CHAPTER 4 DEVELOPMENT OF CIPP (POLICY, STRATEGY AND IMPLEMENTATION)

4.1 Current Situation

4.1.1 Project Area

a. Land use Plan

The CIPP is located at a location of about 60 km to the west of Fortaleza, the State Capital of Ceara. The total land area of CIPP is 33,500 ha. The land areas reserved for a steel mil and an oil refinery, which are the two key industries, are located in the centre of the CIPP. A zone to the east of the steel mil area is reserved for metal processing industries, while a zone to the south of the refinery area is reserved for petrochemical industries and, further down to the south, a zone is reserved for other manufacturing industries. Figure 4.1.1 shows the layout and land use plan of CIPP.

b. Access Highways and railways

Three is a highway network around the CIPP that consists of State Highways CE 085, CE 421 and CE 156 up to Federal Highway BR222, which connects the western Northeast Region and the North Region. The Federal Highway is also connected to other highways: BR-116 towards Southeast Region, BR -020 towards Central-west Region and BR-116/BR-304 towards eastern part of the Northeast Region.

In addition to the state highway network serving Pecem area, a new coastal road between Fortaleza and northwesters cost of the state for the purpose of tourism: therefore, no cargo truck is allowed to pass this new road. A new 20 km-long access road from Br-222 to Pecem Port has also been opened.

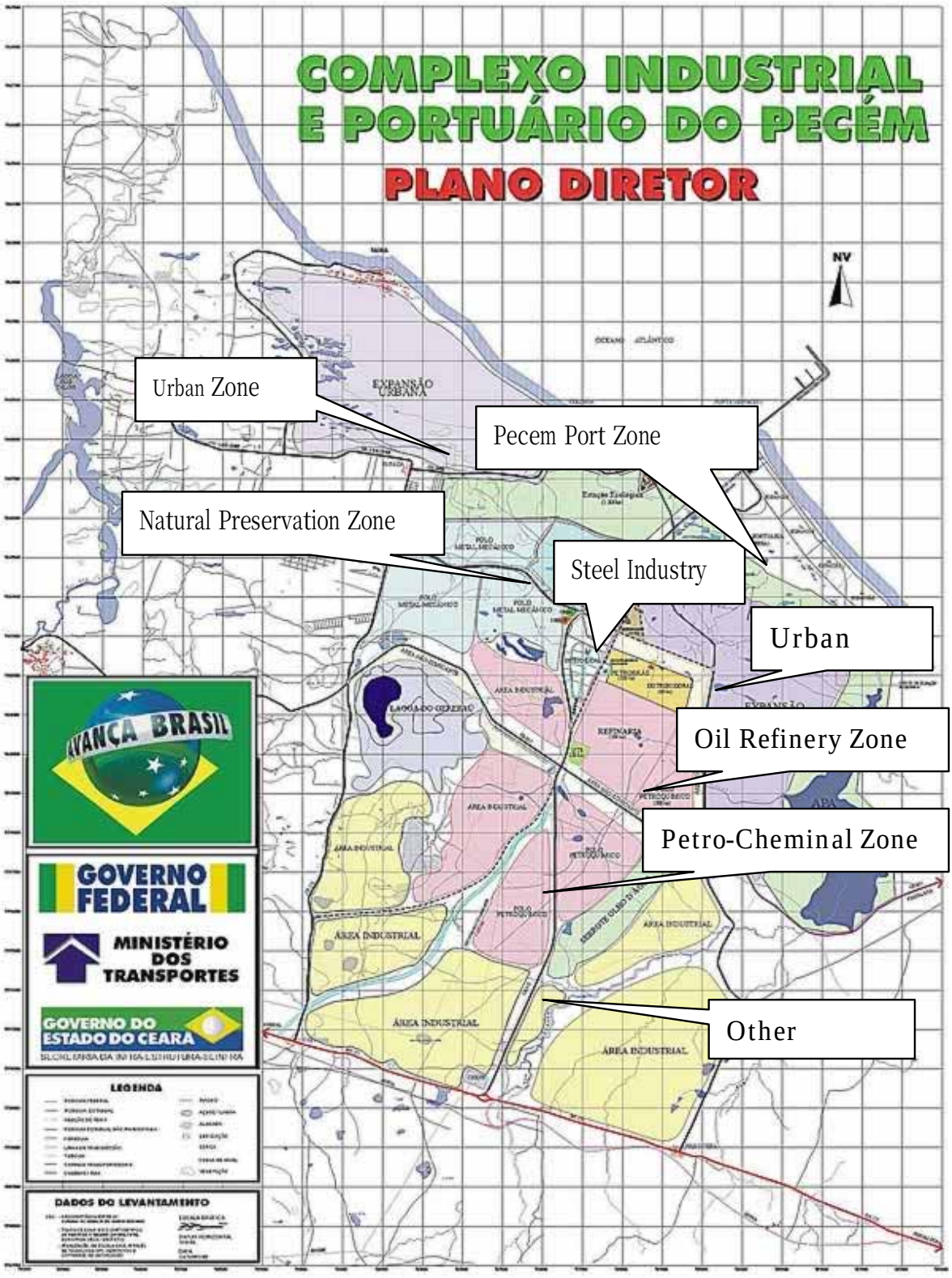
In parallel to BR-222, there is a railway of the Northeast Railway Company that is providing service between Fortaleza and other states in the Northeast Region. The 22 km-long railway access branch between the existing railway trunk line and Pecem Port has been completed (See **Figure 4.1.2**).

c. Port facilities

A full explanation of the existing situation of Pecem Port is given in Section 4.1.5. Since the Port, is the essential infrastructure of CIPP, major features are briefly stated hereunder.(see Figure 4.1.3):

Berthing facilities

- Pier No, 1; 350m long and 45 m wide platform used for the handling of bulk and general cargoes.
- Pier No. 2; used for liquid bulk, especially petroleum
- Breakwater: L-shaped 1,700-m long breakwater.
- Bridge: 2,120 m long and two-way lane bridge connecting the two piers and the yard on land.. The bridge has lateral supports for belt conveyers for bulk cargoes and pipelines for the handling of petroleum products.
- Yards: 380.000 m^2
- Warehouse: 6,250m^2 and owns a capacity of about 55,000m^3.

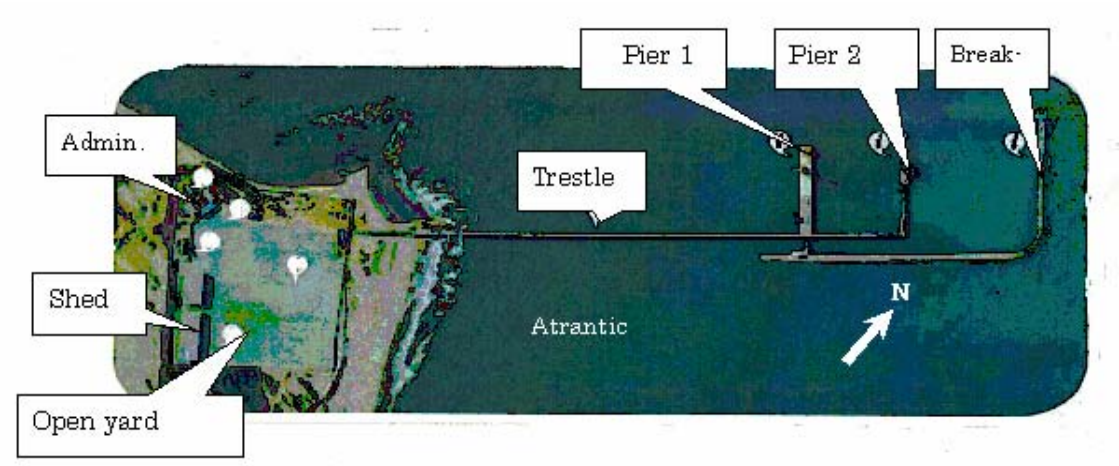


Source: SEINFLA modified by JICA Study Team

Figure 4.1.1 Layout and land use plan of Pecem Industrial and Port Complex (CIPP)

Source: Ministry of Transport Web Sit, Edited by JICA Study Team

Figure 4.1.2 Transport system around CIPP

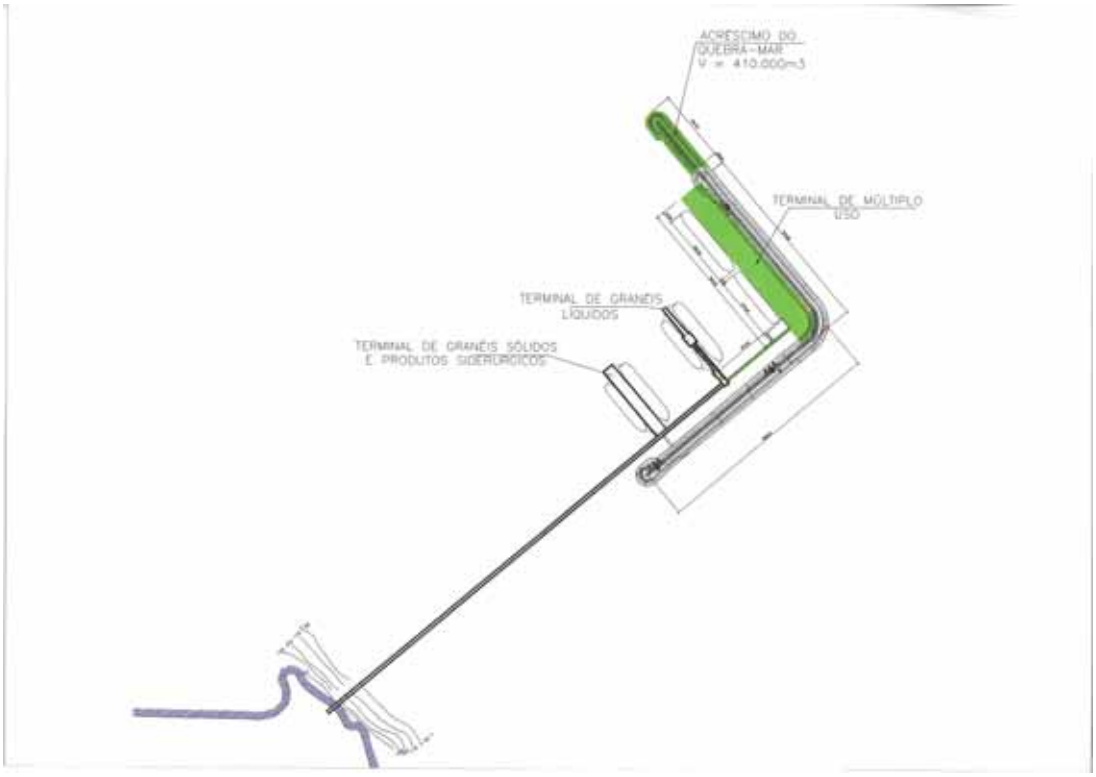


Source: CEARAPORT

Figure 4.1.3 Facility Layout Pecem Port (Existing Situation)

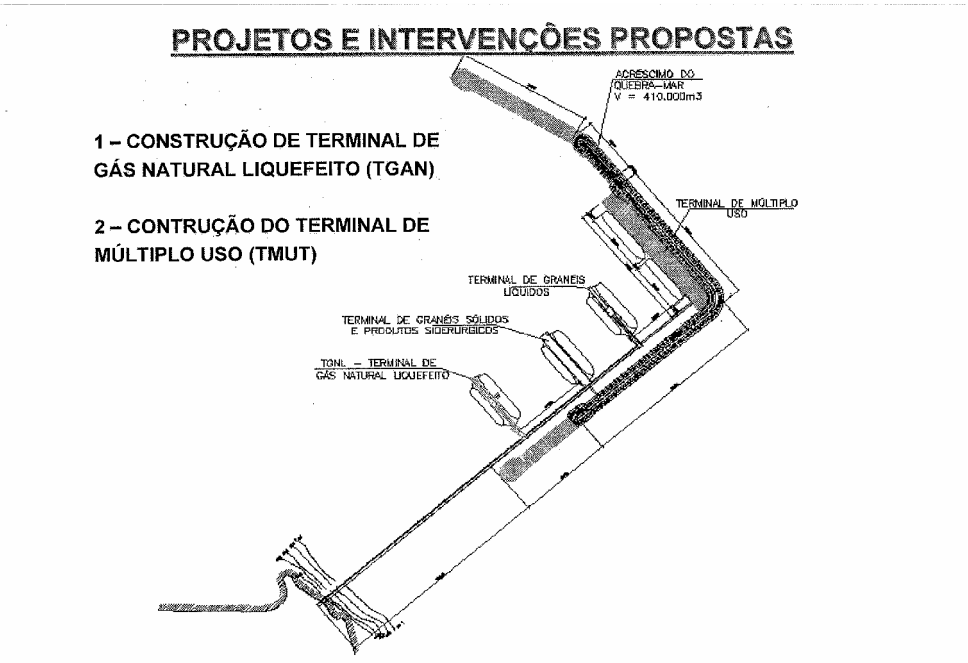
The port has been operational since November, 2001. So far, without neither steel mil nor oil refinery has been established, the port has been handling general cargoes and container cargoes at Pier 1, which is designed for handling cargoes iron ore and steel products. The construction of a steel mil is scheduled to start in the later stage of 2004 and it will start operation sometime in 2007. Thus, the construction of additional pier is urgent.

The Government od Ceara State has the expansion plans of Pecem Port. The plan consitts of two phases. Figure 4.1.4 (1) shows the Phase I expansion that include the development of a multi-purpose berth, which is called Pier No. 3. Phase II plan, shown in Figure 4.1.4 (2) is the further expansion of the breakwaters to shelter another pier named Pier No. 0, which accommodate LNG (Liquid Natural Gas) tankers.



Source: SEINFRA

Figure 4.1.4 (1) Existing Development Plan of Pecem Port (Phase I)

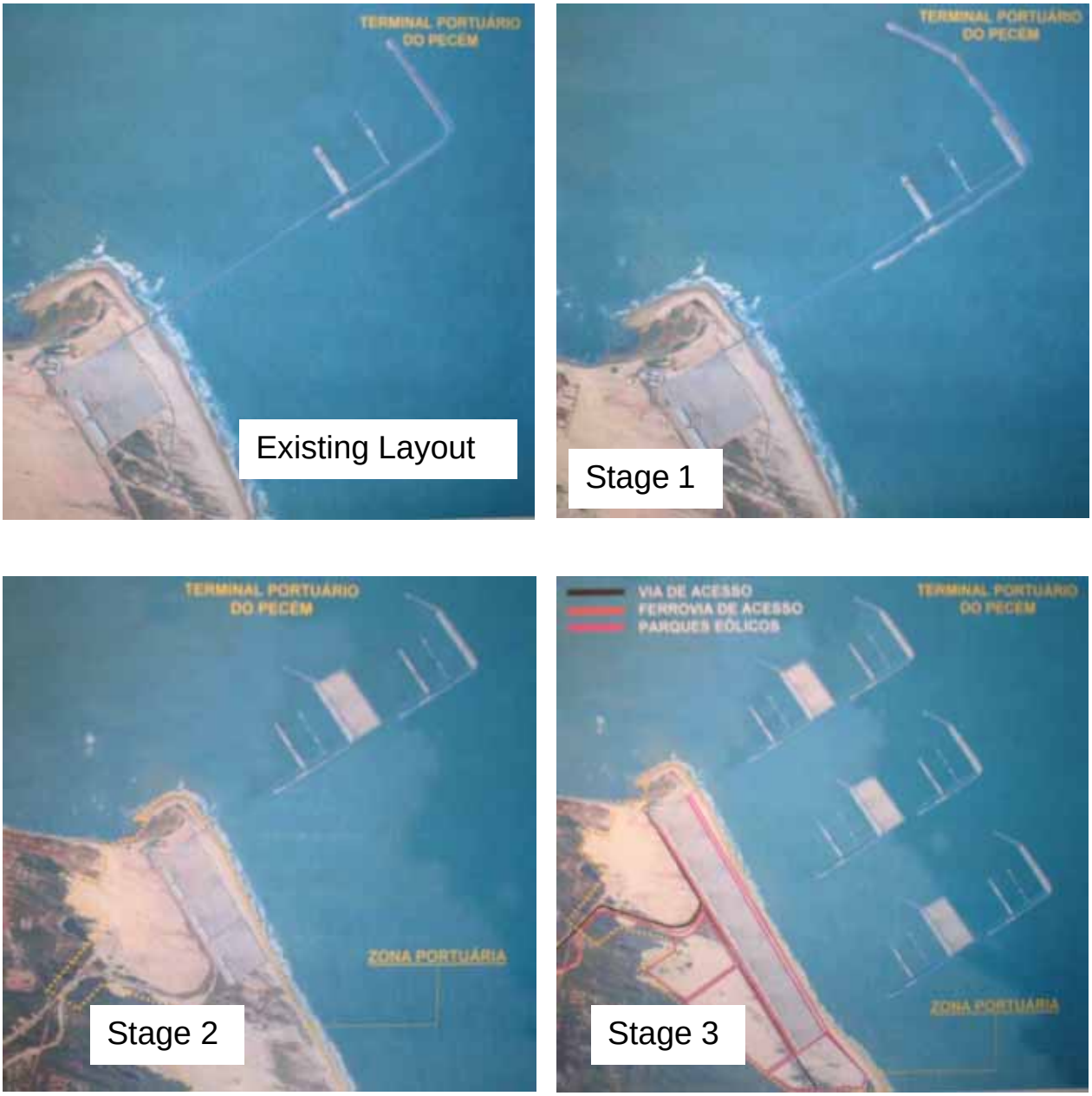


Source: SEINFRA

Figure 4.1.4 (2) Existing Development Plan of Pecem Port (Phase II)

For the further development to meet traffic demands, an idea to expand Pecem port in three stages has been proposed:

Stage 1 Expansion to the west
Stage 2 Expansion toward offshore
Stage 3 Expansion to the east.



Source : SEINFRA

Figure 4.1.5 An idea of future expansion for long term development

4.1.2 Vision

The concept and the vision of the development of CIPP are briefly explained in the Report "THE PECEM INDUSTRIAL AND PORT COMPLEX, Ministry of Transport and the Government of State of Ceara, January, 1995".

Ceara has been one of the poorest states in Brazil. The state government has been challenging all the possible efforts to promote the socioeconomic activities on the basis of the fundamental policy guideline: "the sustainable development of the state with the major goal to improve the quality of life of all 'cearençe - people of Ceara) , economic growth with the improvement of the distribution of income, maximization of the creation of jobs.

With the awareness of the importance of the industrial sector in the process of the development and the recognition of the need for decentralization, the State Government of Ceara had taken concrete action to attract large scale investments to Ceara and its hinterland states.

The conceptual plan of the development of CIPP was elaborated as an integral part of the sustainable development policies. The main goal of the plan is to endow the State of Ceara with a true nucleus of development, from which the progress will be disseminated via the promotion of integrated industrial activities in inter-industrial terms. This will stimulates a greater regional interplay, which should considerably contribute to the reduction of unemployment level.

The Directive Plan for the CIPP was elaborated so as to meet the following basic premises:

- attention to the Plan for Sustainable Development 1995-1998;
- improvement of the quality of life of all "cearençe" in the region;
- maintenance of adequate conditions for the equilibrium of the ecosystem, and the preservation of the non-renewable natural resources;
- assure the quality of life for future populations through the zoning and rationalization of the use of the land;
- assurance of preservation of the areas for future expansion of the seaport zone;
- satisfactory functions as a collection, transformation and distribution center of goods and services, so as to become a long reaching logistic platform for the major world markets;
- spatial organization of the logistic platform so as to better respond to the need of its different users;
- optimization of the initial investments in infrastructure (highways, railways, electric power, natural gas, water, sanitary sewage);
- compatibility with the objectives and investments in the tourism development programs.

Significant efforts were made during the elaboration of the Director Plan for the dissemination and discussion among the people of the region, the press, opinion makers in Fortaleza and with the university community, especially within the Federal

University of Ceara. Such interaction with the public was accomplished by means of talks, interviews, seminars and publications.

A representative landmark of the acceptance by the society was the approval of the RIMA-the Environmental Impact Report of the work of the Pecem Seaport at COEMA-the State Council for the Environment.

Since the introduction of the concept of the development of CIPP, substantial numbers of studies have been carried out. The Environmental Impact Studies are a comprehensive environmental impact assessment studies that were evaluated and approved by COEMA.

4.1.3 CIPP Development Plan

The location of CIPP, the size of which is around 350,000 ha, similar to the size of the city of Fortaleza, is located on the coast of both Caucaia and Sao Goncalo de Amarante municipalities. Caucaia portion belongs to RMF. It could be regarded as an expansion of the metropolitan area, at the same time placing the industrial center outside of RMF in line with decentralization o industry in Ceara.

The vision indicates that several key large industrial plants are to be located, with a number of satellite companies to support or depend upon the nucleus. Industries originally envisioned were; a steel mill and metal-fabrication/mechanic industry, a refinery and petrochemical industry, tank yard, LNG re-gasification plant.

The development of the Industrial Complex will take place in three phases:

Phase I: Steel Plant (Installation of the cold-roll lamination); Metal-Mechanical Industries; Petroleum Refinery; Thermoelectric Plants of 530 MW.

Phase II: Ironworks (hot-roll lamination, refining oven and high oven); expansion of the Petroleum Refinery; Metal-Mechanical Industries, Chemicals Industries;

Phase III: Ironworks (high oven); expansion of the Re-gasification plant; Metal-Mechanical Industries; Chemicals Industries. Each phase of the Complex expansion will correspond to five years.

The steel plant in the first phase will start as DRI and steel slab plant, instead of originally planned cold roll. Also the original radius-nuclei concept may be adjusted to accommodate marshalling districts concept where small and medium companies locate in the same district to advantage the benefits of a common infrastructure. The concept is common in industrial estates with common infrastructures. FIEC is proposing to relocate an EPZ to CIPP to benefit from the new port infrastructure. It will fill the gap of time and space until anchor industry finally decides to locate in CIPP. Also it may help diversification of industry in CIPP. One important matter to be noted is that there is a state policy to decentralize industries in Ceara. There will be a risk of establishments which may have located in rural area of Ceara to come into CIPP to limit the possibility of meeting future needs of industries which must physically locate themselves in CIPP (such as transshipment, storage, repacking, etc.). The industries in this category may include; cleaning, sorting and packing of fresh fruits, contract packaging of mainly consumer products, processing of soya, corn etc., processing of bio-diesel and ethanol for export and domestic markets.

Another point to be taken into consideration is that the CIPP development should not repeat the unwanted side-effects of unplanned urbanization near the industry area and subsequent social pollution and crimes. Also the measures to contain trespassers of CIPP at an early stage to enforce law and orders at all stages will be required to maintain sustainable growth of CIPP in a long range. For this purpose, suitable urban development plan within and outside of CIPP in the above viewpoint is required.

4.1.4 Examination of Type and Size Of Possible Industrial Development

(1) Steel Mill

Steel Mill project is promoted by USC (Usine Siderurgica Ceara), a joint venture of Dongkuk Steel of Korea (50 %), and Danieli (30%) of Italy, and CVRD (20%). Total investment amount is expected to be UA$754 million, about 35% from equity and the remainder from loans. Industrial gas, lime and refractory plats are expected to be in CIPP to service the steel project, with estimated US$60 million investments. It is expected to generate about 3,400 direct employments during plant construction, and 1,600 direct and indirect employments during operation.

As of May 2005, USC Phase 1 plan is to produce 1.5 million tons of Steel Slab. The main raw material is 2.5 million tons of Iron Ore Pellet, supplied by CVRD, to be processed through Direct Reduction process from Danieli, then the product iron goes through electric arc furnace, then through slab caster to produce 1.5 million tons per year of steel slab.

Currently, USC is planning to double the above capacity within a few years of the first phase.

(2) Oil Refinery

Various studies have been done on possibilities of refinery in the Northeast region. A study by TP&E Associados S/C Ltda. dated 2003-05-12 estimates the deficits of petroleum products in the North and Northeast regions in 2010 will be as follows:

- Gasoline 29,300 b/d
- LPG 38,600
- Naphtha 99,000
- Diesel 122,000
- Kerosene 14,800

The study suggests a refinery be set up in CIPP with 200,000 b/d capacity, with the following product slate.

- Gasoline 14,200 b/d
- LPG 12,400
- Naphtha 27,500
- Diesel 117,700
- Kerosene 8,100
- Coke 3,000 t

The refinery fills only a part of the deficits, and another refinery of similar size is bound to be needed in some location in the North-Northeast regions. As of June 2005, location of the new refinery is not decided yet. If it is located in CIPP, the cargo flow through Pecem port will have to start in 2009, and if it is located in other place in the Northeast, there still is a necessity of another refinery within reasonable time span. For the purpose of cargo forecast for Pecem port, optimistic case includes refinery cargo flow to start in 2009, and medium case presumes that the flow starts in 2019.

(3) Petrochemical Industry

World ethylene demand in 2003 was 97.3 million tons. In 2004, the world ethylene demand grew to 103.0 million tons, 5.5% over the previous year, especially in China, where the demand grew 7.6%. Based on the assumption that the world economy will grow steadily, the ethylene demand in 2009 will be 132.8 million tons with an average yearly growth rate of 5.3%. Growth rate differ by regions and countries. Asia will grow at 6.7%, North America by 4.1%, EU by 2.1%. Demand in Japan in 2009 will be 5.5 million tons, 0.1 million tons lower than 5.6 million tons in 2003 and 5.8 million tons in 2004, due to increase of import of ethylene derivatives and relocation of ethylene and derivatives users to outside Japan. As to propylene, the world demand in 2003 was 58.8 million tons, and the forecast for 2009 demand is 78.9 million tons.

Growth in North America will be that of the U.S.A., Mexico will grow at lower rate than the U.S.A. Central and South Americas are represented by Mexico and Brazil. Mexico's Pemex is unable to satisfy petrochemical raw material user by lowering price, at the same time feeling pressure from its labor union against privatization of the petrochemical industry. For some time to come, any remarkable growth of petrochemical industry will not be realized in Mexico. Brazil has its strength in export experience in petrochemicals as it started ethylene from ethanol production and export petrochemicals.

70% of the U.S. ethylene is made from ethane-propane feedstock from natural gas. Natural gas price jumped from traditional $2-2.50/MMBTU to $18 in 2003. It settled later at $4-4.50/MMBTU, but at this level it may put the petrochemicals in U.S.A. uncompetitive in the international market, and may put the U.S.A. in net-importer position of petrochemicals and their downstream products. Brazil may benefit from the situation if the high cost of natural gas in the U.S.A. continues, because the raw material price may become comparatively lower than the U.S.A.

Except for the U.S.A. and oil producing countries, petrochemical building block (ethylene) is produced by thermal cracking of naphtha. Gas based ethylene cracker needs around 25% more in quantity of c2+ over ethylene as feedstock. Natural gas is usually composed of more than 80% methane, which is used as fuel or a feedstock of c1 chemicals such as methanol or N fertilizer. Brazil's existing petrochemical centers are all based on naphtha, and located next to refineries to secure stable supply of major part of naphtha. Brazil's petrochemical centers are as follows:

	Year	Location	Ethylene Capacity	Adjoining Refinery
#1	1972	Cubatao, SP	500,000 t/y	Pres. Bernerdes/RPBC 170,000 b/d
#2	1978	Camacari, BA	1,280,000 t/y	Landulpho Alves/RLAM 307,000 b/d
#3	1982	Copesul, RS	1,135,000 t/y	Alberto Pasquallini/REFAP189,000 b/d

If a naphtha cracker is located in CIPP, it should mean that a refinery should have been located in CIPP before naphtha cracker, unless there is a source of natural gas capable of supplying ample feedstock ethane to produce ethylene. In CIPP, even LNG re-gasification project materialized, the supply of enough ethane would be difficult if ethylene is based on ethane feedstock. In this exercise, petrochemical complex in CIPP is supposed to be based on naphtha from near by refinery, with additional supply from other refineries or import.

A one million tons ethylene plant may be, theoretically, more competitive in production cost and many petrochemical plants of the world have this capacity. The large scale plant, although competitive coastwise, may create another risk of accident of shutdown affecting larger scale of downstream plants. In the present exercise, a naphtha cracker of 500,000 tons per year of ethylene is therefore presumed. Also the downstream products are simplified as much as possible at the same time to realize competitive scale; 500,000 tons per year of LLDPE and 200,000 tons per year of Polypropylene. C4 and C5+ portion plus any excess C2, C3 are presumed to be sold outside. The timing of the start of operation is presumed to be 2016

(4) Supporting Infrastructure

Supporting Infrastructure of CIPP is well planned and being realized to accommodate incoming investment projects, except for federal road condition and railroad system. It is estimated that 56.1% of the pavements of federal roads are in critical condition (CNT 2005-05-19). As central target, Pecem Port, is being prepared. In view of the function of Port as a hub of various transportation systems, and of the fact that contribution of transportation on roads is the main player of inland transportation of Brazil, improvement of federal highway is urgently needed to further improve the performance of Pecem Port.

Another important transportation medium is the railway. In view of the huge quantity of agricultural products of the inland locations such as Cerrado area will necessitate the transportation via railroad to compete with other exporting country such as the U.S.A., where there is an advanced system of transportation by highways, railroads and waterways.

a. Gross and Treated Water, Sewerage and Domestic Solid Waste

Ceara is not really a dry country, with shortage of water resources. Its average annual precipitation of 700mm is on the same level of France. Ceara's problem is the annual fluctuation and uneven distribution of rainfalls (dry and rainy seasons). It necessitates an ample storage of water and its distribution system to the users.

At present, the problem seems to have been overcome by the installation of Castanhao Dam and the Integrated Canal system, connecting the dam with users around Fortaleza metropolitan area and up to Pecem Industrial Area.

The CIPP Infrastructure study by Federal University of Ceara and CV Engineering dated 2000-07-09 states the untreated water requirements of the CIPP are: 139,275 m^3/day in Phase 1, 273,350 m^3/day in Phase 2, and 408,900 m3/day in Phase 3. The availability of water through the Integrated Canal is planned to be 22 m^3/sec, whereas the requirement in Phase 3 is 4.73 m3/sec. The Castanhao dam is completed in 2003, and the Canal will be in operation in the latter part of 2005.

Water price for large industrial users is R$4.53/m3. Industrial water is supplied by COGERH, and treated water and sewerage operated by CAGECE. For large industrial users, price will be decided by negotiations, based on required investment and its operation costs.

b. Electricity Distribution

Ceara's electric power has been supplied by CHESF mainly from its hydroelectric power of San Francisco River. The power is transmitted by 500kV or 230kV high tension lines. Ceara started to diversify the source of electricity to thermal generation and windmill. In CIPP, there are two thermal electric generation plants, CGTF-Central Geradora Termoeletrica Fortaleza S/A (346.63MW) and MXP Termoceara Ltda. (220 MW), based on natural gas to be supplied by Petrobras/GASFOR.

Electricity generation and distribution activities were opened for private investment in 2003, and CGTF is one of the example of private investment of power generation. Distribution system is operated by Companhia de Eletricidade do Ceara-COELCE, which is also privatized. In 2004, COELCE distribution lines reached 80,359 km with 88 substations, with installed capacity of 1,942 MVA.

Power tariff at present consists of three schedules; Blue, Green and Conventional. Customers are free to choose a tariff best fit to their needs and economy. Tariffs are set in accordance with the voltage level, seasons (dry and humid), peak and off-peak hours etc. A customer and supplier can enter into special agreement regardless of the published tariff.

Typical industrial user cost range from R$0.15586 to 0.17651/kwh in Blue Tariff, R$ 0.17027-0.19119/kwh in Green Tariff and R$0.24232/kwh in Conventional Tariff. These figures, at R$2.45/US$ exchange rate, may correspond to 6 for industry, and 10 cents/kwh for households. The power cost seems lower than Japan, and higher than Canada and the U.S.A. Arabian Gulf countries offer lowest cost of around 1.5 cents/kwh

c. Communication and Telephone Systems

As the CIPP Infrastructure study by Federal University of Ceara and CV Engineering dated 2000-07-09 states, it is recommended to install a state-of-the-art communications network and cabling at the very beginning of Phase 1, so that the Pecem Port and the Industrial Complex will be linked to the World effortlessly.

Fixed telephone system is supported by the state government in partnership with TELEMAR, with the primary objective to implant 1,400 public pay telephones in rural areas. In 2001, both installed terminals and operating terminals in fixed telephones are over 300% compares with 1996.

d. Natural Gas Needs for CIPP

A 382 km gas pipeline, Gasfor 1, is transporting 2.4 million m3/day of natural gas from Guamare to Pecem. The second pipeline, Gasfor 2 is scheduled to operate in 2006 with 280km extension, is expected to expand the capacity to 12.0 million m3/day.

LNG Project was once negotiated with Trinidad & Tobago, and due to difference to the gas pricing, was shelved for the time being.

Gas price is charged according to tariff. The current tariff was published by CEGAS on 2004-02-09. Cost to industrial users range from R$0.5235 to 0.5878/$m^3$ in accordance with daily consumption grouping. These figures roughly correspond to U.S.$6.04-6.79/MMBTU at the exchange rate of R$2.45/US$. The figure may be higher than traditional (U.S.$2-2.5) and current (U.S.$4-4.5) U.S.A. price, but comparable to most of the Asian energy importing countries. In Arabian Gulf, Saudi Arabia was charging 50 cents (now 75 cents), and going price is around U.S.$1.50.

4.2 Examination of the Basic Strategy for Industrial Development in Ceara State

4.1 Perspective of the Industrial Activities in Ceara State

Hundreds of commodities are seen in the export and import cargoes of all kinds, i.e. general, dry bulk and liquid bulk cargoes, at Pecem and Mucuripe Ports. For the purpose of the analysis of the activities of the industries in the hinterland of these ports, the commodities were classified into three categories:

(1) Agricultural products,
(2) Products of light industries, and
(3) Products of other industries.

The commodities that fall on each of these categories are listed in **Table 4.2.1.**

Table 4.2.1 Category classification of commodities handled

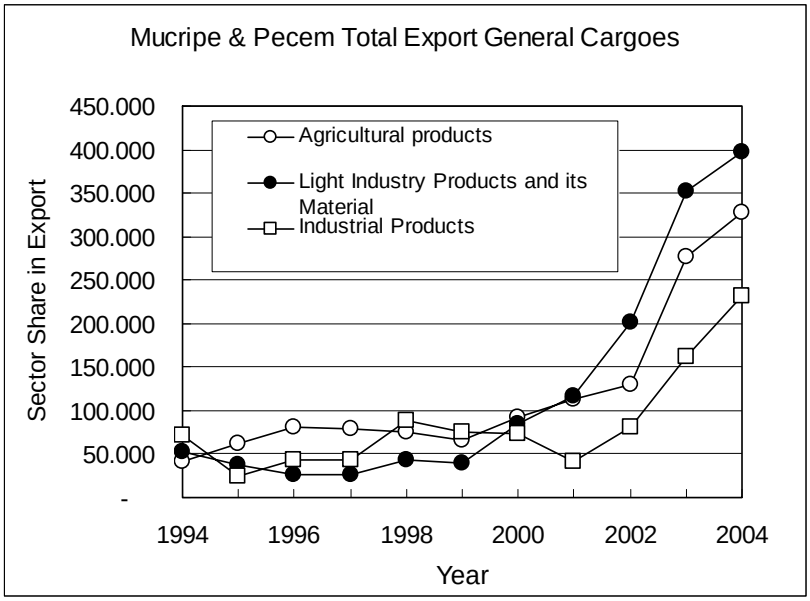
Category for Export c	Export Coimmodity	code	Category for Import con	Import Commodity	code
Agricultural Products	Fresh Fruits	1	Agricultural Products	Rice	1
	Caju products (cashew nut, etc)	2		Wheat	2
	Sea food (shrimp, etc.)	3		Fruits	3
	Juice/Nectar/Pulp of fruits	4		Sea food (shrimp, etc.)	4
	Carnaúba products (wax, etc)	5		Caju Products (chestnut, etc.)	5
	Other Agricultural Products	6		Carnauba products (wax, etc.)	6
				Pulp/nectar of fruits	7
				Other agricultural products	8
Light Industry, Products and its Material	Textile-related industry products (fiber, threads, clothes, etc.)	7	Light Industry Products and its Material	Cotton	9
	Foodstuffs	8		Foodstuffs	10
	Shoes	9		etc.)	11
	Leather and its goods	10		Leather and its goods	12
	Wood	11		Wood	13
	Other Light Industrial Goods	12		Shoes	14
				Other light industrial goods	15
Industrial Products (Electrical, Chemical, Metal, Mineral Industries, Petroleum, etc.)	Stones/mineral	13	Industrial Products (Electrical, Chemical, Metal, Mineral Industries, Petroleum, etc.)	Chemical products	16
	Car/motocycles/buses parts	14		Parts, spare parts	17
	Metal (steel, iron,aluminum, etc.)	15		Industrial Machines	18
	Paper	16		Household appliances	19
	Petroleum Products	17		Metal (steel, iron, aluminum, etc.)	20
	Parts, spare parts	18		Petroleum products	21
	Industrial machines	19		Mineral, stones	22
	Household appliances	20		Paper	23
	Chemical products	21		Car/motocycles/buses parts	24
	Other Industrial products	22		Other industrial products	25

Source: JICA Study Team

Export commodities are the products of the local industries of respective categories, while the import commodities are classified into two categories: those that are consumable goods for the people of the hinterland and those that are the materials and semi-products for industries to produce their export commodities. Most of the Agricultural Products and the Industrial Products comprising the import commodities consist of the goods for people's use while the Light Industry Products consist of those materials and semi-products for the local light industries.

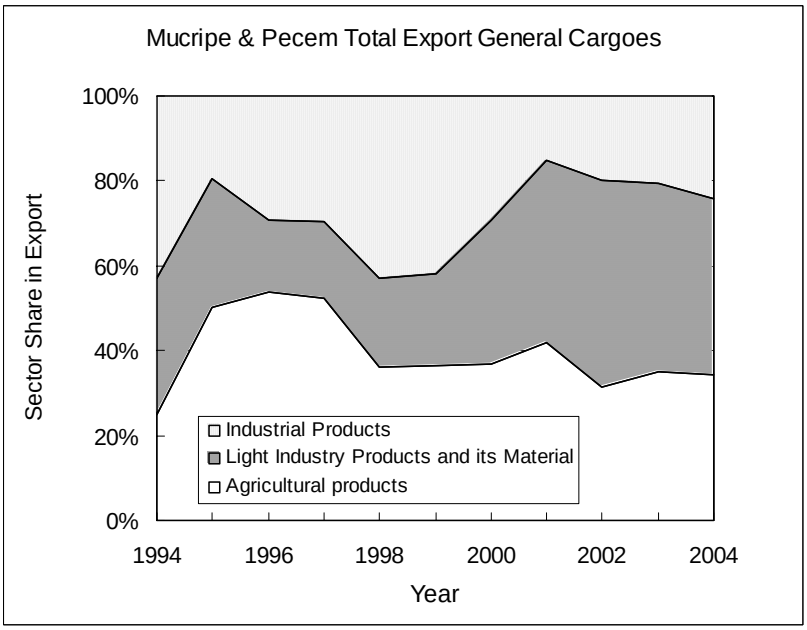
Figure 4.2.1 shows the total export volumes of the commodities of the three categories over the period from 1994 through 2004. The volumes include the international and domestic export volumes at both Pecem and Mucuripe Ports. Figure 4.2.2 shows the share of each category in the total export volume.

It is observed in **Figure 4.2.1** that, since the year 2001, the export volumes of each category have been growing at a much higher rate than in the past. The export volume of the Light Industry related commodities has taken a larger share since 2001.



Source: Mucuripe and Pecem Port (Edited by JICA Study Team)

Figure 4.2.1 Export volume of the three commodity categories (International and Domestic, Pecem and Mucuripe Ports)

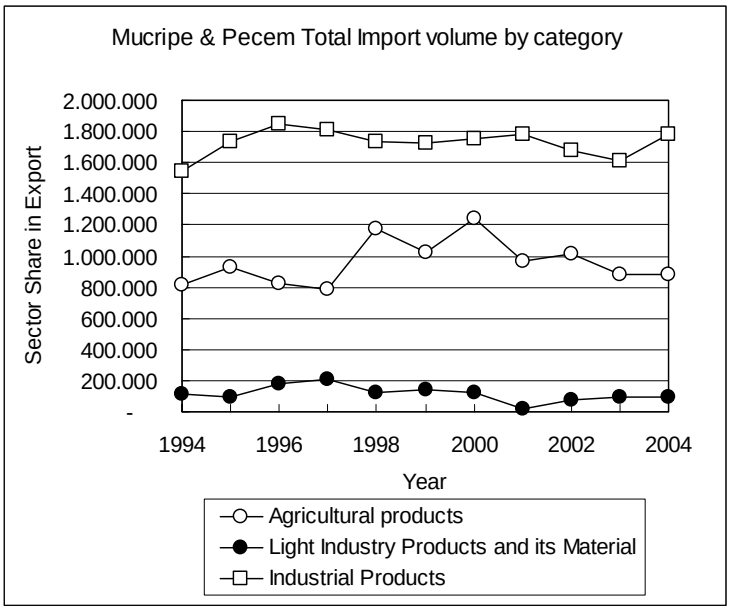


Source: Mucuripe and Pecem Port (Edited by JICA Study Team)

Figure 4.2.2 Category share in the Export volume (International and Domestic, Pecem and Mucuripe `Ports)

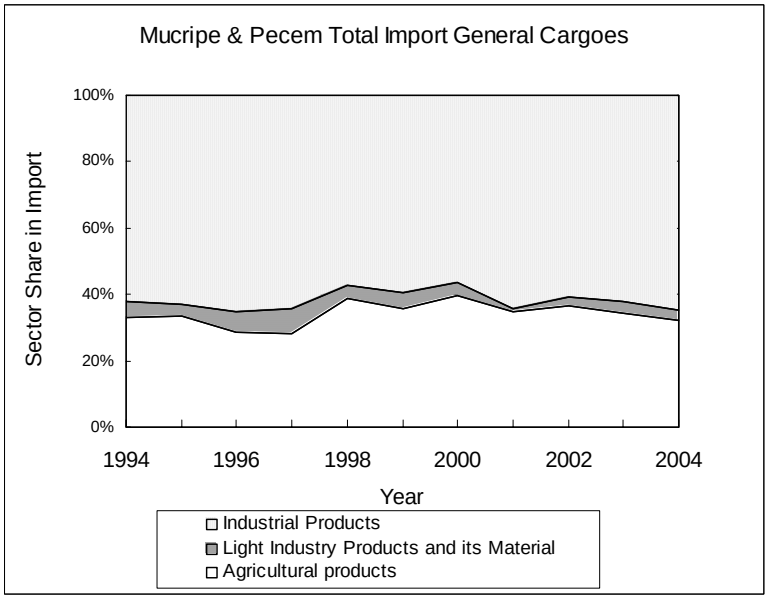
Figure 4.2.3 shows the total Import volumes of the commodities over the same period. It shows a contrast with the export volumes, that import volumes of all three

categories remain almost the same throughout the period. This is especially true for the Light Industry related products. While the light industries of the hinterland became more active in their export and the export volume takes the largest share, the import volume remains the same (also see **Figure 4.2.4**). This shows that the majority of the industries in Ceara State produce the export products out of raw materials locally available.



Source: Mucuripe and Pecem Port (Edited by JICA Study Team)

Figure 4.2.3 Import volume of the three commodity categories (International and Domestic, Pecem and Mucuripe Ports)



Source: Mucuripe and Pecem Port (Edited by JICA Study Team)

Figure 4.2.4 Category share in the Import volume (International and Domestic, Pecem and Mucuripe Ports)

The Agriculture and Light Industry import commodities tend to remain at the same amount. This implies that 1) the consumption of the people has not increased since the GDP per capita, which is a kind of index to denote the purchasing power of the people, has been almost the same over the past 10 years, 2) the agricultural production in the hinterland has increased, for instance, the volume of the production of corn in Ceara has exceeded that of consumption, 3) reduction of the petroleum import due to the supply of natural gas by pipeline.

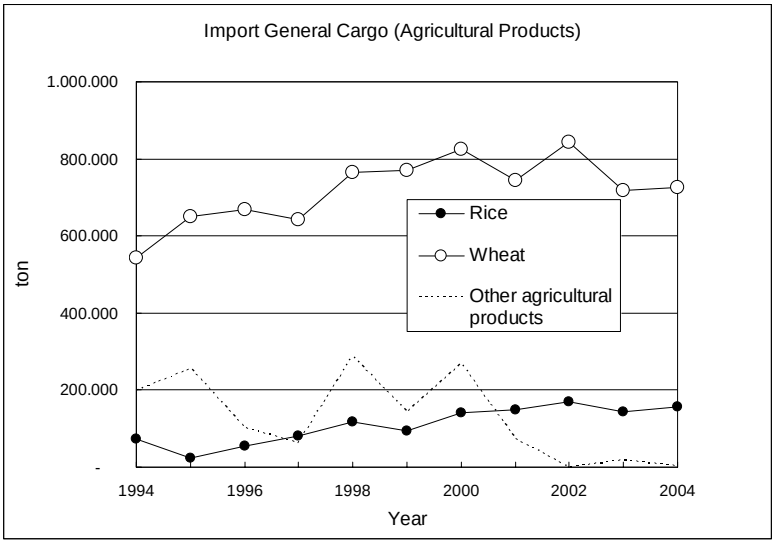
The activities of the each sector shall be discussed in the following sections.

(1) Agricultural products

a Import

Cereals (Wheat, Rice and Corn)

The major commodities in this category are wheat and rice. Import volumes of corn used to be substantial, however, it reduced to a very little amount since 2002 (see **Figure 4.2.5**), when the corn production in Ceara State increased substantially (see **Figure 4.2.6**).

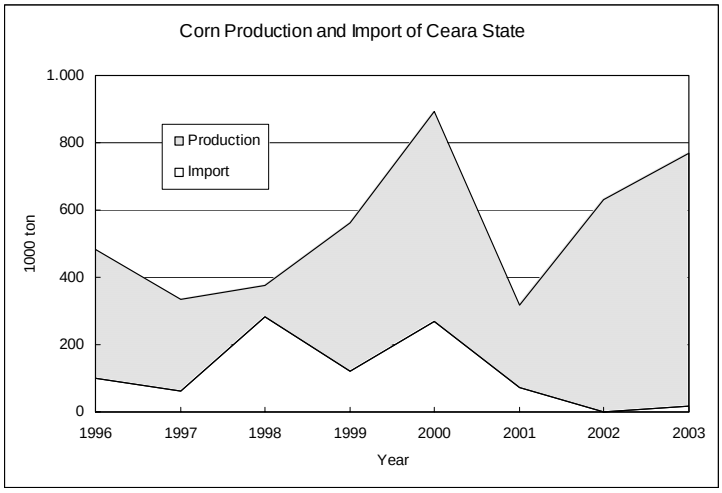


Source: Mucuripe and Pecem Port (Edited by JICA Study Team)

Figure 4.2.5 Major import commodities of agricultural products

The wheat consumption in Brazil was about nine (9) million tons over the period from 1997 through 2003. The average consumption per capita is 52.2 kg (see **Table 4.2.2**).

With the assumption that people of Ceara also consume wheat by 52.2 kg per capita, the wheat import volume at Mucuripe Port is approximately double of the wheat consumption of Ceara Population (see **Figure 4.2.7**). Therefore, it seems that about a half of the import wheat at Mucuripe Port is transported to other states for consumption. The total population of Piaui, Gio Grande do Norte and Paraiba is approximately equal to the population of Ceara. Thus, wheat imported at Mucuripe is transported to these three states.



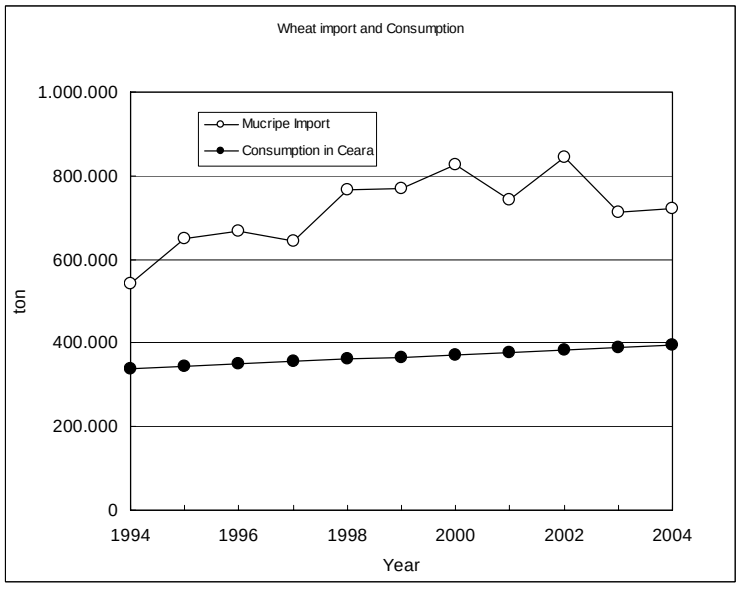
Source: Mucuripe Port cargo statistics and Ceara in Numeros 2004
(Edited by JICA Study Team)

Figure 4.2.6 Production and Import of corn in Ceara

Table 4.2.2 Wheat consumption per capita

Year	Brazil Population 1000	Consumption 1000 t	Consumption per Capita (kg) (kg)
1997	163,471	7,476	45,7
1998	165,688	9,174	55,4
1999	167,910	8,915	53,1
2000	170,143	9,042	53,1
2001	169,080	9,287	54,9
2002	171,317	8,852	51,7
2003	173,553	8,980	51,7
		Average	52,2

Source: Ministry of Agriculture web site (Edited by JICA Study Team)



Source: Mucuripe Port cargo statistics and
IBGE statistics (Edited by JICA Study Team)

Figure 4.2.7 Wheat import at Mucuripe Port and the consumption in Ceara

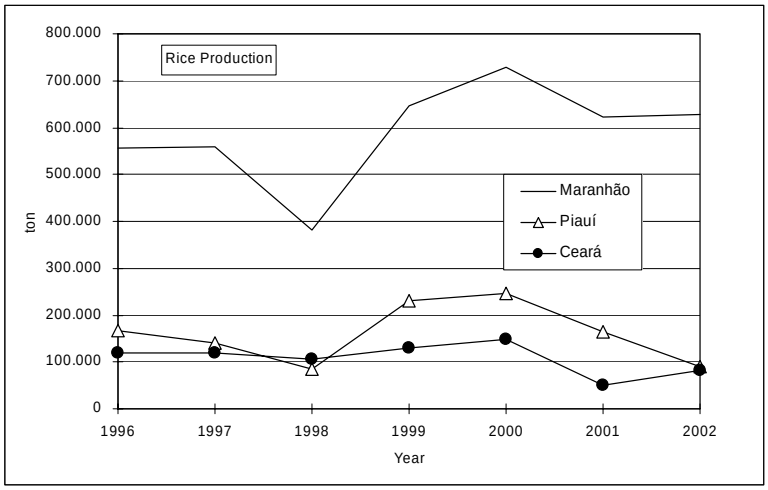
The import and export volumes of rice of Brazil are very small. It seems that the domestic production and consumption of rice are balanced. The average annual consumption per capita is estimated to be 58 kg (See **Table 4.2.3**). However, except Maranhao, the rice production in the states of the Northeast Region is not sufficient to provide this amount to everyone of the state population. For the four states in the northeast Region, i.e. Piaui, Ceara, Rio Grande do Norte and Paraiba, the local rice production provides only 12,8 kg. In addition, the rice production in all the states in the Region remains unchanged or tends to decrease (see **Figure 4.2.8** and **4.2.9**).

Table 4.2.3 Rice production and per capita production

Unit : kg

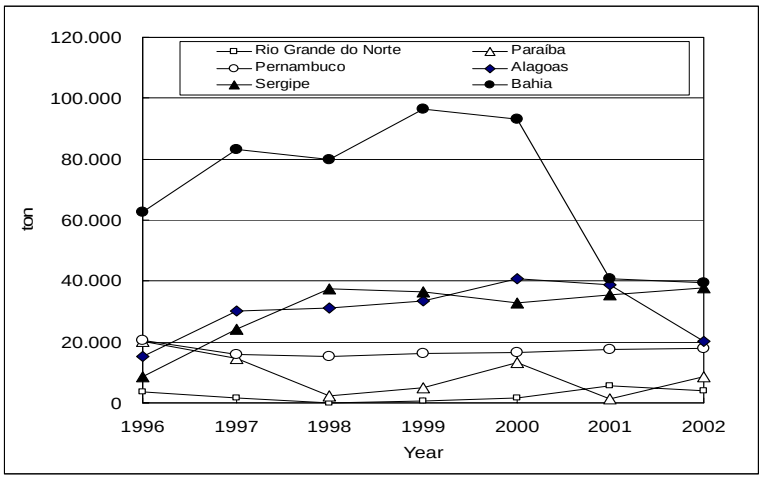
Population	Brasil	Northeast	4 States	Maramhao	Piaui	Ceara	Rio Grand do norte
1996	161.247.046	45.411	20.968	5.331	2.727	6.958	2.617
1997	163.470.521	45.993	21.263	5.411	2.756	7.076	2.657
1998	165.687.517	46.576	21.557	5.491	2.785	7.195	2.697
1999	167.909.738	47.158	21.852	5.571	2.814	7.313	2.737
2000	170.143.121	47.741	22.146	5.651	2.843	7.431	2.777
2001	172.382.797	48.320	22.439	5.731	2.872	7.548	2.817
2002	174.622.472	48.899	22.731	5.810	2.901	7.666	2.857
Prod/Person							
1996	53,6	21,4	14,7	104,1	61,1	16,9	1,4
1997	51,1	21,5	12,9	103,3	50,6	16,9	0,6
1998	46,6	15,9	9,0	69,4	30,6	14,8	0,0
1999	69,7	25,3	16,7	116,0	81,7	17,7	0,2
2000	65,4	27,7	18,5	128,7	86,9	20,0	0,6
2001	59,1	20,2	9,9	108,8	56,8	6,8	1,9
2002	59,9	19,0	8,1	108,2	31,0	10,7	1,4
Average	57,9	21,6	12,8	105,5	57,0	14,8	0,9

Source: IBGE (Edited by JICA Study Team)



Source: IBGE

Figure 4.2.8 Rice Production in Maranhão, Piaui and Ceara States



Source: IBGE

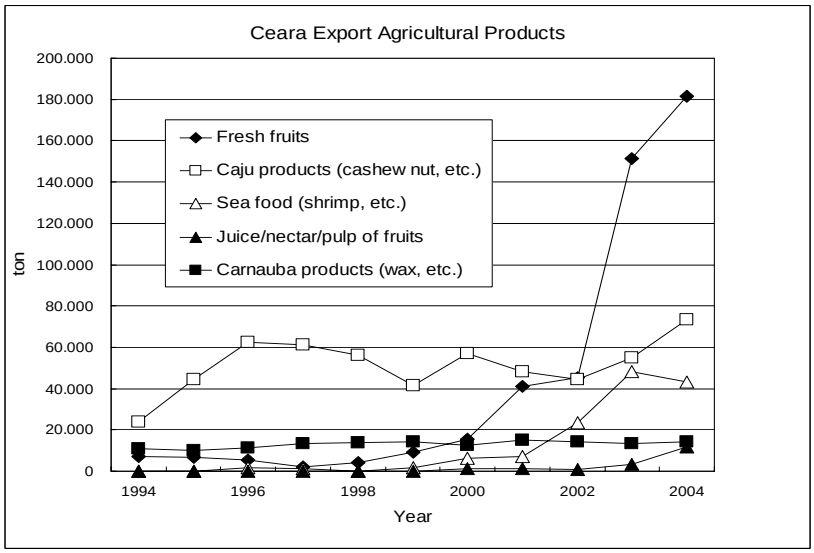
Figure 4.2.9 Production of Rice in other states in Northeast Region

b Export

Agricultural products are the major export commodity. **Figure 4.2.10** shows the export volume of agricultural products over the past 10 years. Cashew nuts have been the principal export products. In the recent years, the increase of banana export has been tremendous, Sea food, especially shrimps, and juice exports are also increasing.

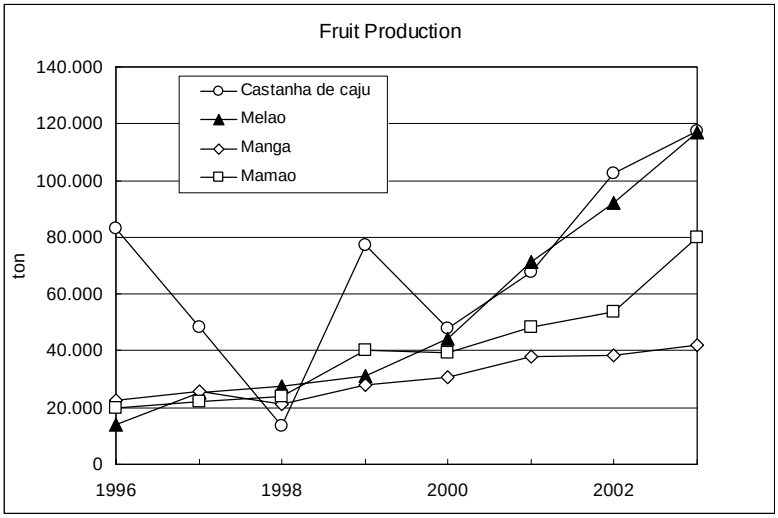
The rapid increase of banana export is due to fruit plantation of foreign agro-industry, such as Del Monte. Ceara does not have enough water for agriculture because of the dry season it goes through. However, when the ongoing "San Francisco River Diversion Project is completed, 48,000 ha of farm land will be irrigated. Thus the agricultural production is expected to grow further.

Besides banana, the volumes of production of other kind of fruits are also increasing. **Figure 4.2.11** shows the annual production of cashew, melon, mango and papaya in Ceara. These fruits are major export commodities, and it seems their production tends to keep growing.



Source: Mucuripe and Pecem Port (Edited by JICA Study Team)

Figure 4.2.10 Export volume of major agricultural commodities of Ceara



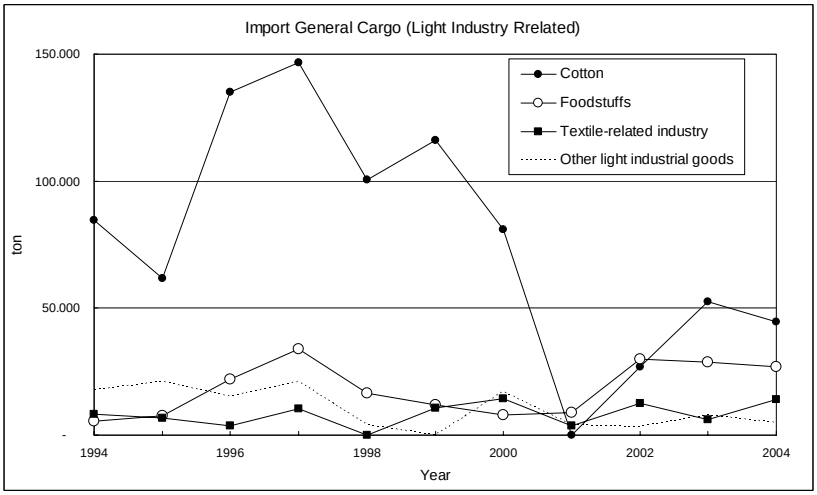
Source: Ceara em Números 2004

Figure 4.2.11 Production of potential export fruit

(2) Small and light industries

a Import

The import volume of light industry related products is relatively small, because most of the local light industries produce their products from locally available raw materials. The textile industries used to import substantial amount of cotton feather, the import volume tends to decrease. This might result from the increase in the local cotton production, Ceara and Bahia States, structural change in textile factory in Ceara: from cotton to synthetic fibers, or competition in the export market (see **Figure 4.2.12**).



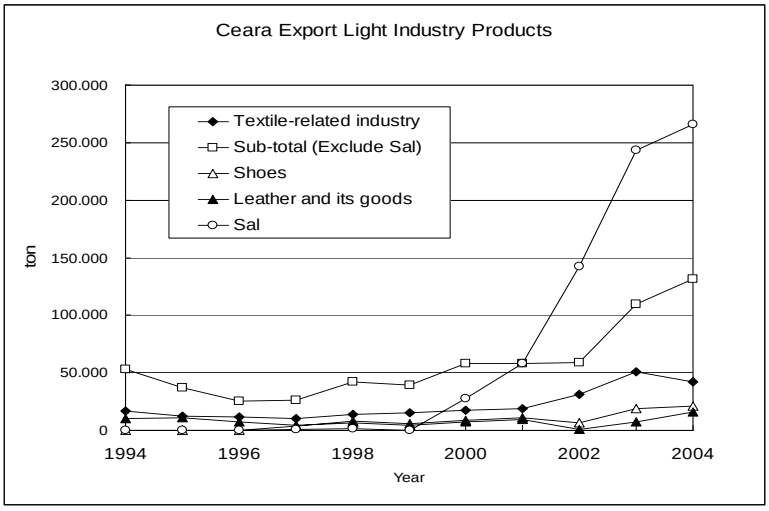
Source: Mucuripe and Pecem Port Statistics (Edited by JICA Study Team)

Figure 4.2.12 Import volume of Light Industry related commodities

b Export

The export volumes of the Light Industry related products are shown in **Figure 4.2.13**. The increase of Salt export is tremendous. The export volumes of local products of

light industries, such as leather and shoes, have been increasing since 2002, while that of textile decreased in 2004. Apart from the rapid increase in salt export, the total of other products (see the curve 'Sub-total excluding Salt" in the Figure drawn with □) has increased more than two folds, while export volume of the textile industry related commodity shows a decrease in 2004.



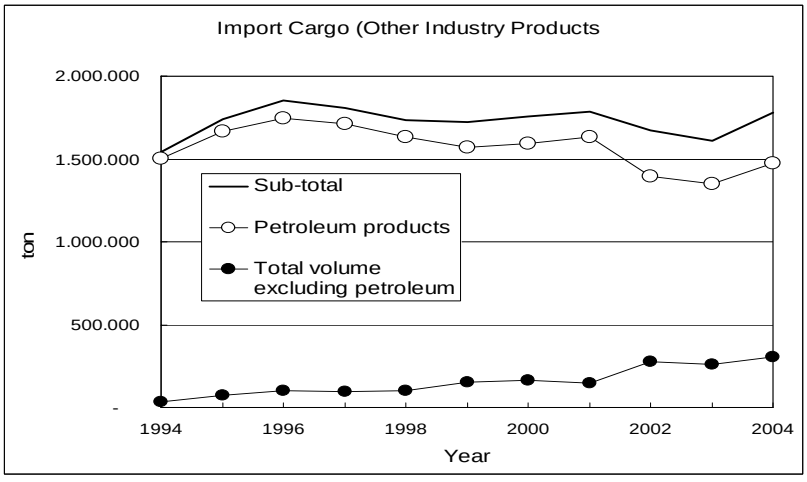
Source: Mucuripe and Pecem Port Statistics (Edited by JICA Study Team)

Figure 4.2.13 Export of light industry related products

(3) Other industry

The products other than the categories of agriculture and Light Industry are classified as other industry products. This category includes the liquid bulk, mainly petroleum products that take substantial part of the total volume of this category. As seen in **Figure 4.2.14**, the petroleum encompasses more than 80% of the total volume of the commodities of this category. However, it is observed that the import volumes of commodities other than petroleum have been growing, while the petroleum import tends to decline.

Thus, the trends of import and export petroleum products are reviewed below.



Source: Mucuripe Port , Edited by JICA Study Team

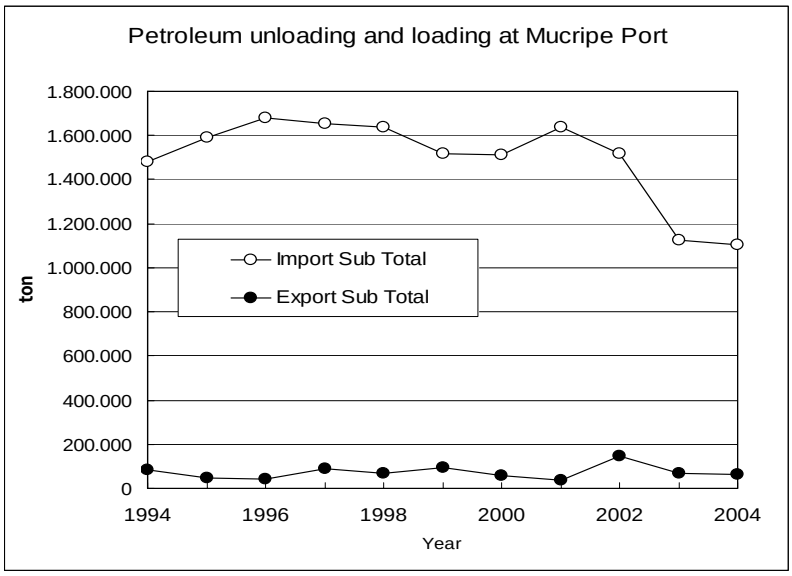
Figure 4.2.14 Import volumes of petroleum and other commodities

a. Petroleum products

(a) Import of petroleum products

Since no storage facilities presently exist at Pecem Port, the petroleum for local consumption is unloaded at Mucuripe Port, while the former handles the transhipment from a ocean going tanker to smaller tanker for coastal service. Thus, the petroleum products consumed in Ceara and other stated nearby are unloaded only at Mucuripe Port.

As **Figure 4.2.15** shows, the total import volume (including both international and domestic) has decreased from 1,700,000 tons in 1996 to 1,100,000 tons in 2004, while the export total has been the same volume over the period. This implies that the pipeline operation from Bahia has reduced the petroleum products at the port. It should be also noted that, due to the Federal Government Policy to achieve self supply of petroleum, import (international) has almost ceased (See **Figure 4.2.16**).

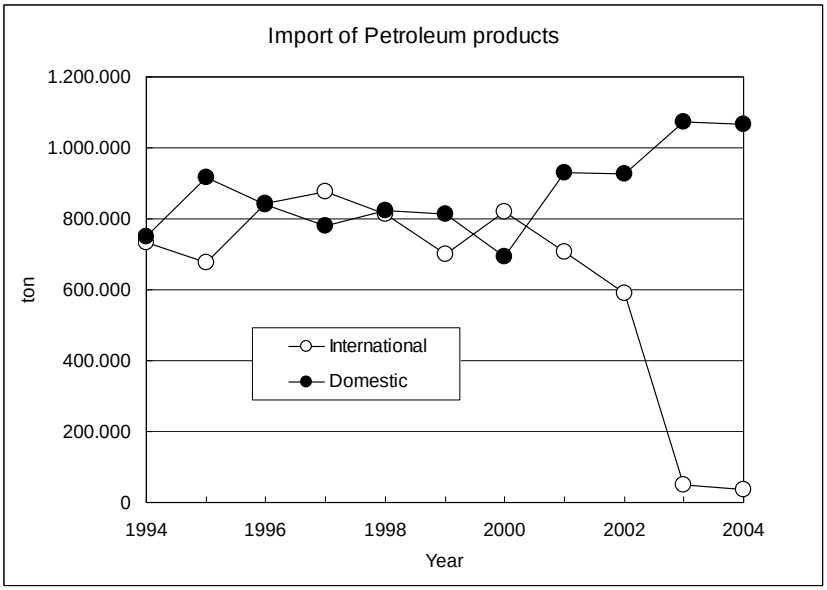


Source: Mucuripe Port, Edited by JICA Study Team

Figure 4.2.15 Import and Export of Petroleum Products at Mucuripe Port

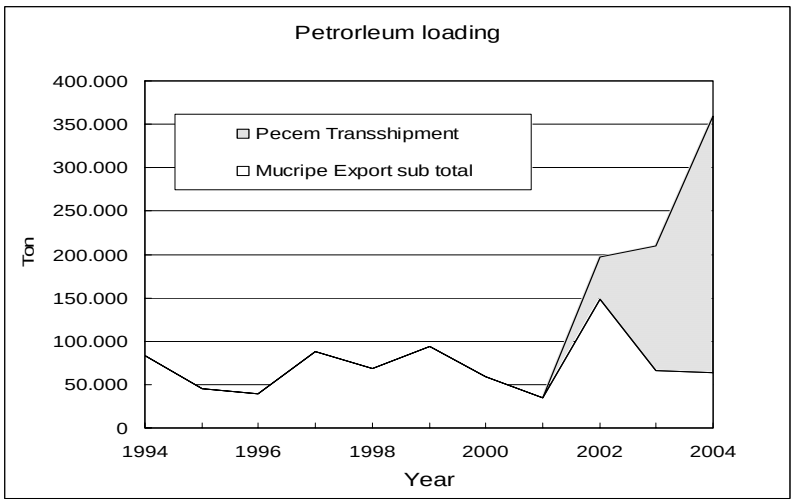
(b) Re-export and transhipment of petroleum products

Mucuripe Port has been re-exporting petroleum product. The volume of re-export has dropped since 2002, when Pecem Port started its transhipment operation of petroleum products (See Figure 4.2.17). Thus, one of the functions of Mucuripe Por thus been taken over by Pecem Port.



Source: Mucuripe Port, Edited by JICA Study Team

Figure 4.2.16 International and domestic import of Petroleum products at Mucuripe Port



Source: Mucuripe and Pecem Ports (Edited by JICA Study Team)

Figure 4.2.17 Petroleum re-export at Mucuripe and transhipment at Pecem Port

b Commodities related to other industries (except petroleum)

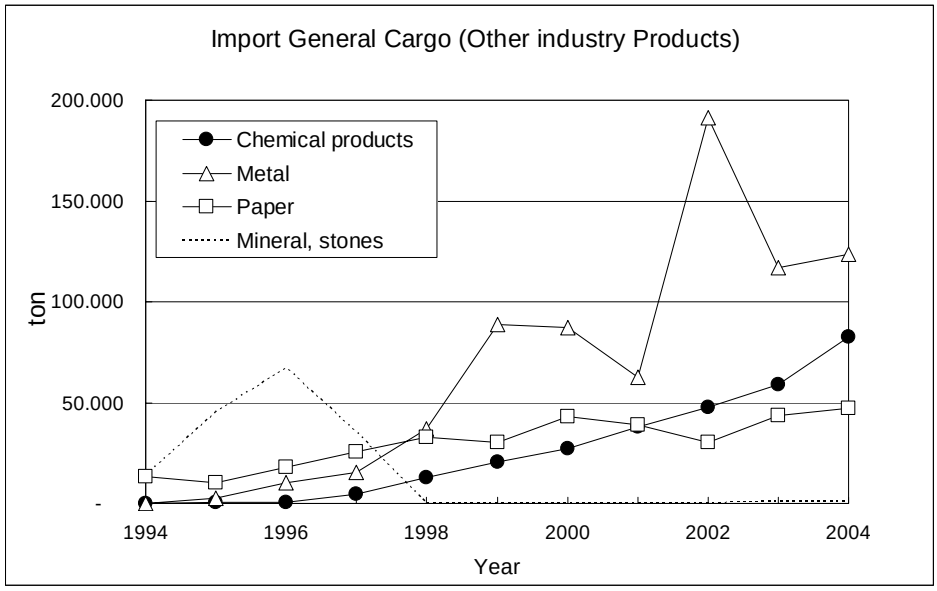
(a) Import

The major commodities of this category are metal, chemical products and paper (see **Figure 4.2.18**).

The main item among metal is roll of steel plate, which is related to the local manufacturing industry that produces construction steel materials for local use. One of the companies of this type of manufacturing business has a plan to expand its factory even without the steel mill in CIPP. The import of chemical products, which are

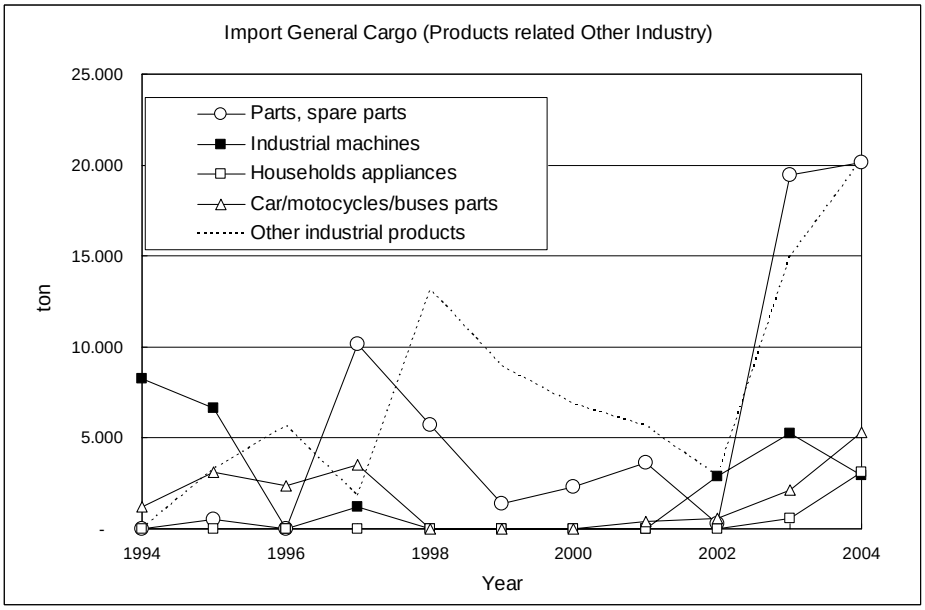
related to the textile business, has been steadily increasing since 1996. The import of paper, which is for newspaper and other publications tends to increase.

Import volumes of minor commodities are shown in **Figure 4.2.19**. Though the volumes have been small so far, the increases of "Parts and Spare parts" and "Car/Motorcycle/Bus spare parts", which are indicated in **Figure 4.2.19** with ○ and △, respectively, over the past few years are remarkable. The sum of import volume of other various commodities of this category has also been increasing for the past two years.



Source: Mucuripe and Pecem Ports (Edited by JICA Study Team)

Figure 4.2.18 Major import commodities related other industry



Source: Mucuripe and Pecem Ports (Edited by JICA Study Team)

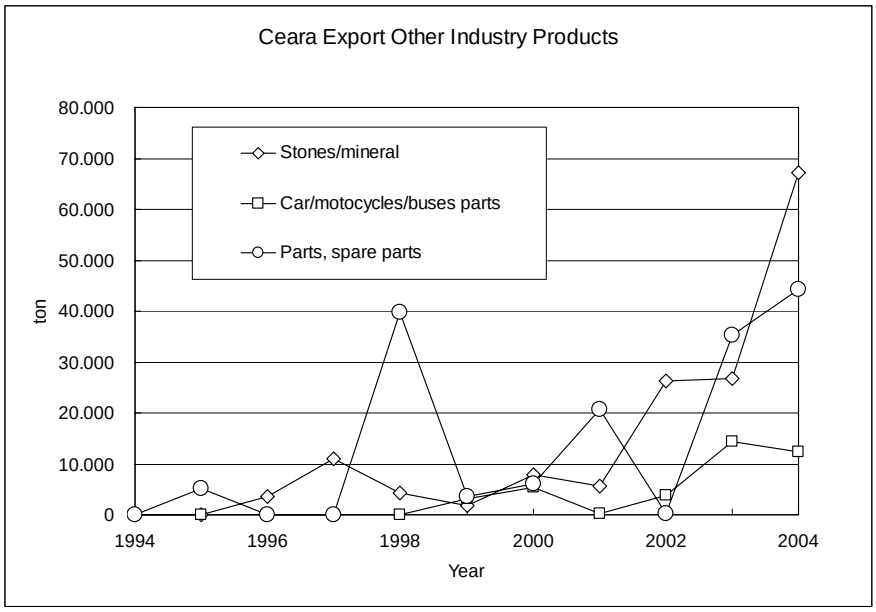
Figure 4.2.19 Minor import commodities of industry products

(b) Export

The major export commodities of this category are "Stones/Minerals", "Car/Motorcycle/Bus Spare parts". The increase of export of "Stones/mineral", which consists mainly of granite, is tremendous since 2000 (see **Figure 4.2.20**).

According to the interview with a company that produces granite blocks and plates, there are many granite and marble mining companies in Ceará and other states in Northeast Region. The main products are blocks, which have been transported in containers to those ports in Pernambuco and Bahia. China is the major country of destination. Those granite blocks are processed in China and then exported to Japan. It seems that the demand of granite in Japan tends to increase over the coming decades for its aging population. Ceara state has large resources of granite and other stones. Though the future of stone export is highly dependent on the marketing and sales efforts, the most necessary for granite business in Ceara is to introduce high technique cutting system, which makes the productivity about 10 times higher than the currently used system. The idea of the manager interviewed is to establish a granite processing factory near Pecem Port where the blocks brought by various mining companies are processed with high technique cutting system.

It is worthwhile to note that the increase in the export of "Parts and Spare Parts" and "Car/Motorcycle/Bus" spare parts in the export coincides with that in the import of the same commodities. This trend may be an indication of the fact that such new businesses have started to import semi-products from U.S., manufacture parts and spare parts of automobiles and other machines, and then export their products to the local and international markets.



Source: Mucuripe and Pecem Port, editied by JICA Study Team

Figure 4.2.20 Minor export commodities of industry products

(4) Anchor industries of CIPP (Steel Mill, Oil Refinery and Petrochemical)

The CIPP Development Plan includes three anchor industries: Steel mill, Oil refinery and Petrochemical. According to the plans that are available to date, the specifications of these three anchor industries are as follows:

a Steel Mill

The method employed to produce steel is the Direct Reduction Furnace. The plan will be implemented in two phases. When the whole plan is completed, the steel mill will be producing three million (3,000,000) tons of thick steel slabs per year. Most of the products are expected to be shipped to Korea for shipbuilding.

When the steel mill is fully operational, it will import five millions (5,000,000) of iron pellets from Madeira Port, San Luis. The plant will use natural gas, which will be supplied through the pipeline from Bahia State. The first phase is half of the scale and is intended to produce 1.5 million tons of thick slabs per year.

The First Phase is to start supposedly in August, 2005 and is expected to be completed in 2007.

b Oil refinery

The consumption of diesel oil in Northeast Region has already exceeded the capacity of the existing oil refineries in the region, and substantial amount of diesel oil is transported from southern regions. Thus a new oil refinery is urgently needed.

The Ceara State government has been making efforts to invite Petrobras to set up its plant in CIPP, while Suape has been assessed to be another potential site for the plant. The negotiation is underway and Petrobras is expected to announce its decision sometime in 2005.

According to the plan, the capacity of the plant is to process 200,000 barrels of crude oil per day. The total production of petroleum products will be 7,552,850 tons: Gasoline; 546,700 tons, LPG; 409,200 tons, Naphtha; 1,058,750 tons, Diesel Oil; 5,178,800 tons, Kerosene; 356,400 tons, and Coke; 3,000 tons.

c Petrochemical

Since the construction of the oil refinery has net yet been confirmed, there is no fixed construction plan of the Petrochemical plant.

The following is the specifications seen in the plan:

The capacity of the naphtha processing is 1,500,000 tons. This amount exceeds the capacity of the Oil Refinery planned above by 450,000 tons. Thus, when the petrochemical plant is fully operated, the plant need to import 450,000 tons of naphtha.

The annual productions are estimated as follows:

LLDPE (Linear Low Density Polyethylene);	500,000 tons,
PP (Polypropylene);	200,000 tons,
C4+;	200,000 tons.

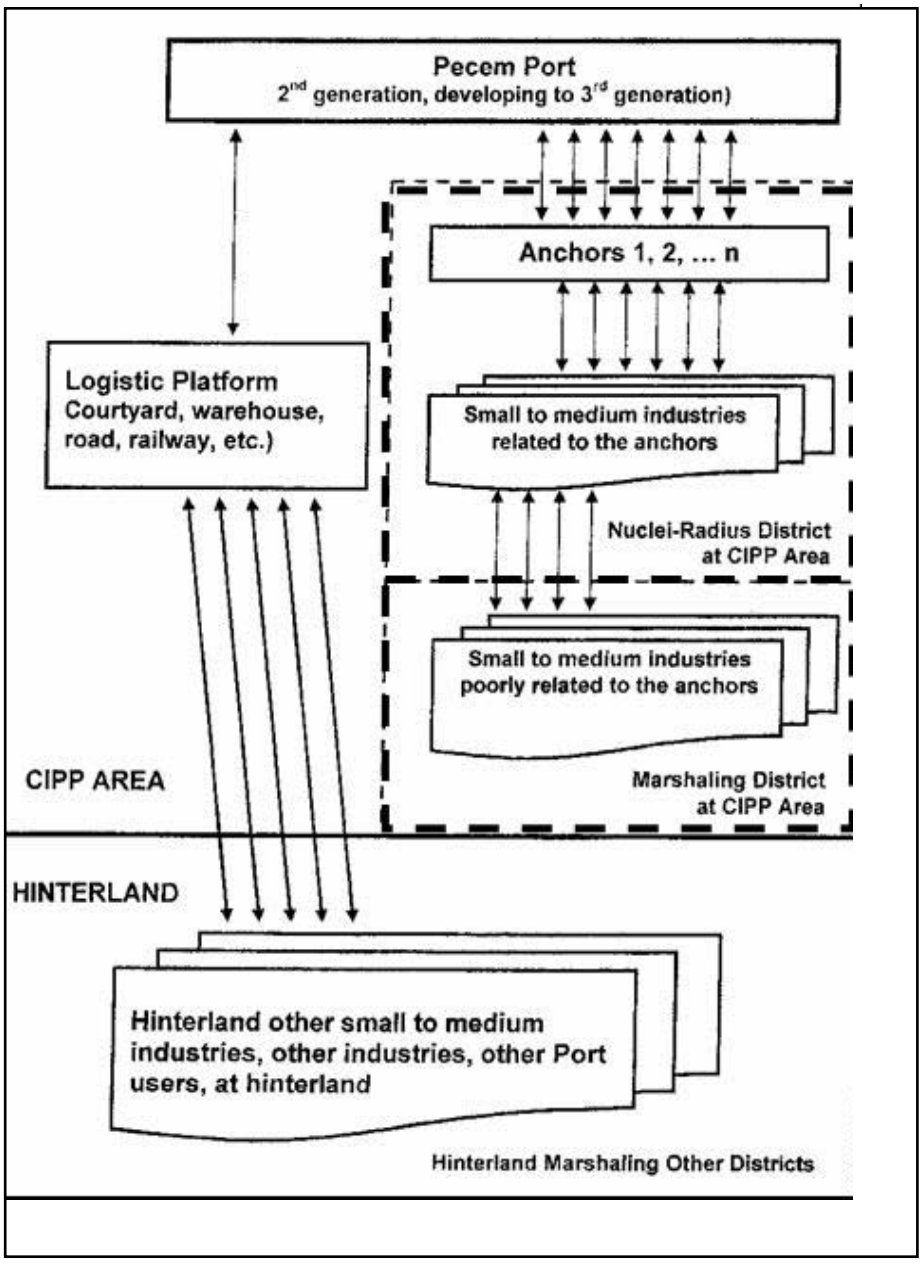
All these products are for export.

4.2.2 Industrial Development Plan of CIPP

(1) Original Plan and current status

a Original Plan

The concept of CIPP development plan is intended firstly to attract the anchor industries, i.e., steel mill, oil refinery and petrochemical. Then these anchor industries attract immediately related industries. This, in turn, attracts other industries inter-connected through productive chains. In addition to the industry complex within the CIPP, the logistic platform such as transportation system including warehouses will be developed for the effective transportation of goods between the port and hinterland outside of CIPP. With the establishment of an industrial complex that consists of various kinds and scales of industries, substantial amount of jobs will be created.



Source: Report, Pecem Industrial and Port Complex, 2002

Figure 4.2.21 Original development concept of CIPP

Figure 4.2.21 is the schematic exhibit of the CIPP development concept.

This concept is highly dependent on the existence of the anchor industries. Without them, the whole development concept will corrupt. Therefore, the Ceara State government has been making great effort to attract the anchor industries, especially, steel mill and oil refinery. The port facilities for conventional cargoes such as iron ore and steel products and unloading and loading facilities as well as pipelines have been constructed by the state government. While the port facilities have been ready to provide services to the anchor industries since 2001, the establishment of these industries has been delayed. The steel mill, which is finally about to start the construction, will produce only thick plates for specific use overseas. The metallurgical industry, which has been growing presently, will not be benefited by the steel mill in CIPP and have to keep importing roles of steel and coils. Thus, the steel mill that will be operating in the time due is still apart from line of the original concept of CIPP development.

b Current Status

The location of CIPP, the size of which is around 350,000 ha, similar to the size of the city of Fortaleza, is located 3 32´33”S 38 48´30”W on the coast of both Caucaia and Sao Goncalo de Amarante municipalities. (Since December 29, 1999, Sao Goncalo de Amarante became a part of FMR.

CIPP is a planned large scale industrial district where the state government purchased the land for future allocation of incoming factories. In other locations in Ceara, industrial aggregation was realized as a result of inflow of many factories, not by prior planning, although the state government made arrangements for the supply of infrastructure and utilities, but mainly due to incentives both from federal (SUDENE-FINOR) and state government (FDI).

.Another point to be taken into consideration is that the CIPP development should not repeat the unwanted side-effects of unplanned urbanization near the industry area and the subsequent social pollution and crimes. Also, the measures to contain trespassers of CIPP at an early stage and to enforce law and orders at all stages will be required to maintain sustainable growth of CIPP in a long range. For this purpose, a suitable urban development plan within and outside of CIPP in the above point of view is required.

As of August 2005, only four (4) companies are located in CIPP:

- Central Geradora Termeletrica Fortaleza S/A – CGTF
- MPX Termoceara Ltda.
- Wobben Wind Power Industria Comercia
- Jota Dois NE Ltda.

The first two are thermoelectric plants based on natural gas, and power plants are considered one of key industries for CIPP. MPX Termoceara Ltda. is inoperative at present due to the actual balance between supply and demand in electric energy. These plants were projected as stand-by sources of electric energy, in the event of shortage as occurred in 2001-2002 in Brazil. A Steel Mill is expected to start construction towards the end of 2005, while Refinery location is not yet decided

between Pernambuco and Ceara. The delay of the Anchor industries to locate in CIPP resulted in a lack of subsequent medium-small industries catering to those Anchors.

a. Power plants

Power plants were planned to fill the gap between the demand of electricity and the supply by conventional hydro-electricity, which caused the black out of 2001.

There are two power plants based on natural gas in CIPP. One is a 346.63MW plant owned by COELCE, the other with 230MW capacity.

b. Steel mill

The steel plant in the first phase will start as DRI and steel slab plant, instead of originally planned cold roll plant.

Steel Mill project is promoted by USC (Usine Siderurgica Ceara), a joint venture of Dongkuk Steel of Korea (50 %), and Danieli of Italy (30%) and CVRD of Brazil (20%). The total investment amount is expected to be US$754 million, about 35% from equity and the remainder from loans. Industrial gas, lime and refractory plants are expected to be in CIPP to serve the steel project, with estimated US$60 million investments. It is expected to generate about 3,400 direct employments during the plant construction, and 1,600 direct and indirect employments during operation.

As of May 2005, USC Phase 1 plan is to produce 1.5 million tons of Steel Slab. The main raw material is 2.5 million tons of Iron Ore Pellet, supplied by CVRD, to be processed through Direct Reduction process of Danieli, then the product iron goes through electric arc furnace, then through slab caster to produce 1.5 million tons per year of steel slab.

Currently, USC is planning to double the above capacity within a few years of the first phase.

c. Refinery

Various studies have been done on possibilities of refinery in the Northeast region. A study by TP&E Associados S/C Ltda. dated 2003-05-12 estimates the deficits of petroleum products in the North and Northeast regions in 2010 will be as follows:

Gasoline	29,300 b/d
LPG	38,600
Naphtha	99,000
Diesel	122,000
Kerosene	14,800

The study suggests a refinery be set up in CIPP with 200,000 b/d capacity, with the following product slate.

Gasoline	14,200 b/d
LPG	12,400
Naphtha	27,500
Diesel	117,700
Kerosene	8,100
Coke	3,000 t

The refinery fills only a part of the deficits in Northeast, and another refinery of similar size is bound to be needed in some location in the North-Northeast regions. As of June 2005, the location of the new refinery is not decided yet. If it is located within CIPP, the cargo flow through Pecem port will have to start in 2009, and if it is located in another place in the Northeast, there still is a necessity of another refinery within a reasonable time span. For the purpose of cargo forecast for Pecem port, optimistic case includes refinery cargo flow to start in 2009, and medium case presumes that the flow starts in 2019.

d. Petrochemical Complex

World ethylene demand in 2003 was 97.3 million tons. In 2004, the world ethylene demand grew to 103.0 million tons, 5.5% over the previous year, especially in China, the demand grew 7.6%. Based on the assumption that the world economy will grow steadily, the ethylene demand in 2009 will be 132.8 million tons with an average yearly growth rate of 5.3%. Growth rates differ by regions and countries. Asia will grow at 6.7%, North America by 4.1%, EU by 2.1%. The demand in Japan in 2009 will be 5.5 million tons, 0.1 million tons lower than 5.6 million tons in 2003 and 5.8 million tons in 2004, due to the increase of import of ethylene derivatives and the relocation of ethylene and derivatives users outside Japan. As to propylene, the world demand in 2003 was 58.8 million tons, and the forecast for 2009 demand is 78.9 million tons.

Growth in North America will be that of the U.S.A., Mexico will grow at a lower rate than the U.S.A. Central and South Americas are represented by Mexico and Brazil. Mexico's Pemex is unable to satisfy petrochemical raw material users by lowering price, at the same time feeling pressure from its labor union against privatization of the petrochemical industry. For some time to come, any remarkable growth of petrochemical industry will not be realized in Mexico. Brazil has its strength in export experience in petrochemicals as it started ethylene from ethanol production and export petrochemicals.

Seventy per cent (70%) of the U.S. ethylene is made from ethane-propane feedstock from natural gas. Natural gas price jumped from traditional $2-2.50/MMBTU to $18 in 2003. It settled later at $4-4.50/MMBTU, but at this level it may put the petrochemicals in U.S.A. uncompetitive in the international market, and may put the U.S.A. in net-importer position of petrochemicals and their downstream products. Brazil may benefit from the situation if the high cost of natural gas in the U.S.A. continues, because the raw material price may become comparatively lower than that of the U.S.A.

Except for the U.S.A. and oil producing countries, petrochemical building block (ethylene) is produced by thermal cracking of naphtha. A gas based ethylene cracker needs around 25% more in quantity of c2+ over ethylene as feedstock. Natural gas is usually composed of more than 80% methane, which is used as fuel or a feedstock of c1 chemicals such as methanol or N fertilizer. Brazil's existing petrochemical centers are all based on naphtha, and located next to refineries to secure stable supply of the major part of naphtha. Brazil's petrochemical centers are as follows:

	Year	Location	Ethylene Capacity	Adjoining Refinery	
#1	1972	Cubatao, SP	500,000 t/y	Pres. Bernerdes/RPBC	170,000 b/d
#2	1978	Camacari, BA	1,280,000 t/y	Landulpho Alves/RLAM	307,000 b/d
#3	1982	Copesul, RS	1,135,000 t/y	Alberto Pasquallini/REFAP	189,000 b/d

If a naphtha cracker is located in CIPP, it should mean that a refinery should have been located in CIPP before the naphtha cracker, unless there is a source of natural gas capable of supplying ample feedstock ethane to produce ethylene. In CIPP, even LNG re-gasification project materialized, the supply of enough ethane would be difficult if ethylene is based on ethane feedstock. In this exercise, petrochemical complex in CIPP is supposed to be based on naphtha from a refinery nearby , with additional supply from other refineries or import.

A one million ton ethylene plant may be, theoretically, more competitive in production cost and many petrochemical plants of the world have this capacity. The large scale plant, although competitive costwise, may create another risk of shutdown accident affecting larger scale of downstream plants. In the present exercise, a naphtha cracker of 500,000 tons per year of ethylene is therefore presumed. Also the downstream products are simplified as much as possible at the same time to realize competitive scale; 500,000 tons per year of LLDPE and 200,000 tons per year of Polypropylene. C4 and C5+ portion plus any excess C2, C3 are presumed to be sold outside. The start of operation is presumed to be 2016.

(2) Alternative plan for CIPP Development

In line with the state government policy of decentralization and job creation on the rural municipalities, industrial estates have been established in remote municipalities outside of Fortaleza, the State Capital (see **Figure 4.2.22**). This might be one of the reasons why most of the light industries established so far tended to produce their products out of locally available materials. Thus, the state government introduced a concept of developing an industrial complex of anchor industries.

The present number of establishments in CIPP shows that the Anchor companies are not yet located in CIPP. There is no Steel Mill or Refinery yet, against the original plan. They may come in the long run. Steel Mill project is at the final stage of negotiation. Refinery, whether the first one in the Northeast region comes to CIPP is not yet certain, but the possibility of subsequent refineries to be located in CIPP is high, in view of the demand growth of petroleum products in the Northeast.

The original CIPP plan is based on ‘Anchor Industry’ or ‘Radius-Nuclei’ model, where one or more anchor industry is connected with the outside of the industrial district. They generate an extensive medium to small company network that is dependent on the anchor companies. The configuration is similar to ‘Hub and Spoke’ in various model including that of transportation network.

In this paradigm, Anchor Industry is to be located first, followed by satellite companies, not vice versa. Up to September 2005, Steel Company is planning to locate in CIPP, when some of the remaining agreements are finalized. Other ‘Anchor Industries’ originally expected, such as Refinery and Petrochemical Complex, are not

certain yet. Two Power Plants were built, and one is not in operation. Next refinery location is not yet decided. Petrochemical Complex may not be established without refinery unless it is based on ethane-propane-plus portion of natural gas in a region rich in such natural resources.

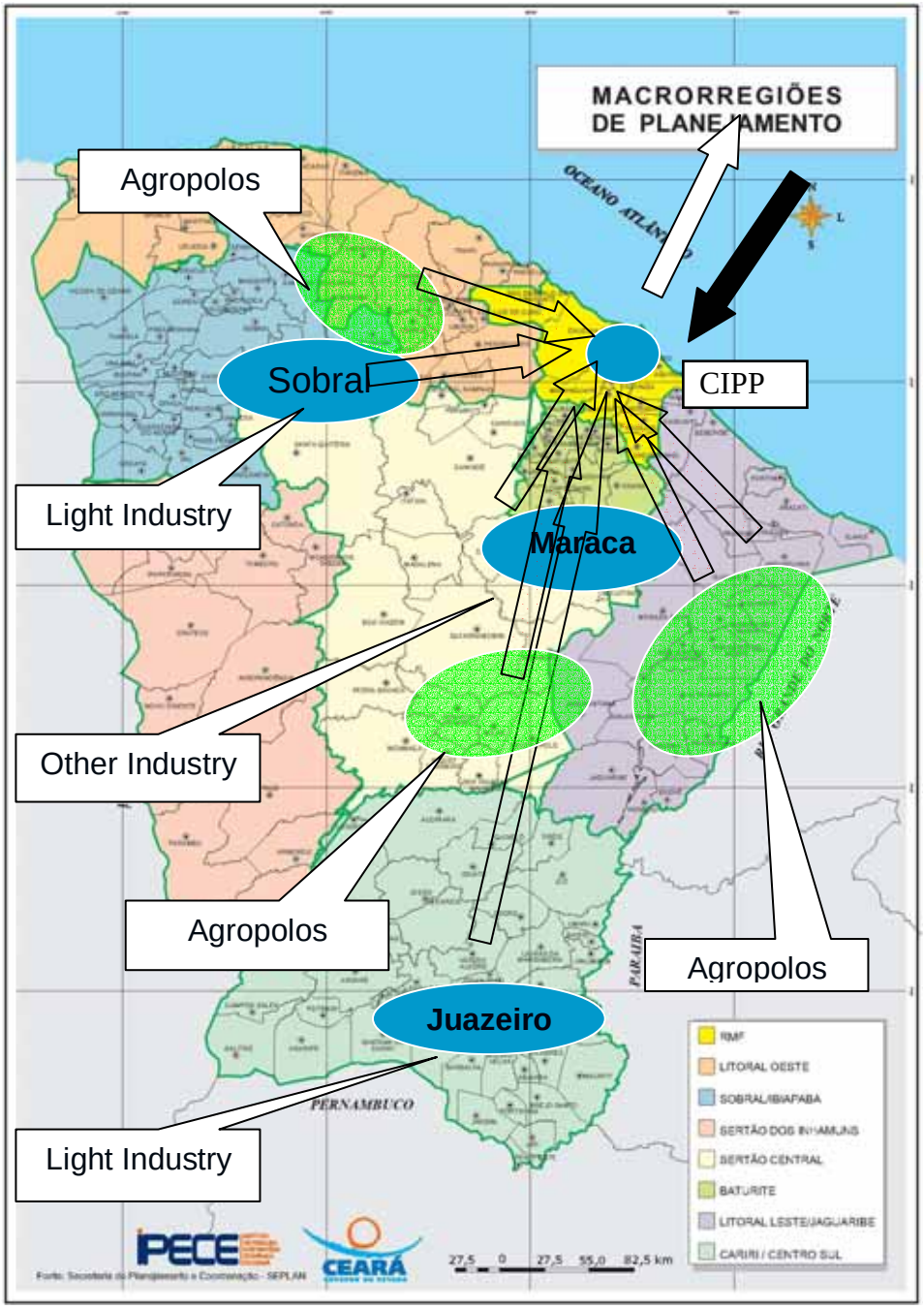
Over the past few years, while the establishment of anchor industries delayed, those traditional light industries as well as the agro-industries have expanded the export of their products and it can be said that the efforts of the state government has been bearing the fruits. In addition, the leap in the export coincides with the opening of Pecem Port, the deep draft port that can accommodate ocean-going container carriers. Due to the direct calls of container ships plying in the sea routes between Europe/East coast of U.S. and South America and due to the lower port charges at the Port, the export industries must have been benefited by the transport cost reduction.

On the other hand, as observed in **Section 4.2.1 (3),** the export of stones, parts and spare parts and car parts has also been increasing. Car parts and spare parts import also tends to increase. This situation may indicate that such a new business has been growing importing intermediate and semi-products and re-exporting the finished products to the foreign or domestic automobile makers. This type of value-adding manufacturing industries will be advantageous if the factories of these industries are located in the neighbourhood of the port, for the transportation cost between the port and their factories.

Ceara State and adjacent states are rich in granite and marble, and therefore, many stone-mining companies are producing stone blocks, because they lack modern cutting machines to produce tiles our of the blocks. Since the introduction of high tech-cutting machine requires large amount of investment, which is too much for individual companies, they tend to export stones in blocks. Thus, by establishing a stone cutting center in CIPP area, they will be able to export more value-added products in response to the clients in a timely manner.

The original concept of CIPP development was to attract and promote relating industries to the anchor industries. It is not only the anchor industries that accompany relating industries. Light industries also are interrelated to each other. While the state policy of decentralization created jobs in rural municipalities, it discouraged the establishment of logistic businesses because the industrial estates are apart from each other. This might have led the local society of industries to think of the concept of “Marshalling District” in the CIPP area.

“Marshalling District” is the area where small and medium size companies locate themselves to take advantage of the benefits of a common infrastructure. This type is popular among various industrial estates all over the world. This model does not have the precondition of Anchor industries to locate first. With Pecem Port in the adjacent area, CIPP will have a prime value, to be jealously held by the government of Ceara. The criteria for locating in CIPP would be whether the establishment could be located outside without losing its competitive edge. The establishments to be initially located in CIPP should be in logistics field, with the possibility of enhancing the geographical advantage of Pecem port, thus increasing serviceability to companies both within and outside of CIPP.



Source: Ceara State Government, edited by JICA Study Team

Figure 4.2.22 Location of industrial estates and agro-poles in Ceara

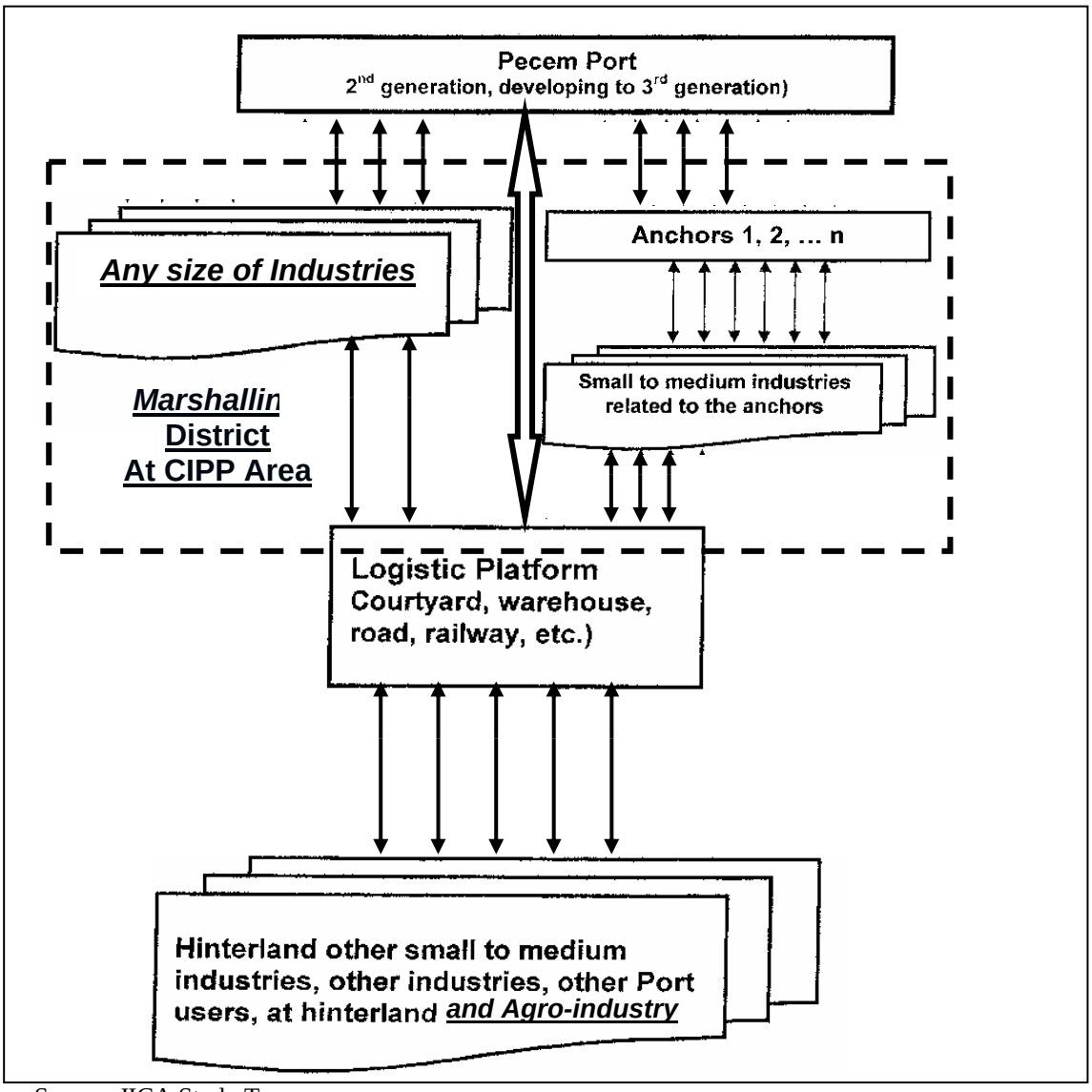
Another category would be an exporting industry based on imported raw materials. Proximity to the port is necessary for this type of operation, and establishment of EPZ may strengthen the operation. There is a study and proposal for reviving EPZ scheme in CIPP by SDE, dated June 2004. EPZ, if realized, would be located within or close to the multimodal logistic yard in CIPP. Existence of EPZ will give additional flexibility and attraction for establishments considering factory location in Ceara.

Establishments locating in CIPP based on Marshalling yard concept may also be located near multimodal logistic yard. It should be noted that the existence of Pecem

port is in itself an attractiveness for municipalities in Ceara and neighbouring states, and those locations outside CIPP will also benefiting as shown in the increase of export through Pecem port.

It is recommended to adhere to the original Anchor industry paradigm, at the same time introduce Marshalling District paradigm and EPZ concept to CIPP for more flexible and early realization of industrial development, not only in CIPP but also in municipalities in Ceara and neighbouring states.

Figure 4.2.23 is a schematic drawing of the new concept of CIPP development.



Source: JICA Study Team

Figure 4.2.23 Alternative develop concept of CIPP

(3) Infrastructure enhancement plan

a Gross and Treated Water, Sewerage and Domestic Solid Waste

Ceara is not really a dry country, with shortage of water resources. Its average annual precipitation of 700mm is on the same level of France. Ceara's problem is the annual fluctuation and uneven distribution of the rainfalls (dry and rainy seasons). It necessitates an ample storage of water and its distribution system to the users.

At present, the problem seems to have been overcome by the installation of Castanhao Dam and the Integrated Canal system, connecting the dam with users around Fortaleza metropolitan area and up to Pecem Industrial Area.

The CIPP Infrastructure study by Federal University of Ceara and CV Engineering dated on July 9, 2000 states the untreated water requirements of the CIPP are: 139,275 m3/day in Phase 1, 273,350 m^3/day in Phase 2, and 408,900 m^3/day in Phase 3. The availability of water through the Integrated Canal is planned to be 22 m^3/sec, whereas the requirement in Phase 3 is 4.73 m3/sec. The Castanhao dam was completed in 2003, and the Canal will be in operation in the latter part of 2005.

Water price for large industrial users is R$4.53/$m^3$. Industrial water is supplied by COGERH, and treated water and sewerage operated by CAGECE. For large industrial users, price will be decided by negotiations, based on required investment and its operation costs.

b Electricity Generation and Distribution

Ceara's electric power has been supplied by CHESF mainly from its hydroelectric power of San Francisco River. The power is transmitted by 500kV or 230kV high tension lines. Ceara started to diversify the source of electricity to thermal generation and windmill. In CIPP, there are two thermal electric generation plants, CGTF-Central Geradora Termoeletrica Fortaleza S/A (346.63MW) and MPX Termoceara Ltda. (220 MW, operation suspended), based on natural gas to be supplied by Petrobras/GASFOR.

Electricity generation and distribution activities were opened for private investment in 2003, and CGTF is one of the examples of private investment of power generation. Distribution system is operated by Companhia de Eletricidade do Ceara-COELCE, which is also privatized. In 2004, COELCE distribution lines reached 80,359 km with 88 substations, with an installed capacity of 1,942 MVA.

Power tariffs at present consists of three schedules; Blue, Green and Conventional. Customers are free to choose the tariff best fit to their needs and economy. Tariffs are set in accordance with the voltage level, seasons (dry and humid), peak and off-peak hours etc. A customer and supplier can enter into special agreement regardless of the published tariff.

Typical industrial user cost range from R$0.15586 to 0.17651/kwh in Blue Tariff, R$ 0.17027-0.19119/kwh in Green Tariff and R$0.24232/kwh in Conventional Tariff. These figures, at R$2.45/US$ exchange rate, may correspond to 6 for industry, and 10 cents/kwh for households. The power cost seems lower than Japan, and higher than Canada and the U.S.A. Arabian Gulf countries offer a lowest cost of around 1.5 cents/kwh

(4) Communication and Telephone Systems

As the CIPP Infrastructure study by Federal University of Ceara and CV Engineering dated 2000-07-09 states, it is recommended to install a state-of-the-art communications network and cabling at the very beginning of Phase 1, so that Pecem Port and the Industrial Complex are linked to the World effortlessly.

Fixed telephone system is supported by the state government in partnership with TELEMAR, with for primary objective to implant 1,400 public payphones in rural areas. In 2001, both installed terminals and operating terminals in fixed telephones are over 300% compared with 1996.

(5) Natural Gas Needs for CIPP

A 382 km gas pipeline, Gasfor 1, is transporting 2.4 million m3/day of natural gas from Guamare to Pecem. The second pipeline, Gasfor 2 is scheduled to operate in 2006 with 280km of extension, and is expected to expand the capacity to 12.0 million m^3/day.

LNG Project was once negotiated with Trinidad & Tobago, and due to the difference of gas pricing, it was shelved for the time being.

Gas price is charged according to tariffs. The current tariff was published by CEGAS on 2004-02-09. The price offered to industrial users ranges from R$0.5235 to 0.5878/m3 in accordance with daily consumption grouping. These figures roughly correspond to U.S.$6.04-6.79/MMBTU at the exchange rate of R$2.45/US$. The figure may be higher than traditional (U.S.$2-2.5) and current (U.S.$4-4.5) U.S.A. price, but comparable to most of the Asian energy importing countries. In Arabian Gulf, Saudi Arabia was charging 50 cents (now 75 cents), and the going price is around U.S.$1.50.

(6) Current status of Land use in CIPP

As discussed above, only four (4) companies are operating in CIPP, one of which; MPX Termoceara Ltda. is in stand-by condition. No Anchor company expected in the original vision is located in CIPP yet, except for two power plants. Steel Mill is expected to start construction within 2005, and the Refinery did not decide the location (Pernambuco or Pecem) yet. Since there was a delay in the establishment of anchor companies in CIPP, the inflow of other companies was not realized yet.

Since the current CIPP land use plan already includes large areas for other industries apart from those zones allocated to anchor industries and related industries, the change in the CIPP development concept will not require a drastic revision of the land use plan. The Marshalling Districts and EPZ are the concepts how to develop the zones for other industries.

4.2.3 Examination of the basic strategy and program for industrial development

The original radius-nuclei concept for CIPP may be adjusted to accommodate marshaling districts concept where small and medium companies locate in the same district to advantage the benefits of a common infrastructure. The concept is common in industrial estates with common infrastructures. SDE is proposing to relocate the EPZ from Maracanau to CIPP to benefit from the new port infrastructure. It will fill the gap of time and space until an anchor industry finally decides to locate in CIPP.

Also it may help diversification of industry in CIPP. One important matter to be noted is that there is a state policy to decentralize industries in Ceara. There will be a risk of establishments which may have located in rural area of Ceara to come into CIPP to limit the possibility of meeting future needs of industries which must physically locate themselves in CIPP (such as transshipment, storage, repacking, etc.). The industries in this category may include; cleaning, sorting and packing of fresh fruits, contract packaging of mainly consumer products, processing of soy, corn etc., processing of bio-diesel and ethanol for export and domestic markets.

(1) Small and light industry

As observed in the analysis of cargo movements of Pecem and Mucuripe in 2.1.2, there is a significant increase of the export of light and other industries' products through Pecem. This shows that the existence of Pecem port gave incentive and competitiveness for export through Pecem port for light and other industries, agro industry not only from Ceara but also from neighbouring states.

Productive Chains

Ceará Research and Strategy Institute - IPECE will provide every year the State Industrial Development Board – CEDIN with the list of productive chains (and respective missing links), which are considered of strategic importance for the development of the State of Ceará, with the objective of supporting the decisions taken by that Board. In other words, missing link here represents indispensable components needed by important industries of Ceara, and their production in Ceara may mean 'import substitution' as observed in industrialization in developing regions and countries. The initial list of such chains and their respective missing links is shown below:

a Leather-footwear chain:

- Tannery for leather finish;
- Leather cut and sewing);
- Notions (threads, labels, elastic, laces, Velcro);
- Metallic components (buckles, straps);
- Simostec plates.
- Reinforced nylon for straps;
- Primer;
- S.B.R. (resin);
- Calcium carbonate (Caulim);
- Plastic components, heels (PU);
- Shoelaces;
- Special linings, *bidim* and synthetic leather;
- Adhesive and embroidered labels;
- Specialized tools (Matrixes, moulds and models)
- Inner soles;
- Low-density polyethylene;
- High-density polyethylene (Resin);
- Recovered PVC;
- Polyester tape (Polypropylene).

b Furniture chain

- Abrasives;

- Synthetic straw;
- Paints and varnishes;
- Upholstering foam;
- Hospital furniture;
- Metallic components;
- Fabrics for upholstered furniture;
- Wooden panels (plywood, particleboards and MDF).

c Ready-made cloth chain:

- Threads, buttons and elastic;
- Metallic and plastic accessories;
- Plastic packing;
- Cutting machines;
- Specialized sewing machines;
- Labels;
- Washing and dyeing;
- Bobbins, needles and tweezers;
- Chemical components (Pigments, bleaching products).

d Textile chain

- Natural, artificial and synthetic fibers (e.g. Lycra thread Elastane);
- Non-woven fibers;
  - Fine plain fabrics;
- Elastic fabrics (Lycra)
- Washing and dyeing;
- Equipment spare parts;
- Pipes and belts;
- Cloth pressers and electronic plates.

e Metal-mechanics chain:

- Ironworks;
- Casting and forging;
- Matrixes for cutting/stamping works;
- Moulds for plastic injection;
- White line;
- Auto parts;
- Specialized sewing machines;
- Cutting equipment;
- Containers
- Component and intermediate products for automotive industry.

f Agro-industry chain

- Irrigation equipment;
- Vacuum glass, polyethylene and PET packing;
- Irrigation facilities;
- Hydrothermal treatment facilities;
- Vegetation houses (seedlings, roses, protected planting, fruit drying, and dehydration);
- Organic defensives;

- Tractors and implements (sprinklers, mechanical planters, mechanical harrows, etc.)
- Seeds and seedlings;
- Cold and acclimatization chambers (fruits and vegetables);
- Equipment for food industry (concentration, bottling, and extraction equipment, ovens, stainless steel);
- Inputs for food manufacturing, such as additives (dyes, conservers, thickeners).

(2) Core industries

Productive chains shown in the Economic Development Policy of Ceara will be in themselves core industries of Ceara. Some of Chemical Downstream Industry may be added; Fertilizers, Agrochemicals, Pharmaceuticals etc., which may not necessarily be located close to a petrochemical complex. Machinery, especially assembly machinery such as electrical, electronic, automobile and motorcycle could be feasible in Ceara in the future. This category could be another Anchor in CIPP.

It may take a long time for Anchor industries to arrive in CIPP. It is important to stick to the original concept until the right time when the Anchor decides to come, at the same time to expand the paradigm to include the Marshalling yard concept so that industrial development is accelerated.

(3) Basic strategy

The CIPP development is an integral part of the state government development programs. The ultimate goal of the CIPP development is to create jobs. To this end, the original CIPP development concept need to be updated to include additional functions to the establishment the Industrial complex with the anchor industries as the core.

While the government continues to make efforts to establish the anchor industries in accordance with the original development concept, it is very urgent to elaborate an alternative CIPP development plan. The Alternative Plan should include the establishment of a logistic platform to support the traditional small and light industries that have been established in Ceara State and that have been expanding the export of their products. There are various ways to help and support their activities. The first step is to provide a warehouse function for the light industries located in remote municipalities, in order to ship their products in timely manners. Such warehouse functions can be expanded to include further value-adding businesses such as packaging and finishing work, and assembling of local and imported materials and semi-products. “Marshalling District” is a general concept of the logistic platform.

The incentives to attract industries should be strengthened to maintain the competitiveness of the state against adjacent state. It is very important to implement the incentives in a timely manner.

Incidentally, the incentives currently given by the state government are as follows:

There are several incentives currently available for new investments in Ceara as explained in the Investor’s Guide and a pamphlet titled General Information, both by SDE:

- Exemption of ICMS

Exemption of destination state ICMS for domestic equipment
Deferment of ICMS on imported equipment
Deferment of ICMS for 1 year on imported raw material

- Exemption of Income Tax
- Exemption of Municipality Tax
- BNDES and BNB loans
- Investment of part of income tax-FINOR System
- Credit line on working capital based on ICMS due –PROVIN and import of finished goods for resale
- Other exemptions such as tax on maritime freight and tax related to import exchange operation, both applicable up to 2010

Total picture of the incentive system is difficult to grasp for a foreigner or a third party. However, the Investor´s Guide issued by SDE, available in English, provides examples and further insight to the matter.

It is also recommended that a unified (single window) organization be established and given authority to plan, execute, market, manage and do all necessary matters for attracting investment in Ceara. Necessary time required to get approval of obtaining incentives is said to be 2 years, which should be shortened to 6 months or less in view of competition with other candidates for investment attraction.

Current development policy as mentioned below is to be adhered to, with action and speed oriented single executing organization outside of the Government to avoid bureaucracy. Most of ASEAN countries have a similar system such as BOI of Thailand.

Economic Development Policy of the government of Ceara, issued by SDE highlights following aspects for industrial development.

- Interior-bound trend of the industrial sector
- Promotion of industrial competitiveness
- Support to the implantation of micro, small and medium industrial companies
- Consolidation of Pecem Industrial and Port Complex
- Promotion of science and technology as a strategic component for the industrial development
- Promotion of the innovating and venturing industrial view
- Industrial Development Support and Incentive Policy

The system of incentives is defined in the Economic Development Policy as a mechanism to optimize the available resources with selectivity for adjusting the system to economic and sector-based guidelines. Projects to be attracted are to be significant for:

- Generation of direct and indirect jobs
- Development of micro, small and medium companies, and creation of first-job opportunities
- Use of local raw material

- Production of high socioeconomic impact
- Regional development decentralization and interior-bound trend
- Supply chain strengthening and consolidation
- Heavy industry, technology-based industry, biotechnology and information technology industries
- Transfer of technology to Ceara companies

Based on the above mentioned policy, Industrial Development Fund grants incentive in the form of loan, in accordance with the benefit calculated through points system. Transformation industries eligible to the above benefits include

- Structuring industries, including capital goods industry, such as ironworks, alternative power, refineries, machines, equipment and respective parts and components
- Manufacturing industries, especially those strengthening the local productive chains, such as leather-footwear chain, ready-made cloth chain, furniture chain, textile chain, electro-electronics chain, metal-mechanics chain
- High-technology industry or technology-based industry, such as information technology, pharmaco-chemistry, biotechnology, genetic engineering, renewable energy, essential oils, physio-therapeutics
- Recycling industry

4.3 Examination of Basic Strategy for Port Development

4.3.1 Growth potential of Pecem Port and its advantage on the competing ports

Since its opening in 2001, Pecem Port has been serving not only Cear State, but also adjacent states in the Northeast Region. The analyses of port statistics of both Mucuripe and Pecem Ports showed such facts that, while some commodities have shifted from Mucuripe Port to Pecem Port, many commodities handled at Pecem Port are new commodities that were not seen among the major commodities at Mucuripe Port before 2001. In addition, as discussed in Chapter 2, the export volume of almost all the commodities including agricultural, light industries and other industry related products, exhibit a big leap since 2002.

These facts imply that opening of Pecem Port, Ceara's deep draft port, have had a great impact on the economy of the hinterland: not only Ceara State but also adjacent states. In fact, in the interviews, some companies revealed their investment plans to expand their business. Above all, the Northeast railway company and the major shipping lines plying their fleet to South America count Pecem Port as one of the key elements in their operation plan.

Even without proper facilities for container cargo handling, the economy of the hinterland requires the port to be the logistic port. All the facts proved that Pecem Port has a great potential as the gateway port of the region. The port has also a potential to expand its hinterland to the whole Northeast Region and further beyond the Region. Except for the immediate hinterland, i.e., Ceara State and adjacent States, the port shares the hinterland with other major ports in ther Northeast Region: Itaqui (Sao Luis, Maranhao), Suape (Recife, Pernambuco) and Salvador (Salvador, Bahia). When the railway upgrading project is completed, these four ports will formulate a port system where the four ports complement each other to serve the inland areas of the Region

Pecem Port has not been legislatively designated as an "Organized Port" that handle any kind of cargoes of the third party, but as a "Terminal Port" that handle cargoes related to specific companies, . This allowed the port to be exempted from the requirement that is imposed on "Organized Ports", i.e., the port workers should be members of a Union. The status of Terminal Port has been an advantage for Pecem Port over the other three ports; it has been one of the factors that made it possible for Pecem Port to set its tariff on container handling at a competitive level.

On the basis of the current operation schedule of ocean going container liners, Pecem or Suape Ports are called by these liners as the last leg before they make a voyage to Europe and the North Coast of U.S. This type of liner operation is very advantageous for the exporters. At present, the total frequency of service made by various international shipping lines is the same for both Pecem and Suape Ports.

It is, thus, assessed that Pecem Port has no geographical disadvantage over Suape Port. The container terminal of the latter is now operated by ICTSI, a Philippine-based world famous terminal operator, and has started to offer more competitive tariffs.

Summing up the factors, Pecem Port has no substantial advantage to Suape Port, though it has an advantage over Salvador Port in the draft of piers and over Itaqui Port in the availability of the international container liner service. Therefore, it is concluded

that it the improvement of container terminal is very urgent for Pecem Port to keep attracting users.

4.3.2 Inland transport network connecting to Pecem Port

(1) Improvement of the Road Network of the Hinterland of Pecém Port

As to the container cargo passing through Pecém Port, about 65% of the total exports departed from Ceará State and about 80% of the total imports had Ceará for destination.

Since almost all the container cargo is transported by truck, road conditions in the state influence use of Pecém Port. Conversely speaking, to advance the maintenance and improvement of the highway network increases accessibility of Pecém Port and the container volume handled in Pecém Port. As a result, developing the highway network of Pecém's hinterland can lead to enhance a competitive strength of Pecém Port.

In this section, the current situation of the highway network in the hinterland is evaluated and a development strategy regarding the infrastructure of federal highway was examined on the basis of the evaluation.

a. Highway Network in Ceara Statae

In the State of Ceará, the highway network is composed of ten federal highway routes which function is main transportation route in Ceará. Three federal highways are extended from Fortaleza in the shape of radiation and make the frame of transportation in Ceará. One of those is BR-020 which is classified "Radial Highway" and makes toward Brasília (Federal Capital), running through the center of the state. Another one is BR-116 which is classified "Longitudinal Highway" and passes through Pernambuco and Bahia, running through the east side of Ceará State. The other is BR-222 which is classified "Transversal Highway"and passes through Piauí and Maranhão alongside the coast of the northeast region, getting across the west side of Ceará State.

Figure 4.3.1 shows the highway network in Ceará drawn as pattern diagrams. In addition, **Table 4.3.1** clarifies the current situation of the federal highway in Ceará. DNIT (National Department of Transport Infrastructure) investigated the condition of federal highway and announced it. From this table, it can be seen that the extension of only about 30% of the whole highway is in good condition and the rest extension remains at a lower level.

The Highway BR-020 is one of the roads which make the structure of transportation in Ceará as above-mentioned, but the condition of the highway is the worst. In the road section of approximately 70% of the whole extension, drivers are required to drive with the greatest care. Although BR-116 is kept in good condition as compared with BR-020, the better part of the whole remains in bad condition. BR-222 is in the worst level as well as BR-020 and the extension of good situation does not come to only 10% of the whole.

In addition, it can be seen in **Figure 4.3.1** that the sections within 100km from Fortaleza are not necessarily maintained in good condition.

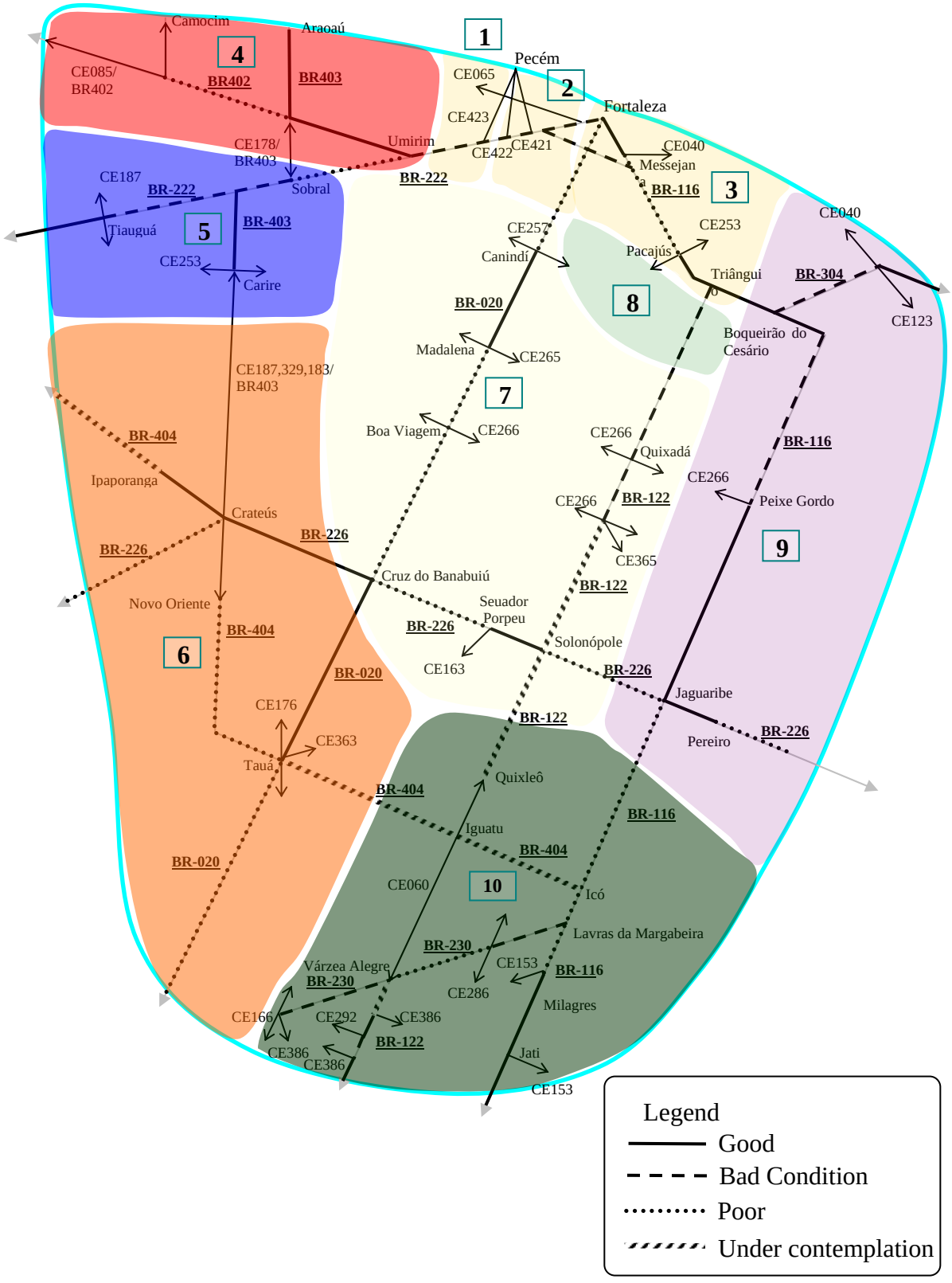


Figure 4.3.1 Road condition of federal highways in the State of Ceará

Table 4.3.1 Road Condition of Federal Highway in Ceará

(Unit:km)

Highway No.	Extension	Road Condition			
		Normal	Bad	Poor	No information
BR-020	411,2	127,9	0,0	283,3	0,0
		31,1%	0,0%	68,9%	0,0%
BR-116	546,7	235,2	58,3	141,5	111,3
		43,0%	10,7%	25,9%	20,4%
BR-122	445,0	53,5	169,2	53,5	168,8
		12,0%	38,0%	12,0%	37,9%
BR-222	348,8	34,4	176,8	137,6	0,0
		9,9%	50,7%	39,4%	0,0%
BR-226	261,6	137,3	0,0	124,3	0,0
		52,5%	0,0%	47,5%	0,0%
BR-270	116,0	0,0	54,1	61,9	0,0
		0,0%	46,6%	53,4%	0,0%
BR-304	102,5	60,9	41,6	0,0	0,0
		59,4%	40,6%	0,0%	0,0%
BR-402	125,6	125,6	0,0	0,0	0,0
		100,0%	0,0%	0,0%	0,0%
BR-403	149,0	0,0	0,0	0,0	149,0
		0,0%	0,0%	0,0%	100,0%
BR-404	30,0	30,0	0,0	0,0	0,0
		100,0%	0,0%	0,0%	0,0%
Total	2536,4	804,8	500,0	802,1	429,1
		31,7%	19,7%	31,6%	16,9%

Source: DNIT

b. Problems on the Highway Network as Transportation Infrastructure

To analyze the highway situation as compared with the container cargo movement in the hinterland can clarify some problems about the highway as transportation infrastructure to Pecém Port.

As to the container cargo in the hinterland (see Table 3.2.2), the east coast area (CE9) accounts for 28 % of the total cargo, followed by Fortaleza (CE3). For outside of Ceará State, Rio Grande do Norte accounts for 11.44%, followed by Bahia (5.47 %) and Pernambuco(5.44%)

From this container cargo movement, it can be understood that BR-116 within the zones of CE3 and CE9 is used for transportation of container cargo. While the better part of the extension at these zones is in bad condition, the road condition of BR-116 could disturb a smooth transportation.

When it is considered that the container volumes from or to Rio Grande do Norte, Bahia and Pernambuco are large, the driving conditions of BR-116 and BR-020 leading to these states could have a negative effect on transportation through these routes.

c. Development Strategy of the Transportation Network in the Hinterland

As shown Table 4.3-3, PPA includes some projects of maintenance and improvement with regard to the federal highways in Ceará State.

Table 4.3.2 Origins and Destination of Foreign Container Cargo via Pecém Port in 2004

(Unit: t)

State		Agricultural and Fishery Products	Light Industry Products	Industrial Products	Others	Total	
Ceara	CE1	424	0	11	10	445	0,10%
	CE2	1.045	0	4.081	99	5.225	1,15%
	CE3	**51.850**	**22.550**	**31.328**	**7.393**	**113.121**	**24,91%**
	CE4	1.495	2.546	31	33	4.105	0,90%
	CE5	984	6.491	667	266	8.408	1,85%
	CE6	0	0	0	0	0	0,00%
	CE7	124	937	**19.188**	24	20.273	4,46%
	CE8	111	15	28	0	154	0,03%
	CE9	**106.428**	**10.624**	**8.574**	**495**	**126.121**	**27,77%**
	CE10	293	956	303	14	1.566	0,34%
	Total	162.754	73.118	64.749	8.335	308.956	68,03%
Maranhao		127	919	11.501	722	13.269	2,92%
Piaui		5.554	1.065	5.844	65	12.528	2,76%
Rio Grande do Norte		**28.733**	**18.382**	**2.796**	**2.059**	**51.970**	**11,44%**
Paraiba		2.726	6.025	182	281	9.214	2,03%
Pernambuco		**22.867**	**660**	**759**	**426**	**24.712**	**5,44%**
Sergipe		0	45	22	0	67	0,01%
Alagoas		94	0	0	2	96	0,02%
Bahia		**24.678**	**65**	**30**	**45**	**24.818**	**5,47%**
Others		2.965	30.805	3.709	552	38.031	8,37%
Grand Total		250.498	102.085	89.054	12.486	454.123	100,00%

Soruce: Original data was provided by Ceara Port and Processed by JICA Study Team

As to BR-116, if the project is carried out completely, about 60 % of the road extension under bad condition is expected to be improved. In consideration of the importance of BR-116, however, it is required that the whole extension of BR-116 within Ceará be improved immediately. On the other hand, as to BR-020 and BR-222, the improvement will hardly progress within the period of PPA.

Now, there are a lot of container cargoes related to manufacturing products in the urban area of Fortaleza and its neighbouring area as compared with other areas. In the future, a much bigger increase in container demand is expected, from or to the urban area of Fortaleza and its neighbouring area. In addition, it is thought that transportation quality, such as reducing vibration in-transit, comes to be important after this. For this reason, as to BR-020 and BR-222, it is required that maintenance and improvement of the road be done in a phased manner from the section close to Fortaleza.

Table 4.3.3 Highway Projects in Ceará

		Plannnig Length (km)	PPA 2004-2007		Notes
			Excuting Length (km)	Budget (R$*1,000)	
Northeast Corrid		3.893	2.595	14.168.000	BR-020,101,106, 222,226, etc.
Ceara		858	451	346.360	
	BR-020	97	4	3.300	
	BR-116	307	252	229.200	
	BR-122	45	6	1.000	
	BR-222	97	4	3.300	
	BR-226	136	22	6.500	
	BR-304	210	120	60.000	
	others	76	76	75.300	

Source: PPA

(2) Railway improvement

The railways in the Northeast Region, operated by three railway companies, are serving between the major cities, mainly along the coast: Maceio, Recife, Joao Pessoa, Fortaleza, Teresina and Sao Luis. There is practically no service to the inland area in the Region, which have a great potential of agricultural production (see **Figure 4.3.2**).

Source: Ministry of Transport web site

Figure 4.3.2 Existing Railway network in the Northeast Region

Since these railways were privatized, the railway companies have been elaborated their investment plans. The outlines of these railway projects with a broad gauge (1.6m) are as follows (see **Figure 4.3.3**):

- Route: Porto Franco – Balsas (New line construction of approximately 190 km long
- Route: Eliseu Martins — Salgueiro - Missao Velha - Pecem Port (New line construction from Eliseu Martins to Missao Velha and Improvement from a narrow gauge (1m) to a broad gauge (1.6m) from Missao Velha to Pecem Port of approximately 1,040 km long in a total)
- Route: Eliseu Martins — Salgueiro - Suape Port (New line construction of approximately 1,010 km long, the line from Eliseu Martins to Sai Gueiro is common with the above project)
- Route: Barreiras — Ilheus Port (New line construction of approximately 800 km long)

Source: Northeast Railway Company (CFN) presentation material

Figure 4.3.3 Railway development projects

4.3.3 Possibility of Shipment of Cerrado Products through Pecem Port

(1) Outlines of Production and Export of Grains in Brazil

In the Second National Development Plan formulated in 1974, the following three policies in terms of agriculture were published:

- Expansion of agricultural frontier in the Cerrado region
- Promotion of the increase in grain production
- Promotion of the mechanization and increase in the inputs of fertilizer and agricultural chemical

In line with the above policies, the full-scale agricultural exploitation in the Cerrado region started in 1975. From the year 1975 to 2004, soybean yield increased from 9.9 million to 49.2 million tons, indicating five times as much as that in the starting year. In the same period, soybean cultivated land increased from 5.8 million to 21.5 million ha. In the last five years from 2000 to 2004, its yield increased by 50% with an annual increase rate of 10.6%. In addition, in the same period, corn yield increased from 16.3

million to 41.9 million tons, and corn cultivated land increased from 10.8 million to 12.4 million. In contrast, in the same period, wheat yield decreased (see **Table 4.3.4**).

Table 4.3.4 Historical Trend of Production and Export in Brazil (1993 - 2003)

Unit: '000 t

Year	Soya Beans (Grains and Brans)					Soya Bean Oil	
	Production Total	Export			Percentage of Exports	Export Total	Percentage of Exports
		Grains	Bran	Export Total			
1993	22,591	4,185	9,414	13,599	60.2%	746	3.3%
1994	24,932	5,398	10,644	16,041	64.3%	1,533	6.1%
1995	25,683	3,493	11,600	15,093	58.8%	1,764	6.9%
1996	23,167	3,647	11,262	14,909	64.4%	1,332	5.8%
1997	26,393	8,340	10,013	18,353	69.5%	1,126	4.3%
1998	31,307	9,275	10,447	19,722	63.0%	1,360	4.3%
1999	30,987	8,917	10,431	19,348	62.4%	1,552	5.0%
2000	32,821	11,517	9,389	20,906	63.7%	1,073	3.3%
2001	37,907	15,676	11,271	26,946	71.1%	1,652	4.4%
2002	42,125	15,970	12,517	28,487	67.6%	1,934	4.6%
2003	51,919	19,890	13,602	33,493	64.5%	2,486	4.8%
2004	49,222	19,248	14,486	33,734	68.5%	2,517	5.1%

Source: Productions: IBGE, Exports: FAO

Thus, soybean production has widely contributed to the expansion of grain production in Brazil due to the exploitation of the Cerrado region. Around two thirds of soybean yield is exported and soybeans presently ranks first in both volume and value in export of agricultural products in Brazil, whereas corn produced in Brazil is mostly consumed locally, rather than being exported. In addition, Brazil is the second largest exporter of soybeans in the world market following the USA. On the other hand, the largest importer of soybeans in the world market is China, followed by Japan. Thailand, Indonesia and South Korea are also prominent importers. Asia is the major region in terms of soybean import in the world market. In the world market of soybeans, trade volume showed a sharp increase in the recent years caused by import of soybeans by China; China imported 20.7 million tons of soybeans in 2003, indicating 4.8 times as much as that in 1999. Other Asian countries also showed increases in soybeans import in the same period.

(2) Agricultural Frontier in the Cerrado of the Northeast Region

Agricultural frontier in the Cerrado region is estimated around 66 million ha in total in Brazil (EMBRAPA: Brazilian Agricultural Research Corporation). It is said that around 15.4 million ha could be practically exploited considering reservation areas that is stipulated to be at least 30% of individual farmland. The area of 15.4 million ha is divided into two areas. One extends from the south of Para in the north region to the west of Mato Grosso and the north of Goias in the centre-west region. The other extends from the south of Maranhao and Piaui to the east of Tocantins and the west of Bahia in the northeast region (see Figure 4.3.6).

The latter area in the northeast region shown in **Figure 4.3.6** is already the hinterland of Itaqui Port and Ilheus Port in terms of soybean export, with throughputs of 1.7 million tons and 0.9 million tons in 2004, respectively. On the assumption of the completion of the railway projects mentioned in Section 4.3.2, the Cerrado region is considered to be the potential hinterland of Pecem Port and Suape Port in terms of soybean export.

In 2004, soybean yields in the above Cerrado region showed a sharp increase, indicating 44.8% up to the preceding year. The soybean plantations in the region are sustained by sufficient rainfalls with average precipitations of over 900 mm per annum, computer-controlled high-technology in terms of fertilizer provision, etc., and highly mechanized operations, and achieved the highest productivity of 2.8 tons per ha in 2004 whereas the average was 2.3 tons in the entire Brazil. An increase in the productivity in recent years in the northeast region was remarkable, indicating 37% up in 2004 to the preceding year. The productivity of this year (2005) is said to be further high with an average 60 bags per ha (3.6ton per ha) and the maximum 80 bags per ha (4.8 tons per ha) (see **Table 4.3.5**).

Table 4.3.5 Soybeans and Corn Productions by Region in Brazil from 2002 to 2004

Region	2002				2003					2004				
	Area ('000ha)	Production ('000t)	Share	Productivity (t/ha)	Area ('000ha)	Production ('000t)	Increase (03/02)	Share	Productivity (t/ha)	Area ('000ha)	Production ('000t)	Increase (04/03)	Share	Productivity (t/ha)
Soybeans (Grain)														
Northeast	1,125	2,117	5.0%	1.88	1,243	2,525	19.3%	4.9%	2.03	1,317	3,657	44.8%	7.4%	2.78
Maranhão	238	562		2.36	275	660			2.40	340	904	37.0%		2.66
Piauí	86	91		1.05	117	308			2.64	156	388	25.9%		2.49
Bahia	800	1,464		1.83	850	1,556			1.83	821	2,364	52.0%		2.88
North	140	339	0.8%	2.41	212	552	63.1%	1.1%	2.60	312	826	49.4%	1.7%	2.65
Southeast	1,294	3,512	8.3%	2.71	1,528	4,044	15.2%	7.8%	2.65	1,866	4,514	11.6%	9.2%	2.42
South	6,845	15,679	37.2%	2.29	7,498	21,301	35.9%	41.0%	2.84	8,283	16,199	-24.0%	32.9%	1.96
Center-West	6,960	20,478	48.6%	2.94	8,045	23,496	14.7%	45.3%	2.92	9,701	24,027	2.3%	48.8%	2.48
Total of Brasil	16,365	42,125	100.0%	2.57	18,525	51,919	23.3%	100.0%	2.80	21,479	49,222	-5.2%	100.0%	2.29
Corn (Grain)														
Northeast	2,347	2,205	6.1%	0.94	2,552	2,946	33.6%	6.1%	1.15	2,673	2,915	-1.0%	7.0%	1.09
Maranhão	314	317		1.01	353	382			1.08	688	618			0.90
Piauí	278	83		0.30	280	228			0.82	275	134			0.49
Bahia	513	850		1.66	674	1,217			1.81	434	1,411			3.25
Ceará	703	629		0.90	708	745			1.05	656	380			0.58
Others	540	326		0.60	538	373			0.69	620	373			0.60
North	471	784	2.2%	1.66	523	964	23.1%	2.0%	1.84	546	1,044	8.2%	2.5%	1.91
Southeast	2,333	8,913	24.8%	3.82	2,436	10,213	14.6%	21.1%	4.19	2,455	10,754	5.3%	25.7%	4.38
South	4,682	16,799	46.8%	3.59	5,118	24,127	43.6%	49.9%	4.71	4,435	17,669	-26.8%	42.2%	3.98
Center-West	1,918	7,232	20.1%	3.77	2,337	10,077	39.3%	20.9%	4.31	2,295	9,490	-5.8%	22.7%	4.14
Total of Brasil	11,751	35,933	100.0%	3.06	12,966	48,327	34.5%	100.0%	3.73	12,404	41,872	-13.4%	100.0%	3.38

Source: IBGE (Brazilian Institute of Geographic and Statistics)

(3) Potential Export Capacity of Soybeans Produced in the Northeast Region

On the assumption of a productivity of 3.6 tons per ha, the potential soybean production is estimated as 28 million tons per annum in the above-mentioned Cerrado area in the northeast region on the long-term basis. On the assumption of export ratio of 65% to the total production, export potential capacity of soybeans produced in the northeast region is estimated to be 18 million tons per annum.

(4) Historical Trend and Future Prospects of the Production and Export in the World

In the last two decades from 1985 to 2004, soybean production in the world increased 2.9 times due to the increases both in population (1.3 times) and per capita consumption (2.1 times) (see Table 5.3.3). The world population is said to reach 9.1 billion in 2050 from 6.4 billion in 2004 (cited from U.S. Census Bureau, International Data Base) .The world population in 2022 is estimated as 7.6 billion by interpolating.

By using a linear regression method correlating with the historical world population, the total soybean production in the world in 2022 is estimated as 302 million tons (correlation coefficient $r^2 = 0.95$) with an increase by 85 million tons from 217 million tons in 2004. On the assumption that the current percentage of approximately 30% in soybean grain export to the total production and the current percentage of approximately 75%s in soybean bran export to soybean grain export will be kept towards the future, respectively, an increment of soybean export comprising grains and bran is estimated around 49 million tons in 2022 from the present level in 2004 as summarized below.

Year	Population	Production (Soybeans)	Export (Soybean Grains)
2004:	6.4 billion	217 million tons	62 million tons
2022:	7.6 billion	302 million tons	91 million tons
	Increment	85 million tons	29 million tons (Soybean Grains)
			22 million tons (Soybean Bran)
		Total Export	51 million tons (Soybeans)

As mentioned previously, Brazil is the second largest exporter in the world and is increasing its share year by year. On the other hand, the share of northeast region in soybean production recently showed a sharp increase, whereas the production in the traditional production area in the south region decreased its share drastically.

Thus, Cerrado region in the northeast region with the potential capacity of soybean export of 18 million tons per annum mentioned in Section 5.3.3 is highly expected to be cultivated by 2022 to meet the demand in the world market.

Table 4.3.6 Historical Trend of Soybean Production and Export in the World

Year	Production (1000ton) (A)	Soybean Grain Export (1000ton) (B)	Percentage of Soybean Grain Export (B)/(A)	Population (million)	Per capita consumption (kg/capita)
1985	75,605	22,333	29.5%	4,850	15.3
1986	75,932	23,925	31.5%	4,933	16.5
1987	103,385	30,115	29.1%	5,018	20.1
1988	95,862	23,557	24.6%	5,104	19.2
1989	107,202	27,375	25.5%	5,189	20.1
1990	104,288	25,403	24.4%	5,276	19.8
1991	107,320	28,083	26.2%	5,360	20.4
1992	117,400	29,503	25.1%	5,444	21.3
1993	117,792	27,780	23.6%	5,525	21.9
1994	137,716	31,844	23.1%	5,605	23.6
1995	125,033	31,628	25.3%	5,686	23.2
1996	132,349	36,757	27.8%	5,765	23.3
1997	158,191	39,684	25.1%	5,845	24.9
1998	160,045	38,007	23.7%	5,924	26.9
1999	160,669	45,461	28.3%	6,002	26.6
2000	175,884	53,758	30.6%	6,079	28.3
2001	185,095	53,496	28.9%	6,154	30.0
2002	197,039	61,571	31.2%	6,229	30.6
2003	188,547	55,302	29.3%	6,303	30.2
2004	216,878	62,244	28.7%	6,376	31.8

Sources: USDA: PS&D View May 2005; USBC: International Data Base, July 2003
Note: Soybean Gran Export is not indicated in the above tablre.

(5) Transport Cost Analysis

A transport cost analysis was made to estimate transport cost from agricultural land in Cerrado to the principal ports in the northeast region, viz. Itaqui, Pecem, Suape and Ilheus. The resulting figures are shown in **Table 4.3.7**. There no decisive difference between the four ports in transport costs compared with recent FOB price varying from 220 to 280 US$.. If the broad gauge railway construction/improvement projects are materialized, the difference will be narrowed compared with the case where soybeans are transported solely by trucks. Thus, one fourth of soybean exports of 18 million tons in 2022 is allocated to Pecem Port, with the resulting amount of 4.5 million tons per annum, as well as Suape Port. In Itaqui Port and Ilheus Port, in addition to each 4.5 million tons per annum in the same year, the anticipated exports from another Cerrado region extending from the north region to the centre-west region as mentioned in Section 4.3.3 are allocated, with the resulting totalled amount of 13.2 million and 12.4 million tons per annum, respectively.

- Pecem Port: 4.5 million tons per annum
- (Itaqui Port: 13.2 million tons per annum)
- (Suape Port: 4.5 million tons per annum)
- (Ilheus Port: 12.4 million tons per annum)

Table 4.3.7 Transport Costs of Grains from Cerrado to the Principal Ports

US$/ton

Destination	Distance from Center of Cerrado			Railway + Road				Road only
	Road	Railway	Total	Road	Railway	Total	(A) km	
Itaqui	200	840	1,040	8.0	6.9	15.0		30.6
Pecem	200	1,040	1,240	8.0	13.1	21.2	155	35.7
Suape	200	1,010	1,210	8.0	14.2	22.2	182	39.2
Ilheus	200	800	1,000	8.0	11.1	19.1	103	31.2

Note (1): It was assumed that the center of Cerrado is located at the equal distance from the three new railway lines stations adjacent to the Cerrado.

Note (2): The new railway lines construction costs or improvement costs are considered in the above transport costs.

Note (3): (A) indicates equivalent distances to balance cost difference between the destinations of Itaqui and other ports

Source: Estimated by JICA Study Team

4.3.4 Position of Pecem Port in the international and domestic shipping routes

(1) International Alliance and Container Vessel Size

As globalization progresses, mergers are increasingly seen in major industries throughout the world as companies strive for international competitiveness. In particular, the international alliances are becoming increasingly common in the shipping business which has relatively low profit margins.

The international alliances are facing fierce competition as the world container market can be rightly described as an oligopoly. The alliances seek economies of scale to reduce the transport cost. The container industry has therefore witnessed a seemingly never-ending increase in the size of vessels in recent years.

Figure 4.3.4 shows the load capacity (TEU) by each container vessel size in the world. Although the container ships exceeding 4,000 TEUs represented about one-third of the total in 2000, the same type accounts for about one-half of the total as of 2005, and the proportion of large vessels is increasing. Furthermore, the super-large vessels exceeding 8000TEUs have appeared.

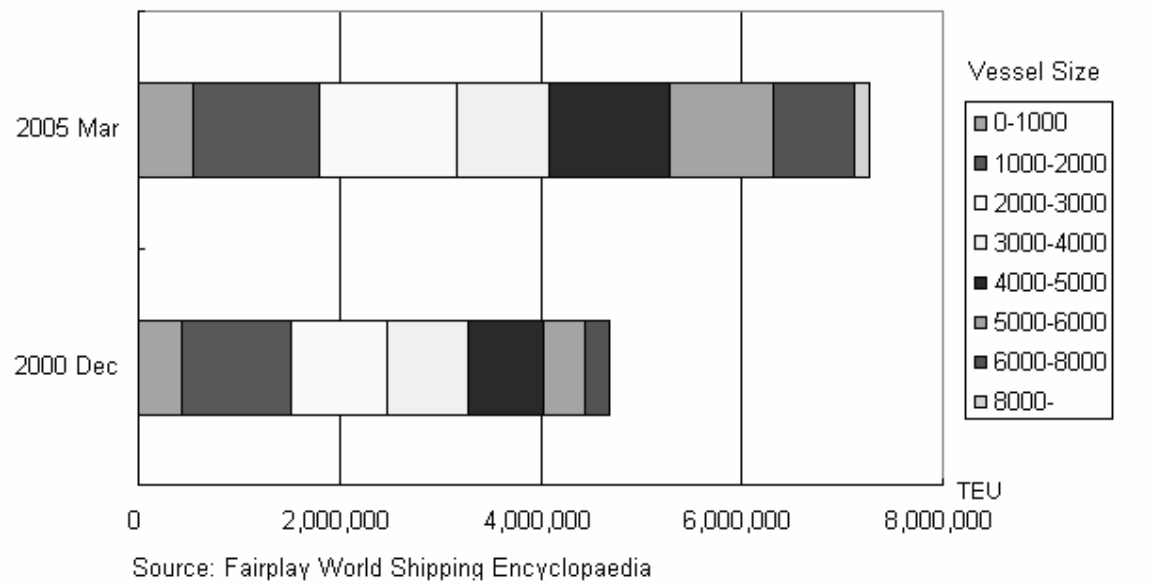


Figure 4.3.4 Container Vessel Size

As a result of progressing enlargement of container vessel size, each trade route tends to use the adequate vessel size showing the highest cost performance under the environment of the traffic demand of the route. The Ocean Shipping Consultant has published its forecasts of vessel sizes by trunk route in the future (see **Table 4.3.8**)

Table 4.3.8 Forecast vessel sizes in World container trades to 2015

(TEU)

	1998	2000	2005	2010	2015
Transpacific					
Typical Vessel	4,500-5,000	4,500-5,000	5,500-6,500	6,500	7,500
Largest Vessel	6,250	6,700	8,100	8,500	10,000
Far East-Europe					
Typical Vessel	4,500-5,000	4,500-5,500	5,500-6,500	8,000	8,500
Largest Vessel	7,500	7,500	8,100	12,500	12,500
Transatlantic					
Typical Vessel	3,500	3,500	4,000	5,000	6,500
Largest Vessel	4,500	4,500	4,800	6,500	8,500
North-South					
Typical Vessel	2,500	2,500	3,000	3,000	3,500
Largest Vessel	3,000	3,000	3,500	3,500	4,000

Source:"Marketing of container terminals", Ocean Shipping Consultants

(2) Imbalance of Boxes and Transshipment

Since, the import and export cargo volumes handled at a port are not the same, imbalances of container boxes occur in all the container trunk lines in the world. In this era of international alliances and the enlargement of container vessel, the shipping business try to minimize the imbalance in their trunk service routes and tend to take full advantage of their onboard space for service. For this reason, each shipping company is endeavouring to cancel the imbalance by effectively utilizing transhipment services and carrying out duty-cycle operation of the onboard space.

As a result, the combination of mother ship to feeder boat transhipment is widely introduced in today's container transport. In major world ports, well-developed feeder network and transhipment capabilities are prerequisites to remain competitive, and the terminals which offers efficient transhipment have the advantage.

(3) Potentiality of Transhipment at Pecém Port

a Transshipment at Brazilian Ports

It isn't expected that main ports in Brazil will develop as international transhipment ports like Singapore, which is located on the East/West trunk line and is acting as the transhipment for neighboring countries, but it is expected that they will develop as regional hub ports serving the substantial feeder network within the region namely on the side of South America in the North/South America trunk line and the Europe/South America trunk line. It can be said that the role of the main ports in Brazil will be similar to those of Rotterdam, Hamburg or Antwerp in the Europe. Incidentally, the rate of transhipment of these European ports (the ratio of transhipment cargo to the total volume) is between 30 - 40% at present.

The conditions required for a regional hub port are shown as follows;

- High accessibility to trunk shipping line
- Existence of facilities which have the capability to accept a super-large size container vessel
-Well-developed feeder network within the region
-Efficient cargo handling between mother vessel and feeder vessel

b Competition in Brazil

(a). Suape

Together with the industrial development in its neighboring area, the volume of container handling is increasing rapidly in accordance with the progress of regional development in the Northeast Region. The port is strengthening its function as a commercial (logistic) port.

The container terminal in the port, which is operated by a private sector, has two berths with a water depth of 15.5m and a length of 660m, and can accommodate Post-Panamax size container vessels. Moreover, the port has a further expansion plan to construct two additional container berths.

For this reason, the Port of Suape has the potential to become a regional hub port in northeast Brazil.

(b). Salvador

The port of Salvador is located in the State of Bahia, which is the center of the economy of the northeast region of Brazil, and handles the largest volume of container cargo in the region.

Although the container terminal, which is operated by private sector, has two berths, it has a draft restrictions for large vessels due to the berth depth of 12m.

(c). Santos

The port of Santos is located in the State of Sao Paulo, which is the center of the economy and industry of the whole Brazil, and handles the largest volume of container cargo in South America. In 2003, the number of foreign containers reached approximately 1,300,000 TEUs, this is comparative to 38% of grand total of container volume in Brazil.

In the Port of Santos, although four private companies are operating container terminals, only two terminals are fully-equipped container terminals. Since the water depth of the berths is 13.5m at the maximum and the depth of the access channel is restricted to 13m, the port cannot accommodate super-large size container vessels.

(d). Rio de Janeiro

The Port of Rio de Janeiro is located in Rio de Janeiro City which is the 2nd largest city in Brazil.

Although there are two container terminals operated by private sector, draft restrictions on large vessels may emerge in the future due to the berth depth of 12m.

(e). Sepetiba

The port of Sepetiba was developed to support the aluminum-related industrial base. Since the port is located between major cities Sao Paulo and Rio de Janeiro and has a water depth exceeding 15m, Sepetiba has great potential as a commercial port.

The container terminal operated by a private sector has a berth with the water depth of 14.5m and the length of 810m and can accept the 5th generation container vessel which has a capacity of over 4,500TEUs.

(f). Rio Grande

The Port of Rio Grande, which has the hinterland of southern Brazil and Mercosur, is the gateway port in the South region and handles the second largest volume of foreign container in Brazil.

Although the container terminal that is operated by private sector has two berths, restrictions on large vessels may emerge in the future due to the berth depth of 12m.

(g). Paranagua

The Port of Paranagua located in the State of Parana has southern Brazil for its hinterland.

The full-container terminal that is operated by a private sector has two berths with a water depth of 12m. Since the port has a future expansion plan and an access channel with water depth exceeding 14m, the port will be able to accommodate large-size container vessels in the future. **Table 4.3.9** and **4.3.10** show the current features of the major container ports in Brazil.

Table 4.3.9 Container Terminal Facilities of Brazilian Port

Port	Operator	Container Terminal					Multipurpose			Present Capacity	Future Plan	Future Capacity (estimate)
		Berth	Length (m)	Depth (m)	Storage Area (ha)	Storage Area (TEU)	Berth	Length (m)	Depth (m)			
North												
MANAUS-AM	Public						4	1.020				
BELÉM-PA	Public							1.447	3-9			
Northeast												
PECÉM-CE												
FORTALEZA-CE	Public						5	1.054	10			
RECIFE-PE								-	-			
SUAPE-PE	Tecon Suape	2	660	15,5	28	17.045				400,000TEU/Year	Add. Two berths	800,000TEU/Year
	Public						1	320	15			
SALVADOR-BA	Tecon Salvador	2	454	12	7					250,000TEU/Year		250,000TEU/Year
	Public							238	8			
Southeast												**3,840,000TEU/Year**
TERM. TUBARÃO-ES							1	240	12	60,000TEU/Year		60,000TEU/Year
VITÓRIA-ES	Terminal de Vila Velha	1	225	12,5	11	4.800	1	225	12,5			300,000TEU/Year
RIO DE JANEIRO-RJ	Multiterminais Container Terminal	2	533	11,5	18	16.000				400,000TEU/Year		400,000TEU/Year
	Terminal 1-RIO	2	545	11,5	14	5.500				400,000TEU/Year		400,000TEU/Year
SEPETIBA-RJ	Tecon Terminal	3	810	14,5	40	15.000				1,000,000TEU/Year		1,000,000TEU/Year
TERM. CUBATÃO-SP							1	342		200,000TEU/Year		200,000TEU/Year
SANTOS-SP	Tecon Terminal	3	760	12,8	48	11.000					Add. One berth	800,000TEU/Year
	Tecondi Container Terminal						5		14,2			100,000TEU/Year
	Terminal 37	5	1.100	10-13.5	16	12.000				480,000TEU/Year	Dreged to 13.5m	480,000TEU/Year
	Public						3		13			100,000TEU/Year
South												**2,050,000TEU/Year**
PARANAGUÁ-PR	TCP Terminal	2	655	12	29	23.250				360,000TEU/Year	Add. One berth	600,000TEU/Year
	Public								9,5			
S. F. DO SUL-SC	Public	1	175	10	80		2	425	9,11			300,000TEU/Year
ITAJAÍ-SC	Public						4	740	10		New Terminal (150,000TEU/Year)	550,000TEU/Year
RIO GRANDE-RS	Tecon Rio Grande	2	600	12,5	67	15.000						400,000TEU/Year
	Public							1.890	8,8			200,000TEU/Year

Source:Annual report of ANTAQ, Web site of the port authorities

Table 4.3.10 Container Throughputs at Principal Brazilian Ports

(Unit:'000TEU)

Region and Port		1999			2000			2001			2002			2003			2004		
		Foreign	Domestic	Total	Foreign	Domestic	Total	Foreign	Domestic	Total	Foreign	Domestic	Total	Foreign	Domestic	Total	Foreign	Domestic	Total
North	MANAUS-AM	23	26	49	0	0	0	43	59	102	35	94	129	19	91	109	NA	NA	NA
	BELÉM-PA	47	0	47	48	2	49	48	0	48	52	0	53	46	0	46	NA	NA	NA
	Other Ports	1	18	19	1	18	19	1	19	20	1	3	4	2	1	3	NA	NA	NA
SUB-TOTAL		71	44	114	49	19	68	92	79	171	88	97	185	67	92	159	NA	NA	NA
Northeast	PECÉM-CE	0	0	0	0	0	0	0	0	0	30	0	30	67	0	67	NA	NA	NA
	FORTALEZA-CE	40	12	52	0	0	0	35	18	53	33	39	72	36	41	77	NA	NA	NA
	RECIFE-PE	8	18	27	5	22	27	6	25	31	2	4	6	21	36	57	NA	NA	NA
	SUAPE-PE	30	9	39	36	27	63	40	36	76	39	70	109	21	40	61	53	85	138
	SALVADOR-BA	50	29	79	60	36	95	60	47	107	72	63	135	109	60	169	NA	NA	175
	Other Ports	4	8	11	5	7	12	5	9	14	3	5	9	4	3	7	NA	NA	NA
SUB-TOTAL		132	76	208	105	92	197	144	136	280	180	181	360	257	181	438	NA	NA	NA
Southeast	TERM. TUBARÃO-ES	28	0	28	0	0	0	25	0	25	28	0	28	9	0	9	NA	NA	NA
	VITÓRIA-ES	74	13	87	0	0	0	76	17	93	105	24	128	100	25	125	NA	NA	NA
	RIO DE JANEIRO-RJ	182	22	204	0	0	0	214	38	252	233	38	272	277	48	325	NA	NA	NA
	SEPETIBA-RJ	0	0	0	0	0	0	3	14	17	4	16	20	15	12	27	NA	NA	NA
	TERM. CUBATÃO-SP	0	0	0	0	0	0	0	0	0	120	36	156	148	27	175	NA	NA	NA
	SANTOS-SP	733	42	775	758	43	801	955	59	1,014	1,013	56	1,069	1,288	97	1,385	1,771	111	1,882
	Other Ports	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA
SUB-TOTAL		1,017	77	1,094	758	43	801	1,273	129	1,402	1,503	170	1,673	1,837	210	2,046	NA	NA	NA
South	PARANAGUÁ-PR	149	46	195	195	58	253	211	71	282	138	76	214	218	0	218	NA	NA	NA
	S. F. DO SUL-SC	133	18	151	98	70	168	111	65	176	77	98	175	147	107	254	NA	NA	305
	ITAJAÍ-SC	125	11	136	0	0	0	233	11	244	319	15	335	419	23	442	NA	NA	564
	RIO GRANDE-RS	213	49	262	0	0	0	269	78	346	349	90	438	435	88	523	NA	NA	NA
	Other Ports	4	1	5	0	0	0	0	0	0	0	2	2	0	15	15	NA	NA	NA
SUB-TOTAL		624	125	749	293	128	421	823	225	1,048	883	281	1,164	1,219	233	1,452	NA	NA	NA
TOTAL		1,844	322	2,165	1,205	282	1,487	2,333	568	2,901	2,793	729	3,522	3,431	715	4,145			

Source: Annual report of ANTAQ, Web site of the port authorities

(4) Container Shipping Lines in the Northeast of Brazil

Table 4.3.11-4.3.14 show the latest lines of container shipping service with regard to Brazil. According to these tables, there are 12 services between Brazil and Europe, 10 services between Brazil and North America (including the Caribbean Sea) and 4 services between Brazil and Asia (including Africa). Moreover, 4 services are offered in Brazil including Mercosur.

To take the case of the last port call in Brazil in each shipping service, the ports of the northeast region (Pecém, Suape and Salvador) are chosen as the last port in 6 services with regard to Brazil/Europe services and in 5 services with regard to Brazil/North America services. The reason why the ports of the northeast region are utilized as last port is that both Pecém and Suape have the container terminals with deep-water quay wall in addition to their geographical conditions. These ports can serve the container vessels which increase their draft by collecting cargo from the ports of the south region.

And, according to the service frequency in northeast Brazil with regard to container liner service, there are 7 weekly callings in 12 services of Brazil/Europe and 5 weekly callings in 10 services of Brazil/North America. Except for the Brazil/Asia service, more than the half the services has called the ports of the northeast region. Also regarding the cabotage, 3 callings are served in the whole 4 services. Although the ports of the northeast region handle about 9% of all container cargoes in Brazil, the service frequencies at the ports in Northeast Region are relatively high if compared with the ports in the world that handle the same level of container cargo volumes.

For the shipping companies, both Pecém and Suape are in an attractive position in terms of geographical location and facilities. As the cargo volume of the northern part increases in the future, it is expected that these ports will play the role of hub port not only in the northeast region but also in the whole of Brazil including Mercosur.

Table 4.3.11 Container Liner Service – South America/Europe

	Service	Operator	Round Voyage (days)	Frequency (days)	Vessel	Capacity (TEU)	Ports in Europe	**Belem**	**Pecem**	**Fortaleza**	**Suape**	**Salvador**	**Vitoria**	**Rio de Janeiro**	**Sepetiba**	**Santos**	**Paranagua**	**Sao Francisco de Sul**	**Itajai**	**Rio Grande**	Buenos Aires	Montevideo
1	Loop A	Hamburg Sud/Aliança /CMA CGM	42	7	6	12,798	*									1,**5**		4			2	3
2	Loop B	Hamburg Sud/Aliança /CMA CGM	35	7	5	12,420	*				1,**5**				4	4	2		3			
3	Loop A	Maersk Sealand/Safmarine	42	7	6	25,800	*		**6**							1,5				4	2	3
4	Loop B	Maersk Sealand/Safmarine	35	7	5	8,610	*							1		**4**	3		2			
5	Main loop	VSA4	35	7	5	12,670	*					**6**		2		1,5	3		4			
6	Back-up loop	VSA4	42	7	6	10,158	*							1		**4**				3	2	
7	Lambada	P&O Nedlloyd	42	7		(2,182)	*					**7**		6		1,5			4	3	2	
8	Loop A	Meditteranean Shipping Co	42	7	6	16,656	*									2,**5**			4	3	1,6	
9	Loop B	Meditteranean Shipping Co	42	3-4	12	23,796	*							1		2,**7**	6	5		4	3	
10		Grimaldi Lines	54	9	6	4,398	*					1		2,**8**		3,7	6				4	5
11		New Sirius service	42	7	6	13,602	*					**9**		1,**9**		2,8	3	7		6	4	5
12		New Seagul Service	42	7	6	11,496	*		**11**			10		1,9		2,8	3	7		4	5	6

Source: Containerisation International

Numbers on the list indicate calling order.

Table 4.3.12 Container Liner Service – South America/North America & Central America

	Service	Operator	Round Voyage (days)	Frequency (days)	Vessel	Capacity (TEU)	Ports in NA&CA	**Pecem**	**Fortaleza**	**Suape**	**Salvador**	**Rio de Janeiro**	**Sepetiba**	**Santos**	**Paranagua**	**Sao Francisco de Sul**	**Itajai**	**Rio Grande**	Buenos Aires	Montevideo
1	Loop A	Hamburg Sud/Maersk Seeland/Aliança/P&O Nedlloyd/Lykes/TMM	42	7	6	22,434	*	**6**		**6**			5	1,4				3	2	
2	Loop B	Hamburg Sud/Maersk Seeland/Aliança/P&O Nedlloyd/Lykes/TMM	42	7	6	14,694	*			1	**6**			2,5	3	4				
3		CSAV/Libra/Montemar/ CMA CGM	42	7		(2,339)	*	**6**				5		1,5	2	3		4		
4		Zim/Hanjin/K Line/MOL	45	9	5	8,300	*		1,**7**			**7**		2,6			5	4		3
5	Loop A	Mediterranean Shipping Co	42	7	6	16,098	*							1,**5**		4		3	2	
6	Loop B	Mediterranean Shipping Co	40	8	5	9,890	*	**4**		**4**	3	2		1						
7	Loop A	Lykes/Libra/TMM	42	7	6	19,128	*					1,**7**		2,6			5	4	3	
8	Loop B	Lykes/Libra/TMM	42	14		(1,728)	*				**2**			1						
9		Hamburg Sud/Aliança/ P&O Nedlloyd	42	7	6	9,864	*						**2**	1						
10		Costa Container Lines	50	8-9	6	8,124	*					1		2	**4**	3				

Source: Containerisation International

Table 4.3.13 Container Liner Service – South America/Asia & Africa

	Service	Operator	Round Voyage (days)	Frequency (days)	Vessel	Capacity (TEU)	Ports in Asia/Africa	**Pecem**	**Suape**	**Salvador**	**Rio de Janeiro**	**Sepetiba**	**Santos**	**Paranagua**	**Sao Francisco de Sul**	**Itaiai**	**Rio Grande**	Buenos Aires	Montevideo
1		Evergreen/Cosco	70	7	10	28,540	*						3					1	2
2		Hamburg Sud/NYK/Alianca	77	7	11	27,797	*					1.8	2.7	6		5	4	3	
3		CSA V/CMA CGM A SAX	70	7	10	19,890	*				2		1	3		4	5		
4		P&O Nedlloyd/Mol	77	7	11	34,254	*				8		1.7	6	5		4	2	3

Source: Containerization International

Table 4.3.14 Container Liner Service – Cabotage

	Service	Operator	Round Voyage (days)	Frequency (days)	Vessel	Capacity (TEU)	**Manaus**	**Vile de Conde**	**Pecem**	**Fortaleza**	**Suape**	**Salvador**	**Vitoria**	**Rio de Janeiro**	**Sepetiba**	**Santos**	**Paranagua**	**Sao Francisco del sol**	**Itajai**	**Rio Grande**	Montevideo
1	Sling 1	Aliança	35	7	5	8,481	7			6,8	5	9			4,10	3,11				2	1
2	Sling 2	Aliança	28	14	2	2,682				6	5	4,7	3,8		2	1					
3		Mercosul Line-Oceanica AGW/P&O Nedlloyd	35	14	3	3,240	1			2,11	3,10	4,9	8	5		6					7
4		Navegacao Vale do Rio Doce SA		14	1	666							7	6	5	4	3	2	1		

Source: Containerisation International

4.3.5 Identification of potential hinterland and the role of Pecem Port in the region

(1) Identification of the Current and Potential Hinterland and Foreland of Pecem Port

When estimating future demand of cargo passing through the Port, it is essential to identify its hinterland and foreland. In the first step, the current hinterland and foreland were revealed, and in the second step, a potential hinterland and foreland were supposed as mentioned below.

a Current Hinterland and Foreland

The current hinterland and foreland of Pecem Port were revealed from cargo movement records from origins to destinations via the Port in 2004

1) Container Cargoes

Export

In 2004, container cargoes of 356,600 tons in total were exported from Pecem Port. Agricultural and fishery products accounted for 66.4% followed by light industry products (17.8%) and other industrial products (14.9%) (see **Table 4.3.15**). As to agricultural and fishery products, fresh fruits accounted for 47.3% of the total exports, followed by cashew nuts (9.4%) and sea food (5.6%). As to light industrial products, textile related industry products accounted for 6.4% of the total exports followed by foodstuff (4.0%) and shoes (3.1%). As to the remaining industry products, stones accounted for 7.2% of the total exports followed by car parts (1.3%) (see **Table 4.3.15**).

The above-mentioned container cargoes were exported throughout the world (foreland). West and North Europe accounted for 51.4% of the total exports in terms of volume (tons), followed by North America (32.0%), East Asia (5.3%), Carribean countries (3.6%) and South America (3.5%). As to West and North Europe, agricultural and fishery products accounted for 87.1%, followed by light industrial products (8.7%). As to North America, agricultural and fishery products accounted for 58.4%, followed by light industrial products (23.6%) (see **Table 4.3.16**).

On the other hand, the above-mentioned container cargoes were brought into Pecem Port from its hinterland extending from Ceara to the other northeast region and beyond the region. To identify more clearly container cargo origins within the Ceara state clearer, the state was divided into 10 sub-regions (see Figure **4.3.5**). Ceara accounted for 64.5% of the total exports in terms of volume (tons), followed by Rio Grande do Norte (13.0%), Bahia (7.0%), Pernambuco (6.7%), Paraiba (2.4%), Piaui (2.4%) and Maranhao ((1.9%). Thus, almost all the exports originated from the northeast region accounting for 98% . Within the Ceara state, the east coast region (CE9) accounted for 32.6% of the total exports, followed by Fortaleza (CE3) and the central region (CE') (see **Table 4.3.17**).

Table 4.3,15 Percentage of Exported Container Cargo by Cargo Item via Pecem Port in 2004

Cargo Item		Volume (tonnes)	%
Agricultural and Fishery Products	Fresh fruits (banana, mango, melon, watermelon, papaya, grapes, etc.)	168,593	47.3%
	Cashew nuts	33,464	9.4%
	Sea food (shrimps, etc.)	20,057	5.6%
	Juice/Nectar	5,026	1.4%
	Caranauba wax	4,848	1.4%
	Other agricultural products	4,677	1.3%
	Sub-total	236,664	66.4%
Light Industry Products	Textile-related industry products (fiber, threads, clothes, etc.)	22,943	6.4%
	Foodstuffs	14,343	4.0%
	Shoes	10,994	3.1%
	Leather and its derivatives	9,137	2.6%
	Other light industrial products	5,929	1.7%
	Sub-total	63,345	17.8%
Industrial Products (Car, Electrical, Chemical, Metal, Mineral Industries, etc..)	Stones	25,548	7.2%
	Car parts (brakes)	9,082	2.5%
	Metal (steel, alminium, etc.)	4,550	1.3%
	Mineral (ferro-silicon, mica, etc.)	4,037	1.1%
	Paper	3,806	1.1%
	Other industrial products	6,089	1.7%
	Sub-total	53,112	14.9%
Others		3,478	1.0%
Total		356,600	100.0%

Source: Original data was provided by Ceara Port and processed by JICA Study Team

Table 4.3.16 Percentage of Exported Container Cargo by Destination Area and Cargo Item via Pecem Port in 2004

Cargo Item	West and North Europe		North America		East Asia		Carribean Countries		South America excl. Brasil		Other Areas		Brasil (Cabotage)		Total	
	tones	%	tones	%	tones	%	tones	%	tones	%	tones	%	tones	%	tones	%
Agricultural and Fishery Products	159,439	87.1%	66,657	58.4%	695	3.7%	2,583	20.0%	2,899	23.3%	3,735	40.3%	656	11.4%	236,664	66.4%
Light Industry Products	16,006	8.7%	26,887	23.6%	4,033	21.2%	3,689	28.6%	5,417	43.6%	4,456	48.1%	2,858	49.6%	63,345	17.8%
Industrial Products (Car, Electrical, Chemical, Metal, Mineral Industries, etc..)	6,638	3.6%	19,170	16.8%	14,294	75.1%	6,347	49.2%	3,811	30.7%	916	9.9%	1,936	33.6%	53,112	14.9%
Others	1,038	0.6%	1,379	1.2%	5	0.0%	289	2.2%	290	2.3%	161	1.7%	316	5.5%	3,478	1.0%
Total	183,121	100.0%	114,092	100.0%	19,027	100.0%	12,907	100.0%	12,418	100.0%	9,268	100.0%	5,767	100.0%	356,600	100.0%
		51.4%		32.0%		5.3%		3.6%		3.5%		2.6%		1.6%		100.0%

Source: Original data was provided by Ceara Port and processed by JICA Study Team

Figure 4.3.5 Hinterland Area Code in Ceara State

Table 4.3.17 Origins of Exported Container Cargo by Cargo Category via Pecem Port in 2004

State		Agricultural and Fishery Products	Light Industry Products	Industrial Products (Car, Electrical, Chemical, Metal, Mineral , etc..)	Others	Total	
Ceara	CE 1	424				424	0.12%
		100.00%				100.00%	
	CE 2	1,045		3,522	25	4,592	1.29%
		22.75%		76.71%	0.53%	100.00%	
	CE 3	39,069	19,028	16,602	1,616	76,314	21.40%
		51.19%	24.93%	21.75%	2.12%	100.00%	
	CE 4	1,495	1,890	6	15	3,406	0.96%
		43.90%	55.48%	0.18%	0.45%	100.00%	
	CE 5	984	6,442	43	26	7,495	2.10%
		13.14%	85.95%	0.57%	0.34%	100.00%	
	CE 7	124	916	19,188		20,229	5.67%
		0.61%	4.53%	94.86%		100.00%	
	CE 8	111	15	28		154	0.04%
		72.25%	9.75%	18.00%		100.00%	
	CE 9	106,428	9,510	135		116,073	32.55%
		92.12%	8.23%	0.12%		100.47%	
	CE 10		956	285	9	1,249	0.35%
			76.51%	22.78%	0.71%	100.00%	
	Total	149,680	38,756	39,808	1,690	229,935	64.48%
		65.10%	16.86%	17.31%	0.74%	100.00%	
Piauí		5,554	973	2,016	16	8,560	2.40%
		64.89%	11.37%	23.55%	0.19%	100.00%	
Pernambuco		22,867	561	523	74	24,026	6.74%
		95.18%	2.34%	2.18%	0.31%	100.00%	
Paraíba		2,682	5,715	17	272	8,685	2.44%
		32.78%	65.80%	0.20%	3.13%	101.90%	
Rio Grande do Norte		28,575	15,184	1,958	977	46,693	13.09%
		61.20%	32.52%	4.19%	2.09%	100.00%	
Maranhão		127	597	6,092	46	6,862	1.92%
		1.85%	8.70%	88.78%	0.67%	100.00%	
Tocantins		19	170			188	0.05%
		9.86%	90.14%			100.00%	
Bahia		24,678	65	15	14	24,772	6.95%
		99.62%	0.26%	0.06%	0.06%	100.00%	
Alagoas		94				94	0.03%
		100.00%				100.00%	
Pará		503	184	281	341	1,309	0.37%
		38.40%	14.07%	21.46%	26.07%	100.00%	
Goiás				1,084		1,084	0.30%
				100.00%		100.00%	
Minas Gerais		160	2			162	0.05%
		98.68%	1.32%			100.00%	
Espírito Santo				546		546	0.15%
				100.00%		100.00%	
Others		1,727	1,137	772	49	3,685	1.03%
		46.86%	30.87%	20.94%	1.32%	100.00%	
Grand Total		236,664	63,345	53,112	3,478	356,600	100.00%
		66.37%	17.76%	14.89%	0.98%	100.00%	

Source: Original data was provided by Ceara Port and processed by JICA Study Team

Import

In 2004, container cargoes of 97,523 tons in total were imported from Pecem Port. Light industry products and their materials accounted for 39.7% followed by other industrial products (36.9%) and agricultural products (14.2%) (see Tables 5.2.4). As to light industry products and their materials, cotton accounted for31.4% of the total imports, followed by foodstuff (4.4%) and textile related industry products (2.9%). As to other industrial products, chemical products accounted for 21.2% of the total imports followed by spare parts (4.2%) and industrial machines (3.2%). As to agricultural products, rice accounted for 11.0% of the total imports followed by wheat (3.2%) (see **Table 4.3.18**).

The above-mentioned container cargoes were imported throughout the world (foreland). North America accounted for 29.5% of the total exports in terms of the volume (tons), followed by West and North Europe (18.7%), South America excluding Brazil (16.6%), Brazil (14.1%) and East Asia (13.9%). As to North America, light industrial products and their materials accounted for 84.6%, followed by other industriy products and (12.6%). As to Western and Northern Europe, other industrial products accounted for 62.7%, followed by light industry products and their materials (13.6%) (see **Table 4.3.19**).

On the other hand, the above-mentioned container cargoes were brought out from Pecem Port to its hinterland extending from Ceara to the neighbouring states. Ceara accounted for 81.0% of the total imports in terms of volume (tons), followed by Maranhao (6.6%), Rio Grande do Norte (5.4%), and Piaui (4.1%). Thus, almost all the imports were destined to the northeast region accounting for 98% as well as exports. Within the Ceara state, Fortaleza (CE3) accounted for 68.0% of the total imports, followed by the east coast region (CE9) (10.3%) (see **Table 4.3.20**).

Table 4.3.18 Percentage of Imported Container Cargo by Cargo Item via Pecem Port in 2004

Cargo Item		Volume (tonnes)
Agricultural Products	Rice	10,758
	Wheat	3,076
	Sub-total	13,834
Light Industry Products and its Materials	Cotton	30,595
	Foodstuff	4,303
	Textile-related industry products (fiber, threds, clothes, etc.)	2,838
	Other light industrial goods	1,004
	Sub-total	38,740
Industrial Products (Electrical, Chemical, Metal, Mineral Industries, Petroleum, etc.)	Chemical products	20,634
	Parts, spare parts	4,128
	Industrial machines	3,152
	Households appliances	2,186
	Steel plates	2,056
	Other industrial products	1,369
	Mineral, stones	1,357
	Petroleum products	1,060
	Sub-total	35,942
Others		9,008
Total		97,523

Source: Original data was provided by Ceara Port and processed by JICA Study Team

Table 4.3.19 Percentage of Imported Container Cargo by Destination Area and Cargo Item via Pecem Port in 2004

Cargo Item	North America		West and North Europe		South America excl. Brasil		East Asia		Africa exclud. North Africa		Carribean Countries		South Asia		Other Areas		Brasil (Cabotage)		Total	
	tones	%	tones	%	tones	%	tones	%	tones	%	tones	%	tones	%	tones	%	tones	%	tones	%
Agricultural Products	0	0.0%	1,014	5.6%	5,621	34.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	7,199	52.3%	13,834	14.2%
Light Industry Products and its Materials	24,362	84.6%	2,478	13.6%	5,749	35.5%	1,426	10.5%	434	36.5%	532	55.7%	214	22.6%	2,731	70.2%	814	5.9%	38,740	39.7%
Industrial Products (Electrical, Chemical, Metal, Mineral Industries, Petroleum, etc.)	3,618	12.6%	11,442	62.7%	2,722	16.8%	11,236	82.8%	613	51.6%	384	40.2%	735	77.4%	844	21.7%	4,348	31.6%	35,942	36.9%
Others	809	2.8%	3,327	18.2%	2,084	12.9%	902	6.6%	142	12.0%	40	4.2%	0	0.0%	314	8.1%	1,391	10.1%	9,008	9.2%
Total	28,788	100.0% 29.5%	18,262	100.0% 18.7%	16,176	100.0% 16.6%	13,563	100.0% 13.9%	1,190	100.0% 1.2%	955	100.0% 1.0%	949	100.0% 1.0%	3,889	100.0% 4.0%	13,752	100.0% 14.1%	97,523	100.0% 100.0%

Source: Original data was provided by Ceara Port and processed by JICA Study Team

Table 4.3.20 Destinations of Imported Container Cargo by Cargo Category via Pecem Port in 2004

Unit tones

State		Agricultural Products	Light Industry Products and its Materials	Industrial Products (Electrical, Chemical, Metal, Mineral Industries, Petroleum, etc.)	Others	Total	
Ceara	CE 1			11	10	22	0.02%
				52.03%	47.97%	100.00%	
	CE 2			559	74	634	0.65%
				88.25%	11.75%	100.00%	
	CE 3	12,781	32,522	15,266	5,777	66,346	68.03%
		19.26%	49.02%	23.01%	8.71%	100.00%	
	CE 4		656	25	18	700	0.72%
			93.75%	3.61%	2.64%	100.00%	
	CE 5		49	624	240	913	0.94%
			5.34%	68.34%	26.32%	100.00%	
	CE 7		21		24	45	0.05%
			45.71%		54.29%	100.00%	
	CE 9		1,114	8,437	495	10,046	10.30%
			11.09%	83.98%	4.92%	100.00%	
	CE 10	293		18	5	316	0.32%
		92.72%		5.69%	1.58%	100.00%	
	Total	13,074	34,362	24,941	6,645	79,021	81.03%
		16.54%	43.48%	31.56%	8.41%	100.00%	
Piauí			92	3,828	49	3,970	4.07%
			2.32%	96.43%	1.25%	100.00%	
Pernambuco			99	236	352	687	0.70%
			14.44%	34.33%	51.23%	100.00%	
Paraíba		44	310	165	9	529	0.54%
		8.33%	58.71%	31.25%	1.70%	100.00%	
Rio Grande do Norte		158	3,198	838	1,082	5,276	5.41%
		3.00%	60.62%	15.88%	20.50%	100.00%	
Maranhão			322	5,409	676	6,407	6.57%
			5.03%	84.42%	10.55%	100.00%	
Bahia				15	31	46	0.05%
				32.47%	67.53%	100.00%	
Sergipe			45	22		67	0.07%
			66.83%	33.17%		100.00%	
Alagoas					2	2	0.00%
					100.00%	100.00%	
Pará		22		36	28	86	0.09%
		25.63%		42.21%	32.15%	100.00%	
Others		536	311	451	135	1,432	1.47%
		37.41%	21.70%	31.48%	9.41%	100.00%	
Grand Total		13,834	38,740	35,942	9,008	97,523	100.00%
		14.19%	39.72%	36.85%	9.24%	100.00%	

Source: Original data was provided by Ceara Port and processed by JICA Study Team

2) Break-bulk Cargoes

Export

In 2004, Break-bulk cargoes of 65,654 tons in total were exported from Pecem. Most of the cargoes were Iron billets accounting for 90.7% of the total. Central America accounted for 62.2%, followed by Africa (10.2%), North America (9.9%) and West Europe (9.6%) in terms of destinations (foreland). The origins of those cargoes (hinterland) were Fortaleza Metropolitan Area (CE2 and CE3, see **Figure 4.3.6**)

Import

In 2004, Break-bulk cargoes of 121,605 tons in total were imported through Pecem. Almost all the cargoes were steel products. Origins of those cargoes (foreland) were Russia, Ukraine, Argentine and the south of Brazil. The destination of those cargoes (hinterland) is a factory of Aco Cearense (Ceara Steel) 35km from Pecem. The steel products mostly comprising rolls of thin plates and coils of thin bars are processed by shearing, bending and welding, and then are distributed to the north, northeast, centre-west regions. In addition, Minas Geires in the southeast region is also included its market. The processed steel products are transported by truck.

(c) Liquid-bulk Cargoes

In 2004, a total of 295,417 tons of diesel oil was unloaded and transferred to smaller coastal tankers at Pecem Port (from Berth No.4 to Berth No.3). Origins of those cargoes (foreland) were Netherlands, India and Saudi Arabia.

b Potential Hinterland

The major determining factors of a port hinterland are as follows:

- Land transport network composed of railway and road linked to a port,
- Location of principal neighbouring ports and their capacities.
- Distribution of exporters and importers and aspects of their economic activities,

When considering the potential hinterland of Pecem Port on the long-term basis, it was assumed that the three railway projects to construct new lines or improve the existing lines will be completed before the target year of 2022 of this study. The outlines of these railway projects with a broad gauge (1.6m) are as follows (see **Figure 4.3.6**):

- Route: Porto Franco – Balsas (New line construction of approximately 190 km long
- Route: Eliseu Martins — Salgueiro - Missao Velha - Pecem Port (New line construction from Eliseu Martins to Missao Velha and Improvement from a narrow gauge (1m) to a broad gauge (1.6m) from Missao Velha to Pecem Port of approximately 1,040 km long in a total)
- Route: Eliseu Martins — Salgueiro - Suape Port (New line construction of approximately 1,010 km long, the line from Eliseu Martins to Sai Gueiro is common with the above project “b”)
- Route: Barreiras — Ilheus Port (New line construction of approximately 800 km long)

As mentioned in **(1), a** of this Section, the current hinterland of Pecem Port is considered to be mostly the whole Northeast Region, and if the new railway line construction/improvement between Eliseu Martins and Pecem Port is materialized, Pecem Port influence will be strengthened within the northeast region, especially in the south of Piaui, the west of Pernambuco and the north of Bahia in addition to the current influential areas of Rio Grande do Norte, the west of Paraiba and the north of Piaui.

Within the northeast region that is the current and potential hinterland of Pecem Port, the following ports are considered to be the principal ports:

- Itaqui Port (the maximum water depth of 19m)
- Madeira Port (the maximum water depth of 23m)
- Pecem Port (the maximum water depth of 16.5m)
- Suape Port (the maximum water depth of 15.5m)
- Ilheus Port (the maximum water depth of 10m)

All the above ports have already been connected or will be connected to the broad gauge railway lines, and have deep-water berths of over 15m enabling to receive Panamax-type or Cape-size vessels. A deepening of the water depth at Ilheus Port is expected in the future. After the completion of the new land transport network with the broad gauge railway lines, those ports will be functioning as gateways of the Northeast Region to the overseas trade partners in cooperation with each other so as to contribute to regional economies.

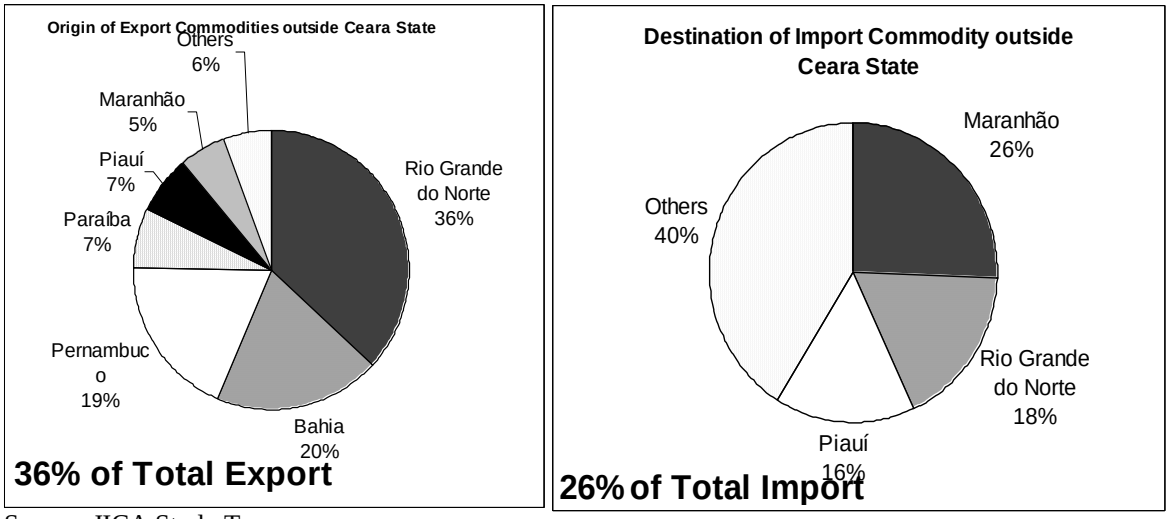
In addition to the current exports through Pecem Port such as fresh fruits, cashew nuts, shrimps, and textile related products generated mainly from Ceara and its border states, agricultural products harvested in Cerrado (wooded plateau) are considered to be the prominent potential cargoes to be exported through Pecem Port. Cement and/or clinker are also considered to be a potential cargo via Pecem Port. The possibility of shipment of Cerrado products is mentioned in the next section.

Legend: Broad Gauge Existing Railway
New Broad Gauge Railway Construction
Broad Gauge Improvement

Figure 4.3.6 Railway Construction/Improvement Projects in the Northeast Region

(2) Summary of the potential hinterland of Pecem Port

As discussed above, in 2004, 36% of export cargoes that were handled at Pecem Port were originated outside of Ceara, while 26% of the import cargoes were delivered to other states in Northeast Region.(see **Figure 4.3.7**). The major export commodities originated from Rio Grande do Norte, Bahia and Pernambuco are the agricultural products, while the import commodities destined to Maranhao Rio Grande do Norte and Piaui are industrial products.



Source: JICA Study Team

Figure 4.3.7 Origin and destination of export and in port cargoes

In addition to the commodities currently seen at the ports, it is most probable that Soy beans produced in Piaui State and fruit produced in the northwest part of Bahia State will be potential cargoes. When the CFN railway completes their improvement and the new railway construction is completed, Pecem Port will be attracting more cargoes to and from the whole Northeast Region.

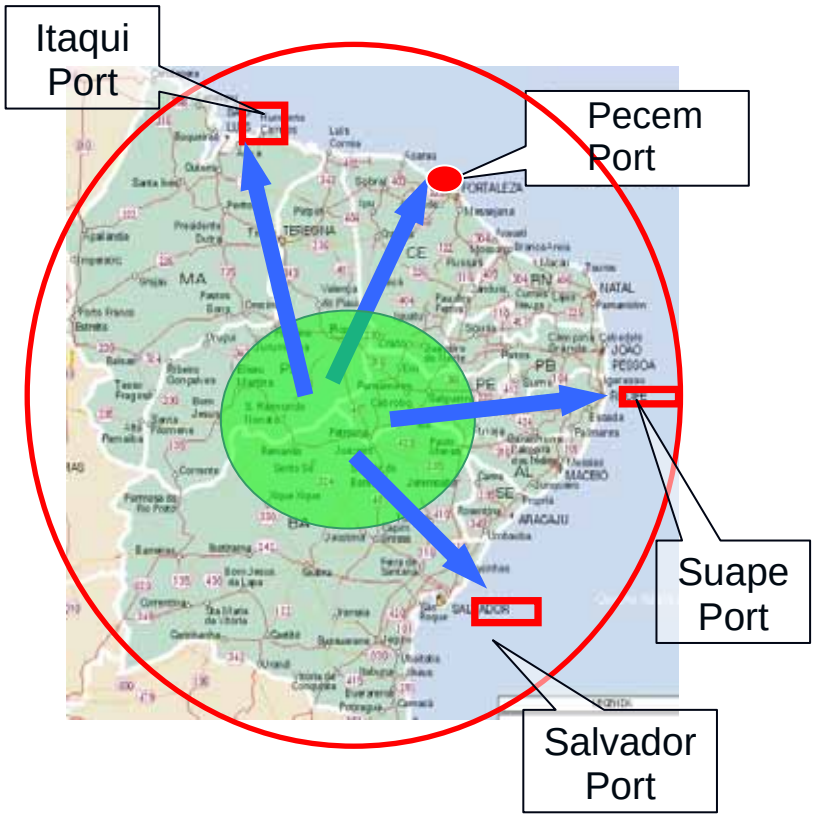
Therefore, the hinterland of Pecem Port consists of the following:

a. Whole Ceara State and adjacent states.

These states are the immediate hinterland. Primarily Pecem is the gateway of them and substantial amount of cargoes are originated and destined to this hinterland.

b. Whole Northeast Region

The product of the states in the Northeast Region, especially in the inland area rich in agricultural products will be shipped through the port system in the Region: Itaqui, Pecem, Suape and Salvador (See **Figure 4.3.8**).



Source: JICA Study Team

Figure 4.3.8 Port system in Northeast Region

4.3.6 Port development concept

(1) Objective of the development of Pecem Port

To pursue the state government's ultimate end, the concept of CIPP development should be updated. The principal objective of Pecem Port was to attract anchor industries. However, , through the operation of the port over the past four years, it was proved that the local agricultural and light industries have long wanted a deep draft port where they can directly ship their export products, and the port really has had a great impact on them to promote their production and export.

The agricultural and light industries have been the target that the State Government has been tried to attract by providing various incentives. It is said that now the state government efforts are bearing fruits. Since the agricultural and light industries are the most important sector for the economy of the state. Even the current status of the port facilities in CIPP, which was not designed to provide services for the existing industries, has brought great benefit to the latter.

In order to take the advantage of the geographical advantage of Ceara, i.e. proximity to the world major market, the port should attract more shipping lines so that the frequency of ship-calls on Pecem Port increases. This, in turn, provides a grate advantage to the local industries to ship their products in timely manner in response to the request of their clients. In order to attract container shipping lines, the port must collect large amount of containers.

The products of local light industries are high-prices commodities and the volume is rather small. Therefore, the container cargo volumes generated by the local light industries tend to be rather small. Therefore, the export of agricultural products, which are bulky commodities, should be promoted simultaneously.

To attract the cargoes from other state in the Northeast Region is another possible way to collect container cargoes. To this end, the interfacing with railways and highways is important elements in the development plan should be well taken into account. Though the principal objective of the development plan of CFN are to transport soy beans from Piaui and fruits from northeast of Bahia to Suape and Pecem Port, the industries located in Ceara State are also benefited by the railway service. Thus, the Pecem Port development should be implemented in concert with the railway project.

In the light of the situation described above, the objectives of the Development of Pecem Port are summarized as follows; (Progress report 5.1)

The objectives of the development of Pecem Port have been recognized to meet the future functional and quantitative demand to the Port so as to serve the economic activities in the hinterland of the Port extending currently or potentially from Ceara State to the neighbouring states in the Northeast Region of Brazil. The development of Pecem Port and its ripple effect on the surrounding region is expected to trigger the economic stimulation in Ceara State, and consequently to narrow regional disparity in terms of inter- and intra- states as well as personal income inequality. In this regard, the following concrete roles that are expected to the Port are recognized:

- To serve coastal industries including the iron and steel manufacture, a refinery and petrochemical plants to be set up or to be attracted within the CIPP industrial zone after this that will import raw materials or intermediate products and will export finished products through the Port,
- To serve agro-industries in the hinterland of Pecem Port exporting their products currently mainly of fresh fruits, sea food and cashew nuts through the Port,
- To serve manufacturing industries in the hinterland of Pecem Port importing raw materials or intermediate products and exporting finished products currently mainly iron and steel products, and light industry products such as textile, foot wares through the Port.
- To serve residents in the hinterland of Pecem Port importing consumer goods through the Port.
- To function as a logistics centre placed at a node of inter-modal transport connecting sea and land through storing, processing and distributing various products such as petroleum products and steel products
- To function as a gateway towards overseas in the northeast region extending from Maranhao to Bahia and including the Cerrado region together with other principal deep-sea ports, viz. the ports of Itaqui and Suape linked by the land transport network composed of roads and railways.
- To function as a local hub port for container transhipment

(2) Functional Allotment between the Ports of Pecem and Mucuripe

The relationship between the ports of Pecem and Mucuripe in Ceara seems to resemble that between the ports of Suape and Recife in Pernambuco though Suape Port has a longer history over 25 years since its start of operations.

Mucuripe Port is a typical city port, and hence it has the disadvantages of the chronic road congestion around the port and constrains on further port area expansion. In addition, the water depth of the port is at most 10 m, clearly too shallow to receive modern vessels getting larger and larger in their drafts. If deepened, considerable sedimentation seems to inevitably occur due to its configuration of infrastructures including breakwaters, whereas Pecem Port is free from those disadvantages.

Mucuripe Port, however advantages of adjacent to the densely-populated Fortaleza Metropolitan Are as a large consumption area. In this regard Mucuripe Port is expected to serve the area through receiving the consumer goods including rice from the south region transported by cabotage (coastal shipping), and then distribute them in and around the Metropolitan area as it is currently functioning. Wheat is considered to be suitable cargo. Mucuripe Port and Pecem Port were compared in transport costs between Argentine and Ceara, and it was judged current transport through Mucuripe Port is more economical than Pecem Port in wheat transport. Saving from the use of larger grain carriers is estimated a few US$ per ton and it can not compensated the increase of truck freight from Pecem Port and Fortaleza and required investment for facilities at Pecem Port.

However, (Interim Report 3.5, P3-19, from the third paragraph) the analysis of the cargo statistics of Mcuripe and Pecem Port indicates the role sharing between the two ports. In general, the former handles domestic cargoes, while latter mainly handles international cargoes. Because unloading and storage facilities of grain are already exist at Mucuripe Port, it is likely that grain will be handled at Mucuripe Port.

Summing up above discussion, the study team proposes that the following concept should be employed in the long-term development plan of Pecem Port.

a. Pecem port should be developed for as a logistic port as well as a industrial port.

To this end,

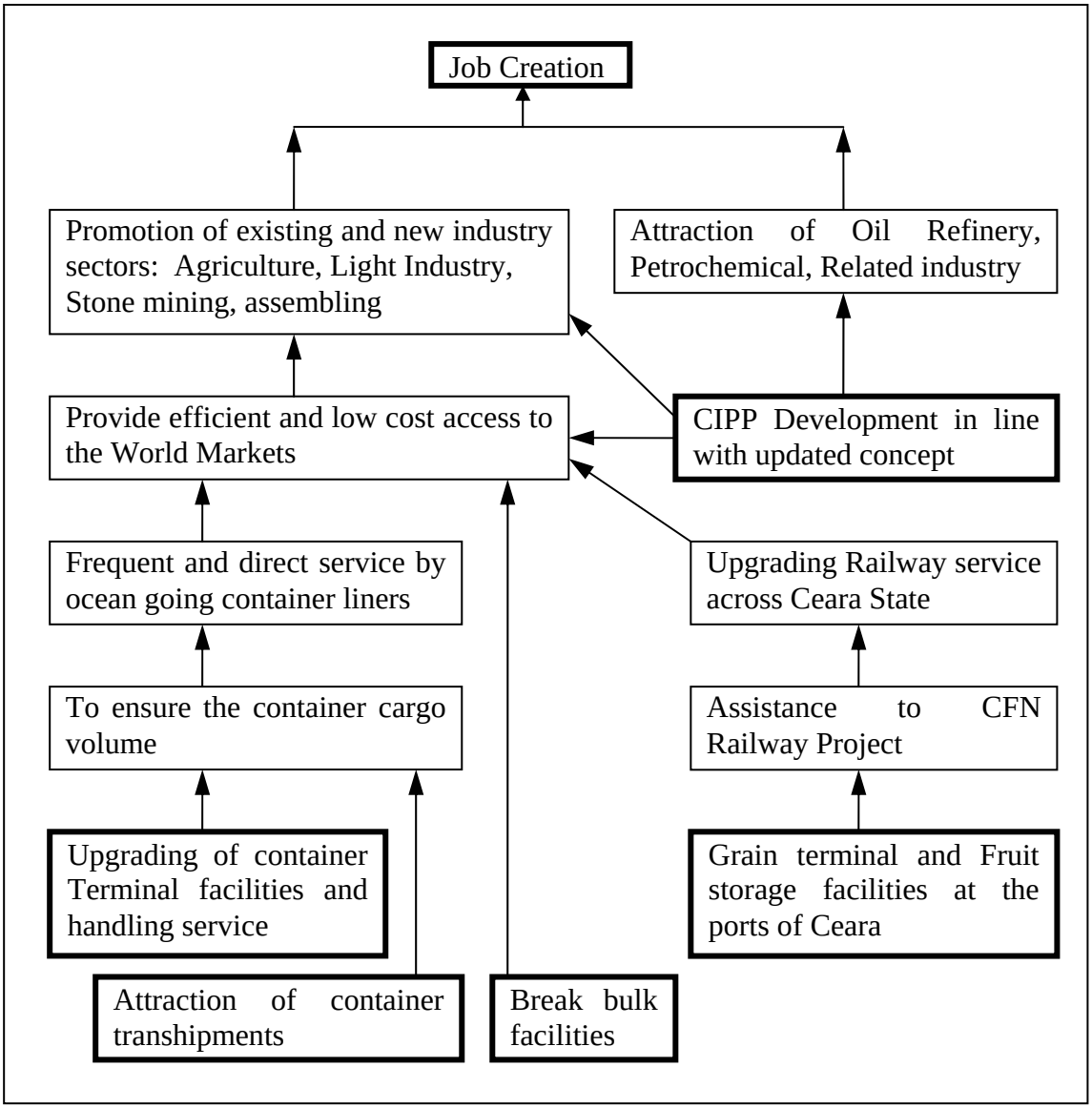
1) The capacity of port should be upgraded as required to meet the cargo volume generated by anchor industries in CIPP

2) The following port facilities should be constructed: a fully equipped container terminal, Grain terminal, fruit storage facilities for the promotion of agricultural and light industries.

The development concept of Pecem Port discussed above is schematically exhibited in **Figure 4.3.9**

b. Mucuripe Port should also be promoted as a domestic port and its grain terminal should be maintained.

((Progress Report 5.10, last paragraph) In addition, Mucuripe Port is expected to accommodate passenger boats cruising sightseeing spots. To this end, it is advisable to shift petroleum tank farms from Mucuripe to Pecem to keep flammable dangerous goods distance from urban residents, especially gasoline



Source: JICA Study Team

Figure 4.3.9 Port development concept

CHAPTER 5 CARGO FORECAST

5.1 Socio Economic Frame Work in 2022

As reviewed in Chapter 2, the export of the agricultural and industrial products of Ceara has been growing tremendously over the past few years, while the import volume remains the same level. Ceara state is not only the state where the export is growing. As reviewed in the Progress Report of this study, the top 20 commodities of Brazilian export have been increasing remarkably. The world market, especially the market of agricultural products keeps on growing with the economic growth of China and Eastern Europe countries. It is, therefore, very likely that the growing trend of Ceara's export will continue over the coming years.

Over the past decade, Ceara State has experienced a slack period of economic growth. Though the GDP has increased at a rate of 2.1%, which is slightly above the growth rate of population (1.6%). Under such economic environment, the purchase power of Ceara people remained the same. During the same period, the agricultural production has increased. This is especially true for the corn production, which has exceeded the consumption and the import of corn practically ceased in 2002. The completion of Natural Gas pipeline also contributed to the decrease in petroleum import of Ceara. The growth in the industrial activities did not contribute to the increase in import, because of the nature of the local industries that produce their products out of locally available materials. As for the effects of these factors, the import volume has remained at the same level.

Ceara State Government has drawn the economic development plan in PPA 2004-2007 with the GDP forecast of the state at 3.6%, while the Federal government set the national GDP growth rate at 5.0%. With the consideration of the very active export business in Ceara, the forecast of the state seems to be too conservative.

Thus, the following three GDP growth scenarios are employed from 2005 through 2020:

(1) 3.6% (Forecast by Ceara State Government),

(2) 5.0% (Forecast of Federal Government),

(3) 5.0% up to 2012 and 3.6% from 2013 through 2022.

The last scenario is based on such a guess of the study team that the current trend of growth in export will continue in the coming years and the brisk activities of industries since 2002 will give an effect on the State GDP over the period between 2005 through 2012.

The reason to employ higher GDP growth rate is not only due to the current export growth trend. The current active production and export of both agricultural and industry sectors took place in 2002 when Pecem Port started operating over-Panamax size container carriers. The availability of the direct export route must have given substantial impacts on the sectors. In fact, the investment has been made on the agribusiness - plantation by Del Monte, for instance- and some light industries such as metal-work business as well as railway companies. Over the coming years, the steel mill will start operation and the Sao Francisco Diversion Project will be completed and Ceara will have more irrigated farmland.

The cargo forecast shall be done on the basis of these three GDP growth scenarios.

5.2 Cargo Forecast Methodology

The cargoes are classified into three categories by origin:

(1) Cargoes generated within CIPP

So far, there is no industrial activities in CIPP, thus the cargoes generated by the industries shall be estimated on the basis of their operation planed by the industries and the import and export cargoes forecasted on the basis of the operational plans of the industries that have been published.

(2) Cargoes generated in Ceara State (outside of CIPP)

Cargoes generated within Ceara State and adjacent states, which presently imported and exported at either Mucuripe or Pecem Ports. The cargoes of this category include the agricultural and industrial productions, raw materials and semi-products of the industries and various consumables for the household and business offices. Those cargoes generated by industries that will be established in the future are also included.

Basically, the correlation between the export/import volumes and GDP of Ceara State will be examined. The future cargo volumes shall be forecasted on the basis of the regression analysis. The major export commodities that are closely related to a specific industry and the increase (or decrease) in recent years are remarkable. Therefore, the simple regression analysis is judged to be inappropriate, because it is unlikely that such a big leap result from simple expansion of the business activities of the existing industries. It seems to be realistic to recognize that, since 2001, some structural changes happened in Ceara's economy: new investment in commercial agro-industry and expansion of production lines in the traditional industries in some sub-sectors.

Thus, the export cargo volume shall start with identifying the commodities produced by those industry sub-sectors that increased export. Then the cargo volume generated by these growing sub-sectors shall be forecasted on the basis of available information and data such as those attained through company interviews, expansion of farmland, and other available information, while the other commodities shall be forecasted by regression analyses on the basis of the trend observed in the past ten years.

(3) Specific cargoes generated in other States in the future

Products that are expected to be produced or brought in the adjacent states of Ceara in large volumes and to be handled at the Ports in Ceara State fall in this category. Soy beans from Piaui, fruits from Bahia and fertilizers for Soy and Fruit farms are the potential cargoes of this category. The cargo volume forecast shall be done commodity by commodity.

5.3 Cargo Forecast

5.3.1 Cargoes generated within CIPP

The import and export plan of the anchor industries are as follows (please refer to **Section 4.2.1 (4)**):

(1) Steel Mill (USC, Ceara Steel Factory)

The first phase intends to import 2,500,000 tons of iron pellets from Madeira Port, Sao Luis, Maranhao State and produce 1,500,000 of thick slabs. The second phase plans to double the production. Thus the cargoes generated by the steel mill are estimated as follows:

Import; Iron Pellet (Dry Bulk); 2012: 2,500,000 tons, 2022; 5,000,000 tons

Export; Thick Slabs (Break Bulk; 2012; 1,500,000 tons, 2022; 2,500,000 tons

(2) Oil Refinery

It seems most likely that the establishment of the oil refinery in CIPP will be further delayed. The study team assumes that first oil refinery will be constructed in Suape and that the second oil refinery in Northeast Region is established in CIPP in later years.

The import and export cargoes generated by the oil refinery are as follows:

Import; Crude Oil (Liquid Bulk); 2022; 8,800,000 tons

Export; None

All the products will be consumed in the local markets.

Gasoline; 546,777 tons,

LPG; 409,200 tons,

Naphtha; 1,058,750 tons (Consumed by the Petrochemical industry in CIPP),

Diesel Oil 5,178,800 tons,

Kerosene; 356,400；tons,

Coke; 3,000 tons,

Total; 7,552,850 tons

(3) Petrochemical

It is assumed that by 2022, the Petrochemical industry is also in operation.

Import: 2022; Naphtha 450,000 tons
(in addition to the import volume, 1,500,000 tons of Naphtha will be provided by the Oil Refinery in CIPP)

Export: 2022

LLDPE（Linear Low Density Polyethylene）	500,000 tons,
PP (Polypropylene)	200,000 tons,
C4+（Crude Gasoline）	200,000 tons.

LLDPE and PP are container cargoes, while C4+ is liquid bulk cargo.

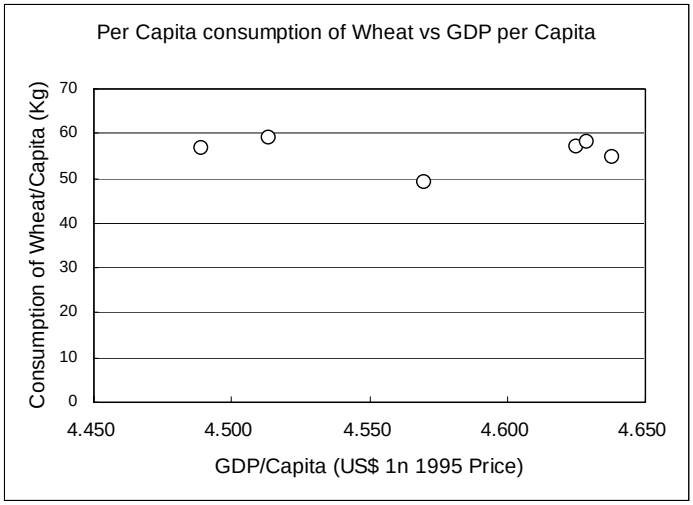
5.3.2 Cargoes generated in Ceara State (outside of CIPP)

(1) Import (foreign and domestic)

Wheat and rice are the principal import commodities at Ceara ports as well as petroleum products. The import volumes of these commodities are closely related to the consumption of the people of the hinterland. Thus, it is rational to forecast in a straight forward manner.

a. Wheat (Foreign dry bulk)

One of the major import commodities is wheat. As mentioned in **Section 4.2.1 (1)**, the average wheat consumption per capita in Brazil is 52.2 kg per year. The per capita consumption has not changed over the period from 1997 through 2003 as shown in **Figure 5.3.1**. With the assumption that the average annual consumption per capita holds true in the states of Northeast Region, the import volume at Mucuripe Port has been the amount that corresponds to the total wheat consumption of Ceara, Piaui, Paraiba and Rio Grande do Norte.



Source: IBGE population and wheat import/export and production data, edited by JICA Study Team

Figure 5.3.1 Wheat consumption per capita in Brazil

With the consideration of the increase in the import of rice at Mucuripe Port, which is also judged to be consumed in Ceara and its three adjacent states, the per capita wheat consumption will remain the same in the future. Thus, the wheat import volume is forecasted by multiplying the population estimates of the four states by the per capita consumption, i.e. 52.2 kg (see **Table 5.3.1**).

In the calculation, with the consideration of the fact that the wheat import volume at Mucuripe port in 2003 and 2004 are smaller than the amount of the whole population of the four state times 52.2 kg, the volume transported from Ceara to the other three states is estimated to be 10% lower than the products of per capita consumption and the population.

The import volumes of wheat in 2012 and 2022 are estimated to be 993,000 tons and 1,099,000 tons, respectively. The wheat will be imported from Argentine, which is the principal origin country of exporting wheat to Brazil.

Table 5.3.1 Wheat import estimate

	Population Year	1980	1991	2000	2004	2010	2012	2020	2022
1	Maramhao	3.996	4.930	5.651	5.969	6.447	6.597	7.140	7.357
2	Piaui	2.139	2.582	2.843	2.959	3.132	3.186	3.384	3.463
3	Ceara	5.288	6.367	7.431	7.884	8.604	8.823	9.624	9.944
4	Rio &rand do norte	1.899	2.416	2.777	2.936	3.175	3.250	3.522	3.631
5	Paraiba	2.770	3.201	3.444	3.552	3.713	3.763	3.947	4.021
6	Pemambuco	6.142	7.128	7.918	8.268	8.792	8.956	9.553	9.792
7	Alagoas	1.983	2.514	2.823	2.959	3.164	3.227	3.460	3.553
8	Sergipe	1.140	1.492	1.784	1.913	2.107	2.167	2.387	2.475
9	Bahia	9.455	11.868	13.070	13.600	14.395	14.643	15.548	15.910
	Total in Nordeste	34.814	42.498	47.742	50.040	53.528	54.613	58.565	60.146
	2+4+5 total	6.808	8.199	9.064	9.446	10.020	10.199	10.853	11.115
	0,9	6.127	7.379	8.158	8.502	9.018	9.179	9.768	10.003
	Consumption per pe. 52,2				721.687	972.173	992.948	1.068.899	1.099.280

Source: IBGE (Population) , edited by JICA Study Team

b. Rice (Domestic, container cargo)

Another major import commodity is rice. As mentioned in **Section 2.1.1**, the average consumption of Rice of Brazil is 63.6 kg (see **Table 5.3.2**). If it is assumed that the per capita rice consumption of 63.6 kg holds true in the North-eastern states, the supply and demand balance is computed as shown in **Table 5.3.3.**

Table 5.3.2 Calculation of average per capita consumption of Rice in Brazil

	Unit: ton					Kg
	Export (1)	Import (2)	Production (3)	Consumption (4) [=(2)+(3)-(1)]	Population (5)	Consu/Cap (4)/(5)
1996	21.860	868.018	8.652.328	9.498.486	161.247	58,9
1997	9.159	858.668	8.351.665	9.201.175	163.471	56,3
1998	6.613	1.513.220	7.716.090	9.222.697	165.688	55,7
1999	47.667	1.207.417	11.709.694	12.869.444	167.910	76,6
2000	26.406	729.549	11.134.588	11.837.731	170.143	69,6
2001	22.128	776.285	10.184.185	10.938.342	172.383	63,5
2002	29.955	639.324	10.457.093	11.066.463	174.622	63,4
2003	19.435	1.293.760	10.198.945	11.473.270	176.862	64,9
				Average Consumption/Capita		63,6

Source: IBGE, Ministry of Agriculture Web Site, Edited by JICA Study Team

Table 5.3.3 Supply-demand balance of rice in North eastern states

Region/States	Production of Rice in 2002 (ton)	Population	Consumption (ton)	Surplus/Deficit
Brasil	10.457.093	174.622	11.473.270	-1.016.177
Northeast	928.830	48.899	1711451	-782.621
4 States + Maranhao	813.465	22.731	795585	17.880
Maramhao	628.672	5.810	203357	425.315
Piaui	89.917	2.901	101528	-11.611
Ceara	82.153	7.666	268296	-186.143
Rio &rand do norte	4.056	2.857	99981	-95.925
Paraiba	8.667	3.498	122423	-113.756
Pemambuco	17.865	8.093	283248	-265.383
Alagoas	20.200	2.891	101192	-80.992
Sergipe	37.757	1.849	64701	-26.944
Bahia	39.543	13.335	466725	-427.182

Source: JICA Study Team

It is assumed that people of Maranhao which has the surplus of rice production consume as much rice as the average of 60 kg per capita of Brazil, and that half of the surplus amount is consumed in the four North eastern states: Piaui, Ceara, Rio Grande do Norte and Paraiba, while the other half is consumed in the North Region.

As the trend in the rice production in the North eastern state has remained the same or tended to decrease over the past seven years (refer to Figure 2.1.8, Section 2.1.1), it is also assumed that the productions in these states remain at the same level in the coming years.

In addition, the rice consumption in the four states will increase from 28.3 kg to 31.5 in 2012 and 35 kg in 2022: **Figure 4.2.5** (**Chapter 4.2.1)** shows that the rice import has been steadily increasing, it is realistic to assume that the consumption of rice in the North eastern states will increase further over the coming years.

The import volume of rice is estimated as the shortfalls, i.e. the difference between the volumes of consumption and production. As shown in **Table 5.3.4**, the rice import volumes are estimated to be 274,000 tons in 2012 and 412,000 tons in 2022.

Table 5.3.4 Forecast of Rice import

Item	Unit	2002	2004	2012	2022
Prod. In 4 States	ton	184.793	184.793	184.793	184.793
Maranao	ton	140.030	140.030	140.030	140.030
Import	**ton**	**153.746**	**176.356**	**273.660**	**412.242**
Consumption	ton	478.569	501.179	598.483	737.065
Population of 4 states	1000	184.793	17.347	19.022	21.059
Consumption/Capita	kg	28,3	28,9	31,5	**35**
			Growth Rate over 20 ye		1,07%

Source: JICA Study Team

Rice is imported from the South and Southeast Regions of Brazil via domestic shipping.

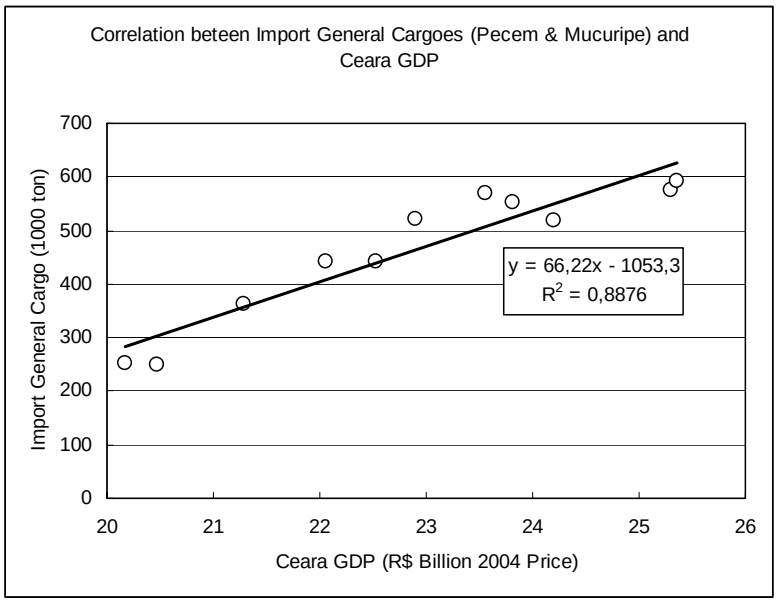
c. Other import commodities (container and break bulk cargoes)

The correlation between the total volumes import general cargoes (bulk cargoes and liquid cargoes are excluded) and Ceara's GDP (R$ in 2004 price) is good (r^2= 0.89) as shown in Figure 5.3.2. The relationship is well approximated by Eq. (5.1).

$$Y = 66.22X - 1053.3 \quad \text{.....(5.1)}$$

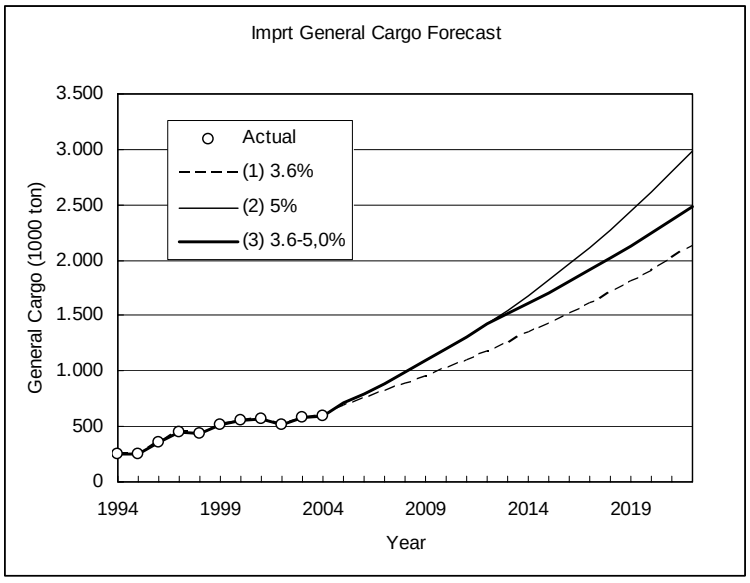
where Y denotes the total volume of import general cargoes (1,000 ton), while X denotes the GDP of Ceara State (R$ Billion) .

With Eq. (5.1) the import volumes of general cargoes are estimated. The results are shown in **Figure 5.3.3**. The estimates of the total general cargoes volumes in 2012 and 2022 are shown in **Table 5.3.5.** Since the import of rice has been estimated above and the import of steel rolls is estimated on the basis of the operation plan of the metal work company as described below, the volumes of the rest of the import general cargoes are estimated as indicated at the bottom line of **Table 5.3.5.** : the volumes of other dry bulk cargoes will be 1,007,000 tons in 2012 and 1,892,000 tons in 2022 for the growth scenario (3).



Source: IPECE (Ceara GDP) and Mucuripe and Pecem Port (Cargo Volumes), edited by JICA Study Team

Figure 5.3.2 Correlation between Import general cargoes and GDP of Ceara



Source: JICA Study Team

Figure 5.3.3 Import dry cargo forecast (Excluding dry bulk cargoes)

Table 5.3.5 Estimates of import general cargoes

Unit 1,000 ton

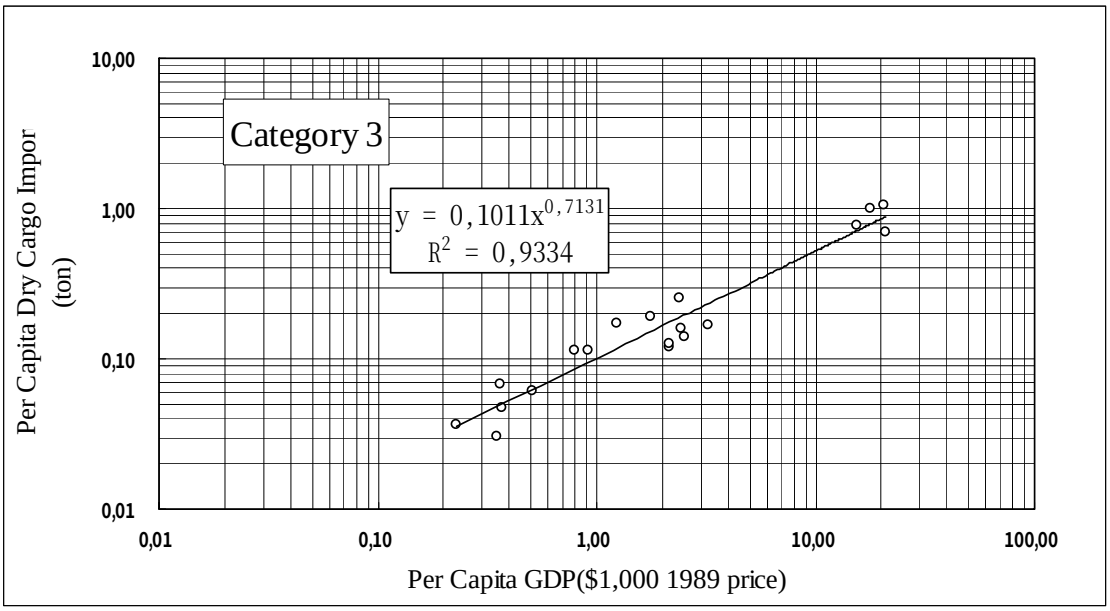
	(1) 3.6%			(2) 5%			(3) 3.6-5,0%		
	2004	2012	2022	2004	2012	2022	2004	2012	2022
Total General Cargo	593	1.177	2.126	593	1.428	2.988	593	1.428	2.484
Rice	154	274	412	154	274	412	154	274	412
Rolls of steel	123	147	180	123	147	180	123	147	180
Other General Cargoes	316	756	1.534	316	1.007	2.396	316	1.007	1.892

Source: JICA Study Team

In order to examine the forecast volumes estimated above, the import general cargoes are estimated by another approach.

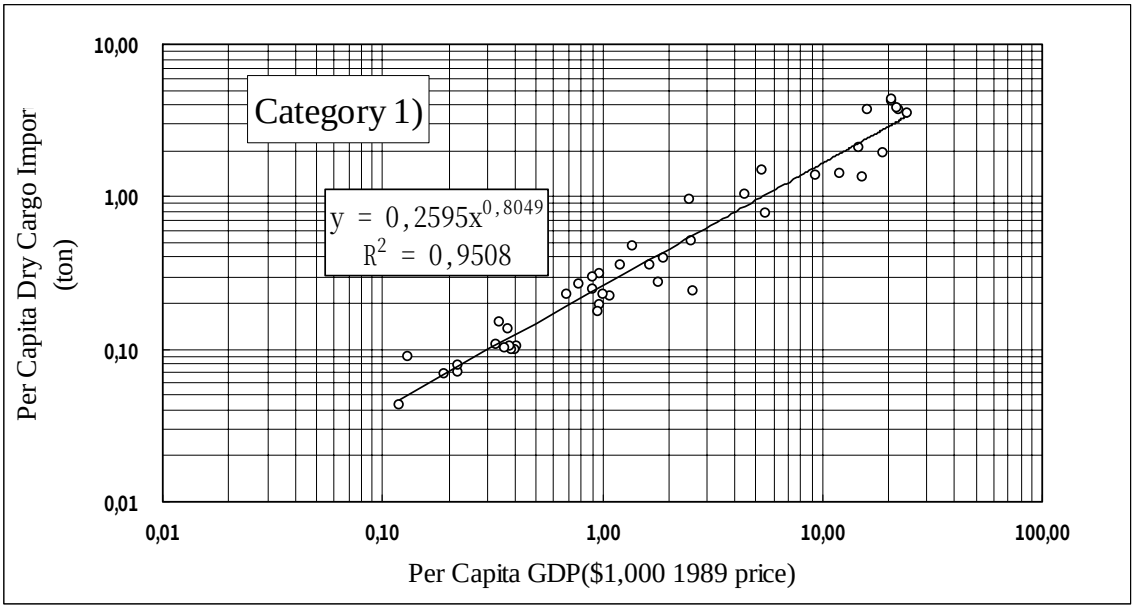
In general, such a tendency is observed throughout the world that the higher the GDP grows, the more the people purchase and consume goods. Apart from the GDP per capita, there is a variety of factors that increase or decrease per capita import dry cargo volumes. It is reported that is a universal relationship between the dry cargo import volume per capita and GDP per capita of a country (*On Project Evaluation in Port Planning in Development Countries*, Y. Nishida and K. Kobune, 1998, PIANC). The report classified a total of 85 countries into three categories on the basis of the characteristics of the countries that affect the volume of import dry cargoes such as the geographical condition (whether the country is located within a continent or on an island), the economic structure (whether the country has industries that import raw materials and semi-products for their production), the cereal self supply rate, and the volume of transhipment and transit. The report showed the relationships between per capita dry cargo volumes and GDP for the three categories: Countries where the per capita import volumes are 1) intermediate, 2) large and 3) small.

Brazil was classified in the report as a county of small import volume, because it is rich in cereal production, has few transhipment and transit cargoes and majority of the industry produce their products out of locally available materials. The relation seen among 19 countries of Category 3) is shown in **Figure 5.3.4.** Incidentally, the relation ship among the 44 countries of Category 1) is shown **Figure 5.3.5.**



Source: Y. Nishida and K. Kobune, 1998, PIANC

Figure 5.3.4 Correlation between Per capita Dry Cargo import volume and GDP (Category 3) Countries with small import volumes)



Source: Y. Nishida and K. Kobune, 1998, PIANC

Figure 5.3.5 Correlation between Per capita Dry Cargo import volume and GDP (Category 1) Countries with intermediate import volumes)

The hinterland of Mucuripe and Pecem Ports has the same characteristics as the whole Brazil: there is land accessed to and from Ceara to other states, majority of the industries produces their products out of locally available materials and agricultural production is substantial. Thus, the relationship among the countries of Category 3 can be applied to estimate the per capita import dry cargoes.

The relationship for the countries of Category 3 is expressed by Eq. (5.2).

$$Y = AX^B \quad \text{.....(5.2)}$$

where A=0.1011, B＝0.7131.

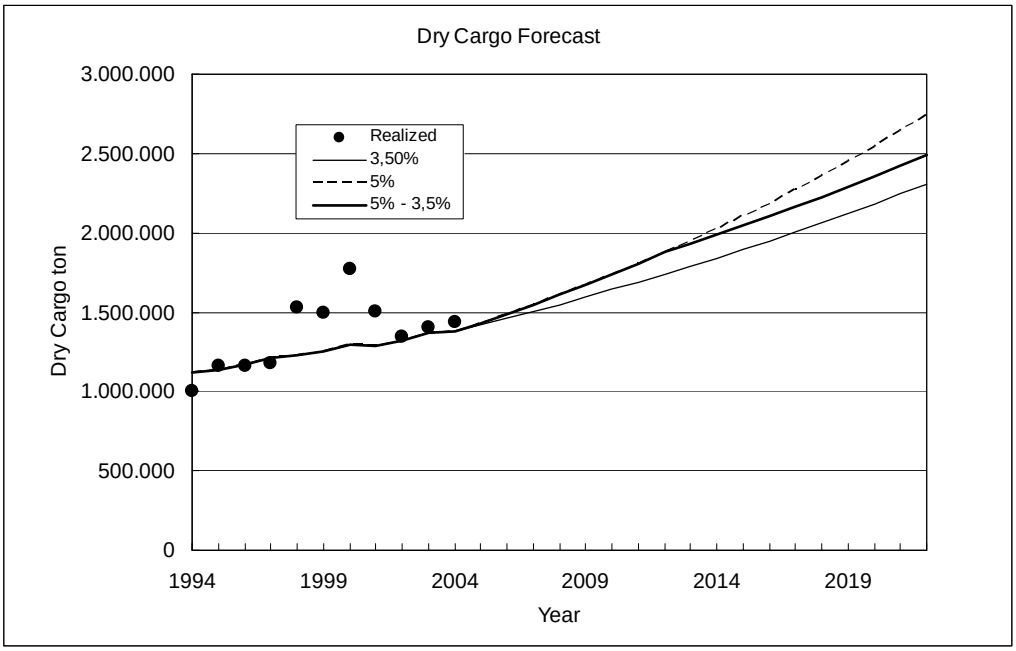
The coefficient B denotes the average rate of increase of per capita dry cargoes in accordance with the increase in per capita GDP among 25 countries, while A the denotes the average of the import volume level among the countries having the same per capita GDP.

For the forecast, therefore, the value of the coefficient B of 0.7131 is employed, while the coefficient A is given the value 0.15 so that the equation best fit the cargo data in the past.

The result of the estimation is exhibited in **Figure 5.3.6.** It should be noted that **Figure 5.3.6** includes Dry bulk cargoes, while **Figure 5.3.2** excludes it. In the same manner, the dry cargo volume other than wheat, rice and roll of steel, which are estimated separately, is estimated to be 464,000 tons in 2012 and 801,000 tons in 2022 for the GDP growth scenario (3).

The total container cargo volume is the sum of the volumes of rice and other cargoes. The import container cargo volume is divided into international and domestic containers at the shares of 70% and 30%, respectively, which is the share of the international and domestic general cargos observed in the recent years (see **Figure**

5.3.7).



Source: JICA Study Team

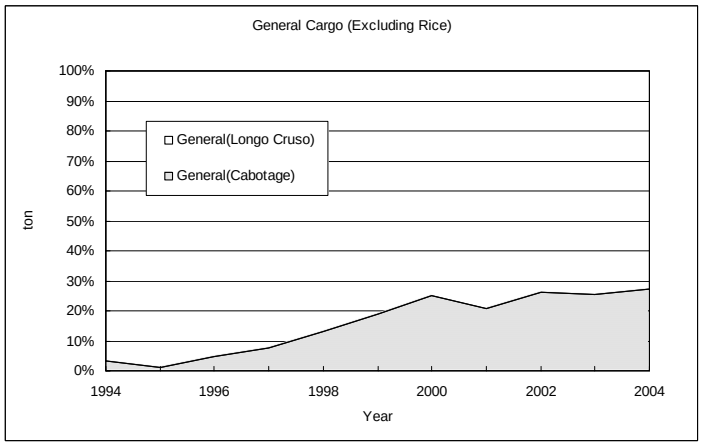
Figure 5.3.6 Import dry cargo forecast

Table 5.3.6 Result of import dry cargoes

Unit : 1000 ton

Ceara Dry Cargo Import	Ceara State			Federal			Study Team		
		3,61%	3,61%		5,0%	5,0%		5,0%	3,61%
	2004	2012	2022	2004	2012	2022	2004	2012	2022
Total Dry Cargo	1.434	1.740	2.310	1.434	1.878	2.740	1.434	1.878	2.492
Wheat	722	993	1.099	722	993	1.099	722	993	1099
Rice	154	274	412	154	274	412	154	274	412
Roll of steel	123	147	180	123	147	180	123	147	180
Other	435	326	618	435	464	1.049	435	464	801
International	412	326	618	412	464	1.023	412	464	801
Domestic	177	274	412	177	274	438	177	274	412

Source: JICA Study Team



Source: Mucuripe and Pecem Port, edited by JICA Study Team

Figure 5.3.7 Share between the international and domestic general cargoes

The study team assessed that the estimates shown in **Table 5.3.6** seem to be more

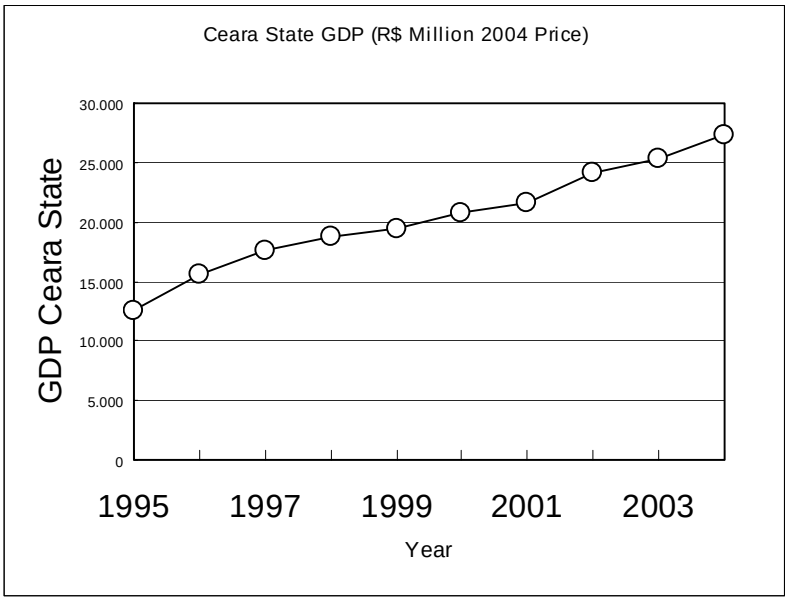
realistic. Therefore, the estimates shall be employed in the master plan.

d. Import of Steel Roll (Break bulk)

The major commodities among the break bulk cargoes is steel rolls, which have been imported in the shape of break bulk by a metal work company. According to the interview with the company, it has the plan to expand its import volume up to 180,000 tons per year. Since the time schedule of the realization of its plan is not given, the study team assumed that the volume of 180,000 tons will be achieved in the years following 2012. The import volume of steel rolls in the year 2012 is estimated as the average of the volume imported in 2004.

(2) Export

As mentioned in Chapter 2, the export volume of the general cargoes has been increasing over the recent years. However, the GDP of Ceara showed a gradual increase (see **Figure 5.3.8)**.



Source: IPECE

Figure 5.3.8 GDP of Ceara

Thus, it seems to be inappropriate to analyse the regression over the full period from 1994 through 2004. Therefore, the forecast of the export commodities were performed in the following manner:

1) All the commodities were classified into three categories; agriculture, light industry and other industry.

2) Among the commodities in a category, the principal commodity that shows a big leap since 2002 was identified.

3) The total volume except the principal commodity was calculated.

4) The regression analysis was made by category between the total cargoes except the principal commodity and the GDP of Ceara over the period from 1994 through 2001.

5) The growth rate of the export volume (except the principal commodity) for the year 2005 and subsequent one or two years were assumed to reduce gradually until the rate falls to the same growth rate exhibited by the regression equation.

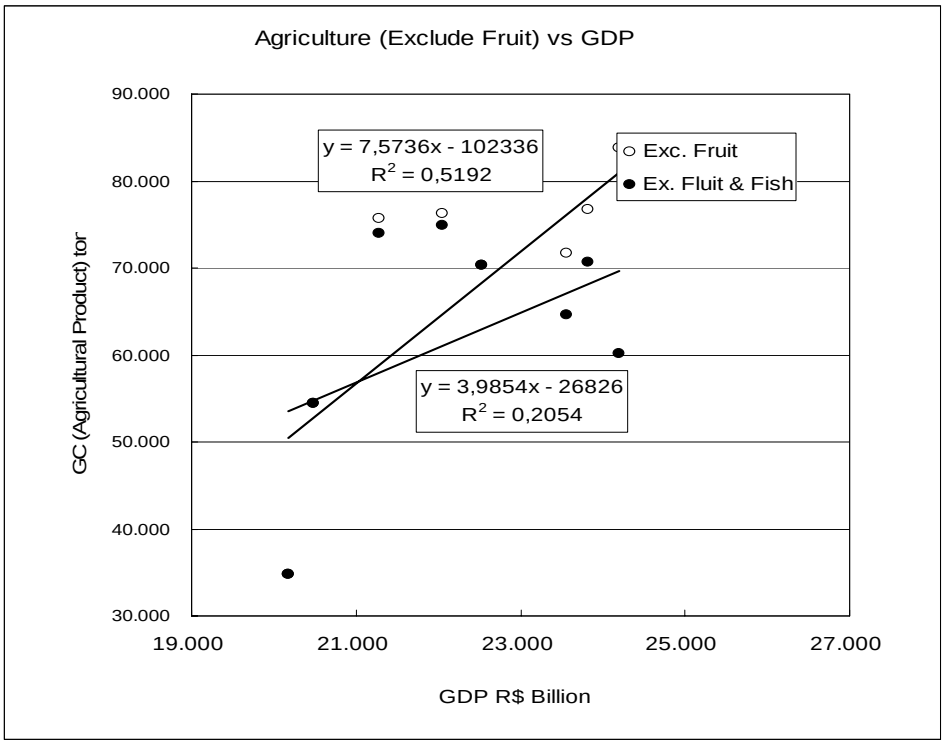
6) The cargo volumes in the later years were estimated as the sum of the amount of leap over the few years since 2002 and the amount given by the regression equation.

7) The volumes of the principal commodity was estimated separately by direct forward on the basis of other information available

8) The cargo volumes was estimated as the sum of the amount obtained at steps 6) and 7)

a. Agriculture related products

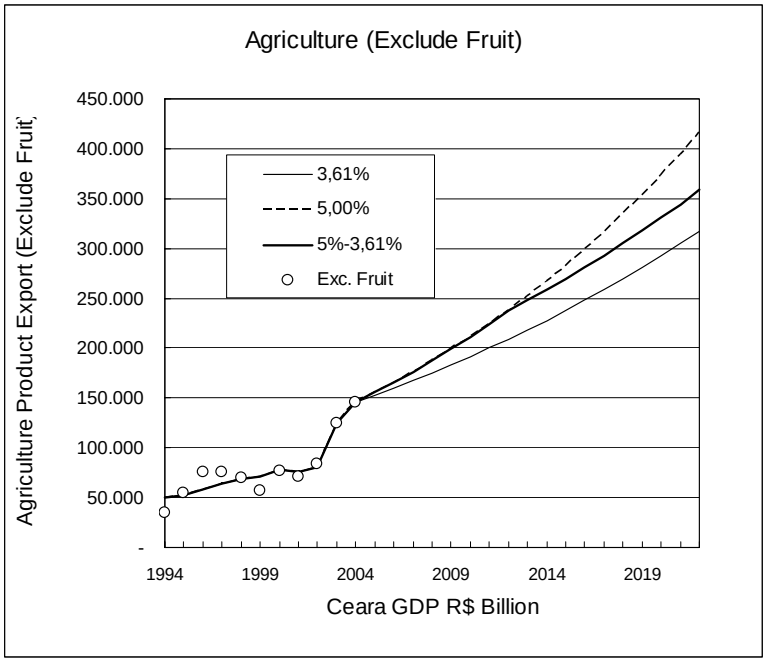
Fruit and fish (especially shrimps) are the major commodities in this category and showed a big leap. The regression analysis was performed for the total volume excluding fruit and fish. As observed in **Figure 5.3.9**, the correlation of the volume excluding fruit and fish with GDP is not good, very low. Therefore, the correlation with the volume excluding fruit only with Ceara's GDP was employed for the estimate



Source: JICA Study Team

Figure 5.3.9 Correlation of the volumes excluding fruit only and fruit and fish with Ceara GDP

The result of the forecast is shown in **Figure 5.3.10**.



Source: JICA Study Team

Figure 5.3.10 Forecast of Agriculture related cargos (excluding Fruit)

The export volume of fruit was estimated as follows:

When the on-going Sao Francisco River Diversion Project is completed, a total farmland of 80,000 ha will be irrigated in Ceara and Rio Grande do Norte. What kind of fruit or cereals will be planted is unknown at present. However, it is most likely that, in the new irrigated farm land, the most profitable kind of fruit will be planted for export.

The productivity varies by kind of fruits as **Table 5.3.7** shows. Banana, Melon a, mango and Papaya are presently the major export fruits. The productivity of these kind of fruits are 10 ton/ha or larger.

Table 5.3.7 Productivity in Ceara State

Fruit	Productivity ton/ha
Papaya	46,22
Pineapple	32,35
Melon	24,43
Passion Fruit	19,08
Orange	9,92
Lemon	9,64
Mango	9,09
Banana	8,23
Cashew nut	0,32

Source: Ceara em Numeros. 2004, edited by JICA Study Team

Thus, it was assumed that the production in the newly irrigated farm land will increase the production by 5 tons per ha. With this assumption, the fruit export will have increased by 400,000 tons in the year 2022. The additional export volume from

the new irrigated farm land in 2012 is estimated to be 2/3 of that expected in 2022, i.e., 267,000 tons.

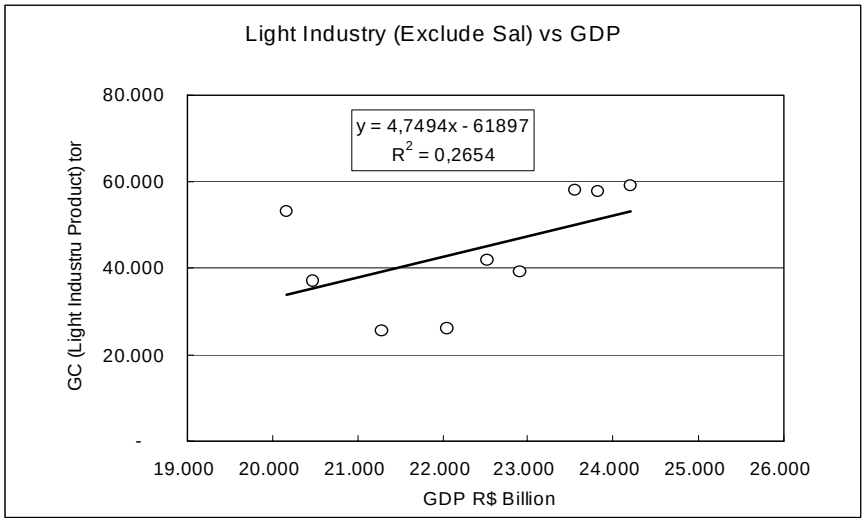
The export of fish (shrimps) has been growing remarkably. However, the shrimps exported are not cultivated but natural ones. Thus, it is likely that the export of shrimps will be controlled from the view point of the conservation of marine natural resources. Thus, it was assumed that the export volume of fish will maintain the same amount as of 2004, i.e., 73,000 tons.

Fruit and fish will be transported in reefer containers, while other agricultural products will be transported in dry containers.

b. Light industry related commodities

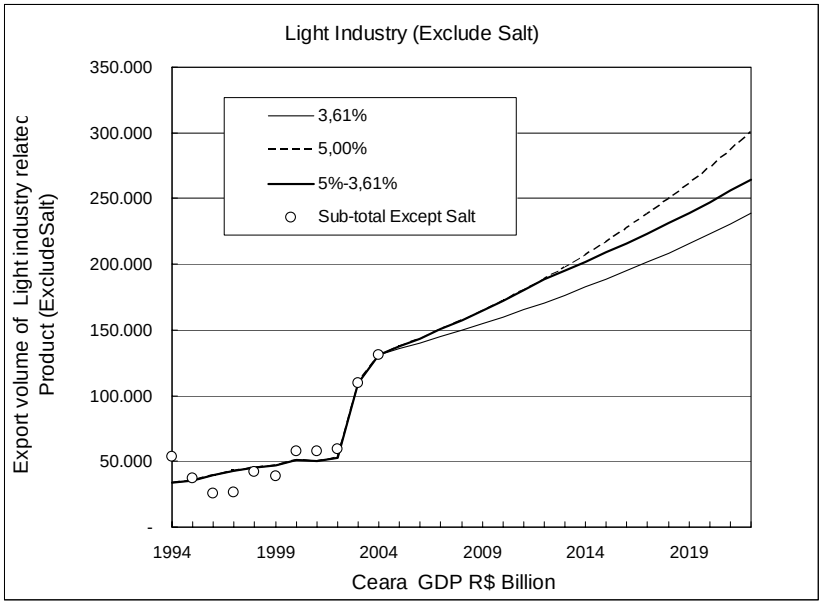
The principal export commodity among the light industry related products is salt. The share of salt in the export volume has exceeded 50% since 2000, and its market is limited to the North Region while other commodities are exported to whole Brazil and foreign markets. Thus, it seems to be reasonable to forecast Salt separately from other commodities.

The correlation between the total export volume of this category except salt and GDP over the period from 1994 through 2002 is exhibited in **Figure 5.3.11**. Though the correlation is not high enough, the regression equation given in **Figure 5.3.11** was employed in the forecast. The result of the forecast is shown in **Figure 5.3.12**.



Source: Mucuripe port and IPECE, edited by the JICA Study Team

Figure 5.3.11 Correlation between total export volume of Light Industry related commodities



Source: JICA Study Team

Figure 5.3.12 Forecast of the export of light industry related products

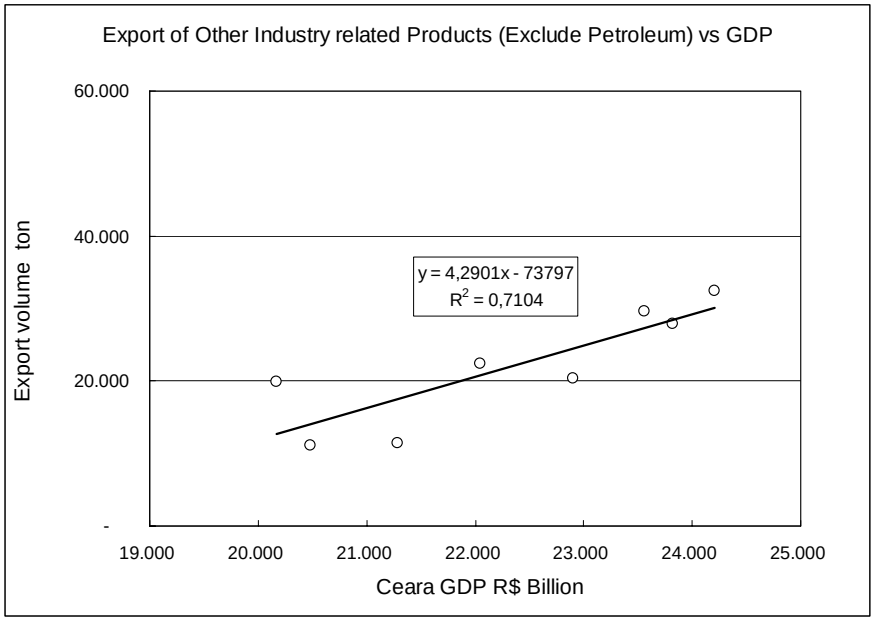
Salt Export

Since the market of salt is limited to the North Region, it is unlikely to increase further at a high growth rate. In addition, the increase rate in 2004 is lower than that in 2003. Thus, it was assumed that the export volume of salt would be 319,000 tons in 2012 and 1.5 times in 2022 as large as the amount exported in 2004.

c. Other industry related products

Petroleum products have been the principal commodity of this category. Since petroleum products are transported by tankers, the export volume should be estimated separately from general cargoes. Thus, the regression analysis was made on the total export volume excluding petroleum products.

The correlation between the export volume, excluding petroleum products and Ceara'sa GDP over the period from 1994 through 2002 is shown in **Figure 5.3.13**. The correlation is good. The result of forecast is shown in **Figure 5.3.14**.

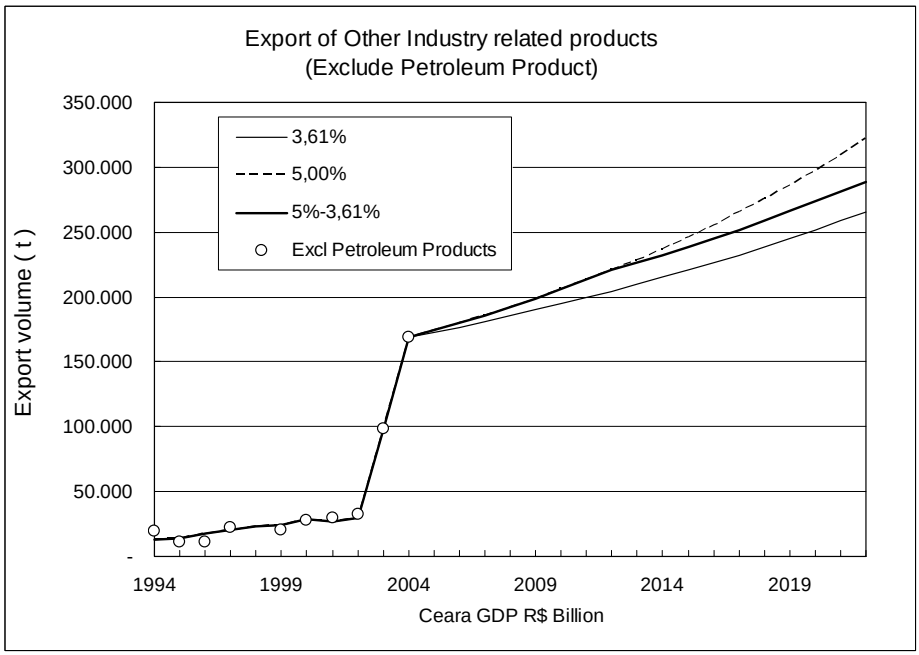


Source: IPEC、Pecem and Mucuripe Port, edited by JICA Study Team

Figure 5.3.13 Correlation between the export volume of Other industry related products excluding Petroleum products and Ceara GDP

Summing up the export dry cargo generated in Ceara State, the total export dry cargoes (all the commodities are container cargoes) is computed as shown in **Table 5.3.8**. For the growth scenario assumed by the study Team, the total export cargoes in 2012 and 2022 are estimated to be 1,421, 000 tons and 1,966,000 tons, respectively.

The amount of export cargoes is divided into international and domestic cargoes by employing the ratio of international and domestic cargoes observed in the recent years. **Figure 5.3.15** shows the trend of the ratio.



Source: JICA Study Team

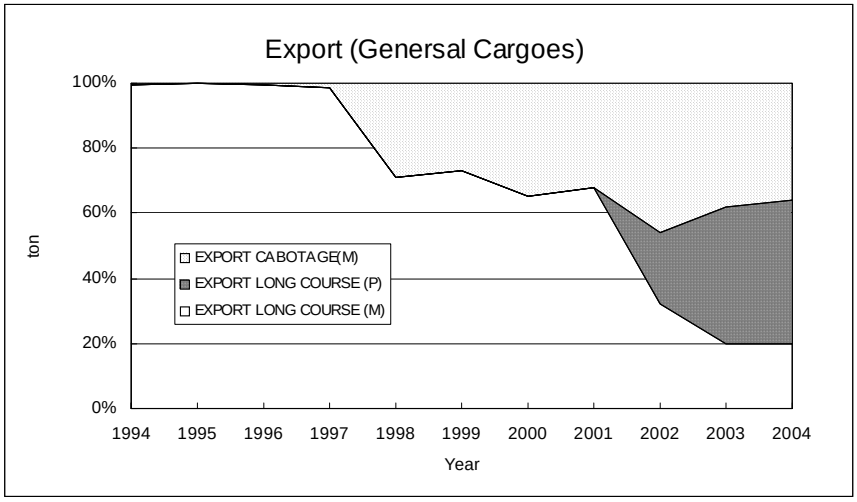
Figure 5.3.14 Forecast of the export of other industry related products

Table 5.3.8 Summary of the forecast volume of export dry cargoes

Unit: 1000 ton

Item	Ceara State GDP Growth Est.			Federal Gov. GDP Growth Est.			Study Team estimate		
		3,61%	3,61%	0,0%	5,0%	5,0%	0,0%	5,0%	3,61%
	2004	2012	2022	2004	2012	2022	2004	2012	2022
Total Dry Cargo Volume	822	1.358	1.876	822	1.421	2.092	822	1.421	1.966
Agricultural Product (Exclude Fruit & Fish)	74	209	318	74	238	416	74	238	359
Fresh Fruit	182	382	582	182	382	582	182	382	582
Fish	73	73	73	73	73	73	73	73	73
Light Industry (Exclude Food Salt)	59	171	239	59	189	301	59	189	265
Salt	266	319	399	266	319	399	266	319	399
Other Industry (Exclude Petroleum)	169	204	266	169	221	322	169	221	289
Dry Container (Excule Steel)	567	903	1.221	567	966	1.437	567	966	1.311
Reefer Container	255	455	655	255	455	655	255	455	655
Export Container Total (Pecem + Mucuripe)	822	1.358	1.876	822	1.421	2.092	822	1.421	1.966
Pecem Porrt (Intnational Dry Container + Reefer)	559	924	1.276	559	966	1.423	559	966	1.337
International Dry Container	304	469	621	304	511	768	304	511	682
Reefer Container	255	455	655	255	455	655	255	455	655
Mucuripe (Domestic incl. Sal) (Domestic 32%)	263	435	600	263	455	670	263	455	629

Source: JICA Study Team



Source : Mucuripe and Pecem Port, Edited by JICA Study Team

Figure 5.3.15 Share of International and domestic export cargoes

d. Other cargoes

Some companies have concrete plans to start exporting their products in the future that have been supplies in the local market only or plans to expand the export volume of their products. The following are their operational plans:

Cement

A cement company in Ceara has a plan to expand its annual production from current 600,000 tons to 1.0 million tons. When their production reaches, they will be exporting 300,000 tons of cement overseas. This plan implies that additional

120,000 tons of coke will be imported as dry bulk cargoes: 0.2 tons of coke is needed to produce 1 ton of cement. Their cement will be exported in sacks.

Thus, it is assumed that the plan will be realized sometime between 2012 and 2022. The additional cargoes added to the above estimated export dry cargoes.

Import of coke (Dry Bulk): 2012; 120,000 tons, 2022; 200,000 tons.

Export of Cement (Container): 2012; 150,000 tons, 2022; 300,000 tons

Iron and Steel

An ironwork company that is processing steel products mainly for construction materials has a plan to expand their production up to 90,000 tons from 60,000 tons at present. To this end, the company will also increase import of intermediate steel products. Since, in 2004, the company imported 121,000 tons of intermediate steel products to export 60,000 tons of billet, their import and export volumes are assumed as follows:

Import: Intermediate steel products,

2012; 150,000 tons, 2022 180,000 tons

Export: Billet

2012: 75,000 tons, 2022; 90,000 tons

5.3.3 Potential cargoes generated in other State in the future

(1) Soy beans in Piaui State

The export potential capacity of soybeans produced in the Northeast Region is estimated to be 18 million tons per annum (Please refer to Section 5.3.3 of the Progress Report of this Study). It is also highly expected to be cultivated by 2022 to meet the demand in the world market.

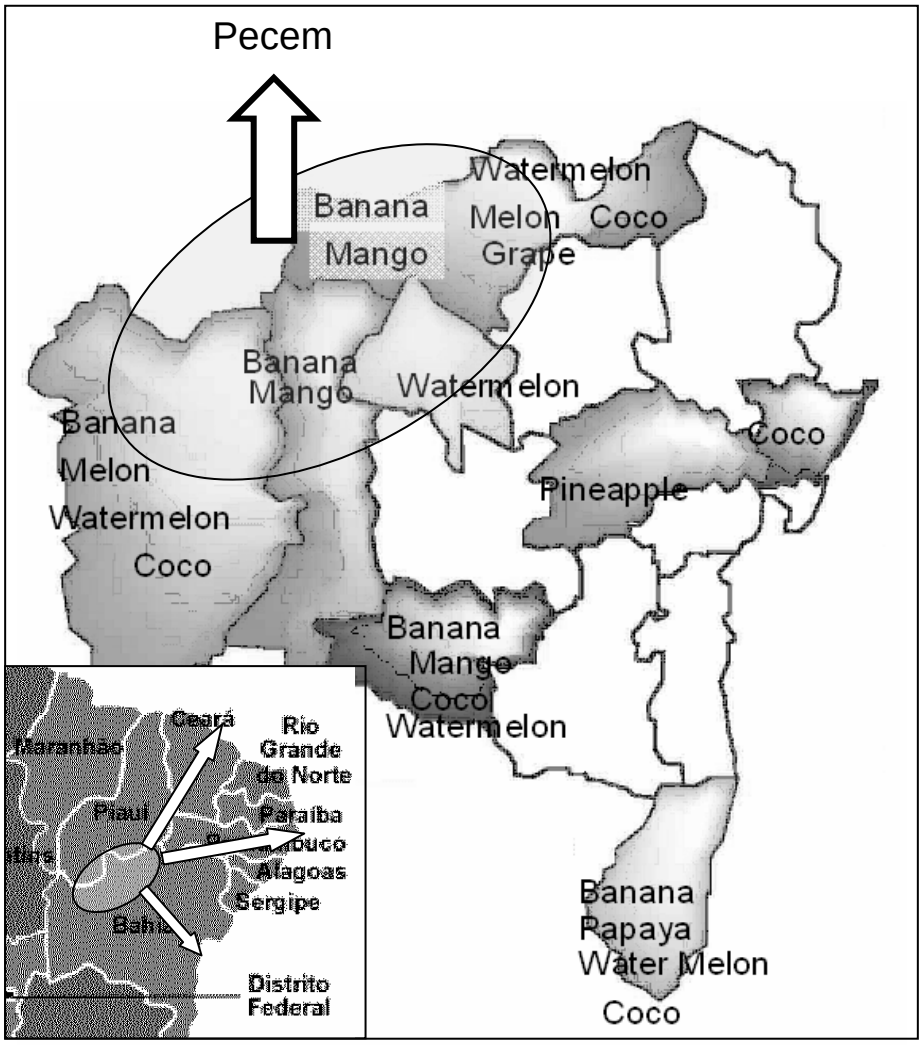
On the basis of the analysis including the transport cost, the study team has concluded that one fourth of soybean exports of 18 million tons in 2022 should be allocated to Pecem Port, with the resulting amount of 4.5 million tons per annum, as well as Suape Port. In Itaqui Port and Ilheus Port, in addition to each 4.5 million tons per annum in the same year, the anticipated exports from another Cerrado region extending from the north region to the centre-west region as mentioned in **Section 4.3.3 (2)** are allocated, with the resulting totaled amount of 13,2 million and 12,4 million ton per year, respectively.

(2) Fresh fruit in Bahia State

The northwest part of Bahia State is rich in fresh fruit production. The fresh fruit production there has been growing. As seen in **Figure 5.3.16**, the geographical location of this area is next to Piaui State and there is quite a distance from Salvador Port in Bahia. Taking into consideration the railway service, which is expected to operate sometime around 2010, it is likely the fruit produced in this area will be exported via Pecem as well as Suape Port.

The volume of fresh fruit brought from this area to Pecem Port for export was assumed to be 300,000 tons; this volume is comparative to 10% of the total export

containers (International) of Bahia, which is estimated in the following section (see **Table 5.3.9**).



Source: Bahia Stahe Web Site, Edited by JICA Study Team

Figure 5.3.16 Fruit production zone of Bahia State

5.3.4 Transhipment container cargoes at Pecem

As mentioned in the previous section, the Port of Pecém has a high possibility of collecting transhipment cargo from the whole of Brazil by feeder service in addition to the cargo from its hinterland.

Demand forecast of transhipment containers at Pecém is conducted by the following procedures;

a. The container throughput of each region in Brazil has been estimated. In this study, the growth rate of container throughput in Brazil is assumed to be 8.0 % per annum to 2012 and a further 4.0 % per annum to 2022 on the basis of several reports of major maritime consultants.

"Annual Review of Global Container Terminal Operators -2004"

Drewry Shipping Consultants forecasts that container throughput in South America will grow by an average of 10.4 % per annum between 2003 and 2009.

"World Containerport Outlook to 2015"

Ocean Shipping Consultants forecasts that container throughput in South America will grow by an average of 6.8-9.3 % per annum between 2003 and 2015.

"Performance of Container Terminal 2004"

ABRATEC (Brasil Public Use Container Terminal Association) forecasts that container throughput in Brazil will grow by an average of 13.8 per annum between 2004 and 2010 to 7 mill TEU.

The result of the above-mentioned procedure is shown in **Table 5.3.9**.

b. Basically, all foreign container cargo of the north region shall be transported by feeder service and be gathered up to Pecém Port. It is considered that the ratio of cargo transported through Pecém Port will increase year after year. In this case, the ratio is assumed to be 50 % in 2012 and 70 % in 2022.

c. Since Salvador Port cannot accept large size container vessels due to the water depth of the container berth, once the volume of container cargo generated in the State of Bahia exceeds the capacity of Salvador Port, the excess container volume shall be handled at Pecém or Suape, where large vessels can dock. In this case, the share of Pecém Port in the handling of the excess container volume is assumed to be 30%, with the consideration of the fact that more frequent shipping service is available at Suape Port than at Pecém Port. In addition, it is also reported on the web site of ANTAQ that the container terminal of Salvador Port has a handling capacity of 250,000 TEUs per annum.

However, it seems to be more realistic to assume that those containers overflowed from Salvador port that have been estimated above (see **Table 5.3.9**), will be brought to either Suape or Pecem overland. Thus, the potential transhipment containers were taken into the cargo forecast as local containers.

Table 5.3.9 Demand forecast of transhipment containers at Pecém

(Unit:'000TEU)

Region and Port		2003			2012(rate=8%)			2022(rate=4%)		
		Foreign	Domestic	Total	Foreign	Domestic	Total	Foreign	Domestic	Total
North	MANAUS-AM	19	91	109	38	182	218	56	269	323
	BELÉM-PA	46	0	46	92	0	92	136	0	136
	Other Ports	2	1	3	4	2	6	6	3	9
SUB-TOTAL		67	92	159	***134***	184	318	***198***	272	470
Northeast	PECÉM-CE	67	0	67	134	0	134	198	0	198
	FORTALEZA-CE	36	41	77	72	82	154	107	121	228
	RECIFE-PE	21	36	57	42	72	114	62	107	169
	SUAPE-PE	21	40	61	42	80	122	62	118	180
	SALVADOR-BA	109	60	169	***218***	***120***	338	***323***	***178***	500
	Other Ports	4	3	7	8	6	14	12	9	21
SUB-TOTAL		257	181	438	514	362	876	760	536	1.296
Southeast	TERM. TUBARÃO-ES	9	0	9	18	0	18	27	0	27
	VITÓRIA-ES	100	25	125	200	50	250	296	74	370
	RIO DE JANEIRO-RJ	277	48	325	554	96	650	820	142	962
	SEPETIBA-RJ	15	12	27	30	24	54	44	36	80
	TERM. CUBATÃO-SP	148	27	175	296	54	350	438	80	518
	SANTOS-SP	1.288	97	1.385	2.575	194	2.769	3.811	287	4.098
	Other Ports	0	0	0	0	0	0	0	0	0
SUB-TOTAL		1.837	210	2.046	3.672	420	4.090	5.436	621	6.054
South	PARANAGUÁ-PR	218	0	218	436	0	436	645	0	645
	S. F. DO SUL-SC	147	107	254	294	214	508	435	317	752
	ITAJAÍ-SC	419	23	442	838	46	884	1.240	68	1.308
	RIO GRANDE-RS	435	88	523	870	176	1.045	1.287	260	1.548
	Other Ports	0	15	15	0	30	30	0	44	44
SUB-TOTAL		1.219	233	1.452	2.437	466	2.903	3.607	689	4.296
TOTAL		3.431	715	4.145	6.757	1.431	8.186	10.001	2.119	12.117

Source: Annual report of ANTAQ, Estimated by JICA Study Team

With the assumption that, in 2012, 50% of international containers generated in NorthRegion should be transhipped at Pecem, while, in 2022, the transhipment rate reached to 70 %.

The transhipment container volumes are calculated as follows:

2012: 134 x 0.5 x 2= 134, 2022 , 198 x 0.7x2=277

5.4 Summary of Cargo Forecast

The results of the cargo forecast discussed above are summarized in **Table 5.4.1**. The cargo that will be handled at Mucuripe Port is summarized in **Table 5.4.2.**

Table 5.4.1 Pecem Port Cargo Summary

('000 ton)

		2004	2012	2022
Dry Container Cargo	Import	96	464	801
Dry Container Cargo(ex. CIPP)	Export	178	511	682
Dry Container Cargo(CIPP)	Export			700
Reefer Container Cargo	Export	189	227	327
Reefer Container Cargo(From Bahia)	Export		150	300
Transhipment Container (North Region)	TEU		134	277
Container Total		**463**	**1,202**	**2,810**
Transhipment Container	TEU		134	277
Iron Ore Pallets	Import		2,500	5,000
Cokes	Import		120	200
Soybeans	Export			4,500
Fertilizers	Import			1,000
Solid Bulk Total		**0**	**2,620**	**10,700**
Thick slabs	Export		1,500	3,000
Steel Products (Pellet)	Import	123	147	180
Steel Products (Billet)	Export	60	75	90
Bagged Cements	Export		120	300
Fresh fruits (Reefer Ship)	Export		227	327
Break Bulk Total		**183**	**2,069**	**3,897**
Crude Oil	Import			8,800
Naphtha	Import			450
Refined Petroleum	Import	295	1,045	
C+ (Crude Gasoline)	Export			200
LNG				3,440
Liquid Bulk Total		**295**	**1,045**	**12,890**
Total Cargo		**941**	**6,936**	**30,297**
Transhipment Container	TEU	0	134	277

Source: JICA Study Team

Table 5.4.2 Mucuripe Port Cargo Summary

(1000 ton)

		2004	2012	2022
Cargo Volume of Mucuripe Port		2.004	2.012	2.022
Dry container Cargo	Unload	177	274	412
Drt Container Cargo	Load	263	455	629
Wheat	Unload	722	993	1.099
Total Dry Cargo		1.162	1.722	2.140

Source: JICA Study Team