oil Jetty is currently assigned for small tankers which load or unload fuel oil, mineral oil and chemical oil in bulk.

The capacity of oil berth depends on handling cargo volume and also size of calling vessels. In Case 1 of the target year, export volume of crude oil is forecasted as 34 million tons. In that case, new oil tanker berth (Terminal) must be constructed.

In this connection, it is necessary to determine the optimum size of calling tankers to load 34 million tons of crude oil per year at one exclusive berth.

A theoretical formula which can analyze waiting time of vessel for berthing is generally used for this purpose.

(a) Berth capacity per hour

Table 4.6.2 Tanker Berth Capacity per Hour

Size of vessel	150,000 DWT	200,000 DWT	250,000 DWT	300,000 DWT	350,000 DWT
Full load efficiency per vessel	0.9	0.9	0.9	0.9	0.9
Berth occupancy	0.7	0.7	0.7	0.7	0.7
Working hours per day	24 hours	24 hours	24 hours	24 hours	24 hours
Berthing hours other than cargo handling	5 hours	6 hours	7 hours	7 hours	7 hours
Cargo handling efficiency	0.7	0.7	0.7	0.7	0.7
Maximum allowable working days per vessel	2 days	2 days	2 days	2 days	2 days
Berth capacity per hour	6,988 tons per hour	9,667 tons per hour	12,084 tons per hour	14,501 tons per hour	16,917 tons per hour

(b) Berthing days per vessel

Table 4.6.3 Number of Berthing Days per Oil Tanker

Size of vessel	150,000 DWT	200,000 DWT	250,000 DWT	300,000 DWT	350,000 DWT
Full load efficiency per vessel	0.9	0.9	0.9	0.9	0.9
Number of loading facilities	1	1	1	1	1
Berth capacity per hour	6,988	9,667	12,084	14,501	16,917
Working hour per day	24	24	24	24	24
Cargo handling efficiency	0.7	0.7	0.7	0.7	0.7
Working days per year/365	1	1	1	1	1
Average berth days per vessel	1.15 days	1.11	1.11	1.11	1.11

(c) Vessel waiting days for berth

Table 4.6.4 Number of Vessel Waiting Days for Tanker Berth

Cargo volume per year	34,000 thousand tons/year	34,000 thousand tons/year	34,000 thousand tons/year	34,000 thousand tons/year	34,000 thousand tons/year
Size of vessel	150,000 DWT	200,000 DWT	250,000 DWT	300,000 DWT	350,000 DWT
Full load efficiency per vessel	0.9	0.9	0.9	0.9	0.9
Average berth days per vessel	1.15 days	1.11	1.11	1.11	1.11
Traffic consistency (Tc)	0.79	0.57	0.46	0.38	0.33
Average number of calling vessels per day (Tv)	0.69 vessels per day	0.52	0.41	0.35	0.30
Service days per berthing vessel (Ts)	0.87 days per vessel	0.90	0.90	0.90	0.90
Average number of vessels waiting days	4.42 days	1.50	0.94	0.69	0.54
Average number of vessels waiting for berth	3.05 vessels	0.78	0.39	0.24	0.16

Tv ; Average number of calling vessels / day
Ts ; 1 / (Average number of berthing vessels / day)
Tc ; Tv / Ts

As a result, in this case, although it is better to introduce even larger vessels in order to minimize vessel waiting time in the port, possible average size is assumed at 200,000 DWT. 150,000 DWT will be too small for this case.

(7) Cement

The export volume of cement has been decreasing from 1.3 million tons in 1990 to 563 thousand tons in 1994. But in the target year, cargo volume is forecasted as 1.5 million tons in Case 1, 2 million tons in Case 5 and 2.5 million tons in Case 9. Currently size of calling vessels to load cement in bulk at Mushtarak Berth is 7,000 to 15,000 DWT, though some are more than 25,000 DWT. But in the target year, the size is expected to become larger, for instance, 25,000 to 30,000 tons, due to the increased volume, and average cargo volume per vessel is expected to be 20,000 tons.

As the designed capacity of one loader is 400 tons per hour, berth capacity is calculated as follows ;

Qd = 400 tons x 0.7 x 1 unit x 24 hours x 0.8
= 5,376 tons / day

By = Qd x 351 days x 0.7
= 1,320 thousands tons / year

As a result, cement berth capacity will be sufficient in all cases.

(8) Livestock

Cargo volume of livestock including transit is forecasted to increase greatly, that is 5 times in 2010 compared with that of 1994.

JFI-1 Berth will be suitable for this cargo because of its remote location from the town. On the other hand large sized livestock vessels are assigned for other berths because its length and depth are insufficient and such sized vessels will increase in the near future. Therefore in the Short-Term Plan, a study is excuted regarding the enlargement of this berth, which is described in Chapter 5.

(9) Rice

Imported rice in bulk is discharged at Mu'ta floating berth by using buckets. As far as cargo volume is concerned, forecast cargo volume does not differ from the present volume of 330 thousand tons. Average size of rice vessels is expected to be 15,000 - 20,000 DWT and average cargo volume per vessel will be about 17,000 tons in the target year.

Berth capacity in the target year is determined using the following formula ;-
In case of bucket operation

Qd = 500 tons x 0.7 x 24 hours x 0.8
= 6,720 tons / day

By = Qd x 351 days x 0.7
= 1,650 thousand tons / year

As a result, this berth capacity will be sufficient in all cases.

On the other hand, productivity in case of bagged rice for export is described in the above "general cargo".

(10) Container

As explained in the above (2) Evaluation of Present Capacity, present capacity will be sufficient even in the target year, provided container dwelling time could be improved. But two existing problems concerning yard layout must be solved prior to the increase of container throughput.

Solution of problems is as follows ;
- To remove the public road between Yard 1 & 4 and 2 & 3.
- To level all container marshaling and stacking yards

After the above problems are solved, new operation system will be introduced. The system basically consists of computerization and transfer crane (transtainer) crane system, because of the following reasons

- Required grand slots can be minimized.
- Safe operation is expected because the movement flow of transfer crane and tug master with chassis is usually stable.
- High technical skill to handle transfer crane is not required.
- Cost involved in this system is expected to be relatively low from long term point of view, because work force and maintenance rate of equipment are small, though initial investment is large.
- This system is most suitable for computerization.
- Existing system which is being operated by straddle carrier, top lifter handler and tug master with chassis is similar to transfer crane system.

Container Terminal Capacity by means of the above new system is determined as follows ;-

1) The conditions on the new system

a) Forecast container throughput in the target year

Table 4.6.5 Annual Container Throughput in the Target Year

The target year, 2010	Case 1	Case 5	Case 9
Full container (TEUs)	214,500	216,400	211,800
Empty container (TEUs)	195,000	200,000	200,000
Container throughput (TEUs)	409,500	416,400	411,800

b) Type of transfer crane is assumed as rubber mounted transfer crane.

- Four stack and one over
- 6 lines for stacking containers and one lane for vehicle traffic between crane legs

c) Container dwelling days

- 10 days for full containers
- 7 days for empty containers

d) Number of container stacks in the yard

- 3 stacks for full containers
- 4 stacks for empty containers

e) Number of ground slots per stacking block

- 6 lanes x 18 rows = 108 TEUs

2) Required number of ground slots

Required number of ground slots is calculated by the following formula.

Ml = (My x Dw x p) / Dy
Ml ; Required storage number of container (TEUs)
My ; Annual container throughput (TEUs)
Dw ; Average dwelling time (days)
P ; Peak ratio (1.3)
Dy ; Working days per year (days)

Sl = Ml / L
Sl ; Required number of ground slots
L ; Stacking height of containers (TEUs)

a) Case 1 in the target year

For full container;
Mlf1 = (214,500 TEUS x 10 days x 1.3) / 351 days = 7,945 TEUs
For empty container;
Mle1 = (195,000 TEUs x 7 days x 1.3) / 351 days = 5,056 TEUs
Sl-1 = Mlf1 / 3 stacks + Mle1 / 4 stacks = 3,911 TEUs

As a result, in Case 1, required ground slots are 3,911 TEUs.

b) Case 5

For full container ; Mlf5 = 8,015 TEUs
For empty Container ; Mle5 = 5,186 TEUs
Sl-5 = 3,969 TEUs

As a result, in Case 5, required ground slots are 3,969 TEUs

c) Case 9

For full container ; Mlf9 = 7,845 TEUs
For empty container ; Mle9 = 5,186 TEUs
Sl-9 = 3,912 TEUs

As a result, required ground slots are 3,912 TEUs

3) Required stacking blocks in the yard

Case 1 ; Sl-1 / 108 = 36.22 < 37 blocks
Case 5 ; Sl-5 / 108 = 36.75 < 37 blocks
Case 9 ; Sl-9 / 108 = 36.22 < 37 blocks

As a result, 37 blocks are sufficient in all cases and available storage number of container is more than 13,200 TEUs in Case 5.

4) Berth dimension

Required length of container berth is decided on the basis of larger type of calling vessels.

The standard type of container vessel is as follows ;

Table 4.6.6 Standard Types of Container Vessel

DWT	LOA (meters)	Breadth (meters)	Draft (meters)
16,000	170	23.0	9.0
22,000	210	31.0	10.0
27,000	230	32.2	11.0
35,000	260	32.2	12.0

In the target year, the type of container vessel is expected to be mainly 27,000 to 35,000 DWT. In this case, required berth length and depth are estimated as follows ;-

Berth length > (Length of vessel) + (Breadth of vessel)
Berth depth > (Draft of vessel) + (0.5 ~ 1.5 meters)

Therefore, the following berth lengths and depths are required.

For two 35,000 DWT vessels ; Total berth length = 2 x (260 + 32.2)
= 584 meters < 600 meters
Required berth depth = 12.0 + 1.0
= 13 meters

As a result, required length of container berth is 600 meters in total and required minimum depth is 13 meters in the target year.