Project Study on the Grand Design for Global Logistics in the African Region

Final Report

Summary

June 2023

Japan International Cooperation Agency (JICA)

Pacific Consultants Co., Ltd. (PCKK)

IM
JR
23-087

Table of Contents

List of Tables

List of Figures

Abbreviation Table

Acronym	Description
AfCFTA	African Continental Free Trade Area
AfDB	African Development Bank
AUDA-NEPAD	African Union Development Agency - New Partnership for Africa's Development
BAU	Business as Usual
CAGR	Compound Annual Growth Rate
CCI	Chamber of Commerce and Industry (Cote d'Ivoire)
CCTTFA	Central Corridor Transit Transport Facilitation Agency
COMESA	Common Market for Eastern and Southern Africa
CPA	Communaute Portuaire d'Abidjan(Cote d'Ivoire)
EPA	Economic Partnership Agreement
ESG	Environmental, social, and governance
EU	European Union
FTA	Free Trade Agreement
GDP	Gross Domestic Products
GHG	Greenhouse Gases
GLINS	Global Logistics Intermodal Network Simulation
GTAP	Global Trade Analysis Project
GTAP-RD	Global Trade Analysis Project -Recursive Dynamic
ICD	Inland Container Depot
ICT	Information and Communication Technology
JETRO	Japan External Trade Organization
IIASA	International Institute for Applied Systems Analysis
JICA	Japan International Cooperation Agency
IPCC	Intergovernmental Panel on Climate Change
MEER	Ministry of Equipment and Road Maintenance
KPA	Kenya Port Authority
LSCI	Liner Shipping Connectivity Index
MGR	Meter Gauge Railway
MoA	Ministry of Agriculture (Cote d'Ivoire)
MOT	Ministry of Transport (Cote d'Ivoire)
MoWT	Ministry of Works and Transport (Uganda)
MPD	Ministry of Planning and Development
MWTC	Ministry of Works, Transport and Communications (Tanzania)
NAMPORT	Namibian Ports Authority
NDPIII	Third National Development Plan (Uganda)

Acronym	Description
OECD	Organization for Economic Co-operation and Development
OECD-DAC	Organization for Economic Co-operation and Development - Development Assistance Committee
OSBP	One Stop Boarder Posts
PCI	Productive Capacities Index
PIDA	Program for Infrastructure Development in Africa
PIDA-PAP	PIDA Priority Action Plan
PSFU	Private Sector Foundation Uganda
RCEP	Regional Comprehensive Economic Partnership
SDGs	Sustainable Development Goals
SEZ	Special Economic Zone
SGR	Standard Gauge Railway
SIPF	Government Agency for Rail Management (Cote d'Ivoire)
SSP	Shared Socioeconomic Pathways
TANROADS	Tanzania National Roads Agency
TanTrade	Tanzania Trade Development Authority
TAZARA	Tanzania-Zambia Railway Authority
TPA	Tanzania Ports Authority
TRA	Tanzania Revenue Authority
TRC	Tanzania Railway Corporation
TPP	Trans-Pacific Partnership
TTIP	Transatlantic Trade and Investment Partnership
URA	Uganda Revenue Authority
URC	Uganda Railway Cooperation
URF	Uganda Road Fund
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
USD	United States Dollar
WAGRIC	West Africa Growth Ring Corridors
WHO	World Health Organization
WTO	World Trade Organization

Summary

Introduction

(1) Background of Study

Interest in sustainable development in Africa has been on the rise recently, as represented by the success of TICAD7 in 2019. Some countries are experiencing rapid economic development, with investors from inside and outside of Africa focusing on agriculture, industry, infrastructure, ICT, and other fields as attractive investments.

Regarding development in Africa, the African Union Development Agency (AUDA-NEPAD) has identified infrastructure development and trade facilitation as one of its goals, and the Programme for Infrastructure Development in Africa (PIDA) also promotes Africa's socioeconomic development and poverty reduction by improving access to infrastructure networks and services. As these indicate, there is a need for quality infrastructure investment (QII) to support Africa's development, contributing to sustainable economic and social development and maximizing development effectiveness.

JICA has created master plans for economic corridors in Africa and done other work since TICAD 5 in 2013 as part of its approach to correcting regional disparities and achieving comprehensive / sustainable high-quality growth by connecting industrial potential and logistics infrastructure.

However, the factors affecting the global economy and trade volume and the basis for calculating future demand in each corridor region are not sufficiently consistent quantitatively across the region, as each master plan sets different conditions. Furthermore, it is inevitable that future predictions will involve uncertainty, not to mention the financial crisis brought about by the COVID-19 pandemic in 2020, and it is essential to take uncertainty into account when conducting studies.

Therefore, a long-term logistics infrastructure strategy needs to be formulated that has a bird's-eye view of Africa and encompasses corridor development in each region. It is imperative that a logistics system be designed that accelerates growth of the entire Africa region in an integral manner.

On the other hand, in the JICA Project Study entitled "Project Study on the Grand Design for Global Logistics in the Indo-Pacific Region" (hereinafter called "previous study"), a logistics analysis targeting coastal countries and neighboring landlocked countries in East Africa was conducted after organizing future transport costs between regions, cargo flow volumes, etc., and a grand design for global logistics was proposed that pivots on growth in Africa was proposed.

When JICA reported these results at PIDA WEEK which was held in Egypt in 2019, comments were made by AUDA-NEPAD that this would help AUDA-NEPAD in terms of corridor development, and they would like to utilize the results of the previous study. In addition, hopes were voiced for an in-depth look at development / analysis of the Western African region in order to help facilitate long-term planning by PIDA.

On the other hand, the previous study did not target countries in West Africa for analysis, and a quantitative comparative analysis targeting Africa as a whole including West African countries is needed from the standpoint of integrated logistics infrastructure development.

Furthermore, the spread of the COVID-19 pandemic in 2020 had a large impact on global logistics, and a quantitative analysis that takes this impact into consideration is important.

(2) Objective of Study

The target year for this study is 2040, which expands the results of the previous study to conduct a quantitative analysis of logistics bottlenecks in each country in Africa, while taking into consideration the impact of the spread of the COVID-19 pandemic. The objectives consist of formulating a logistics infrastructure strategy for Africa as a whole and proposing the direction/potential of cooperation by JICA in a post-corona society.

(3) Results of Study

During this study, the objective will be to achieve the results described in the table below with 2040 designated as the target year, taking the results of the previous study into consideration.

Outputs to be Achieved for This Study

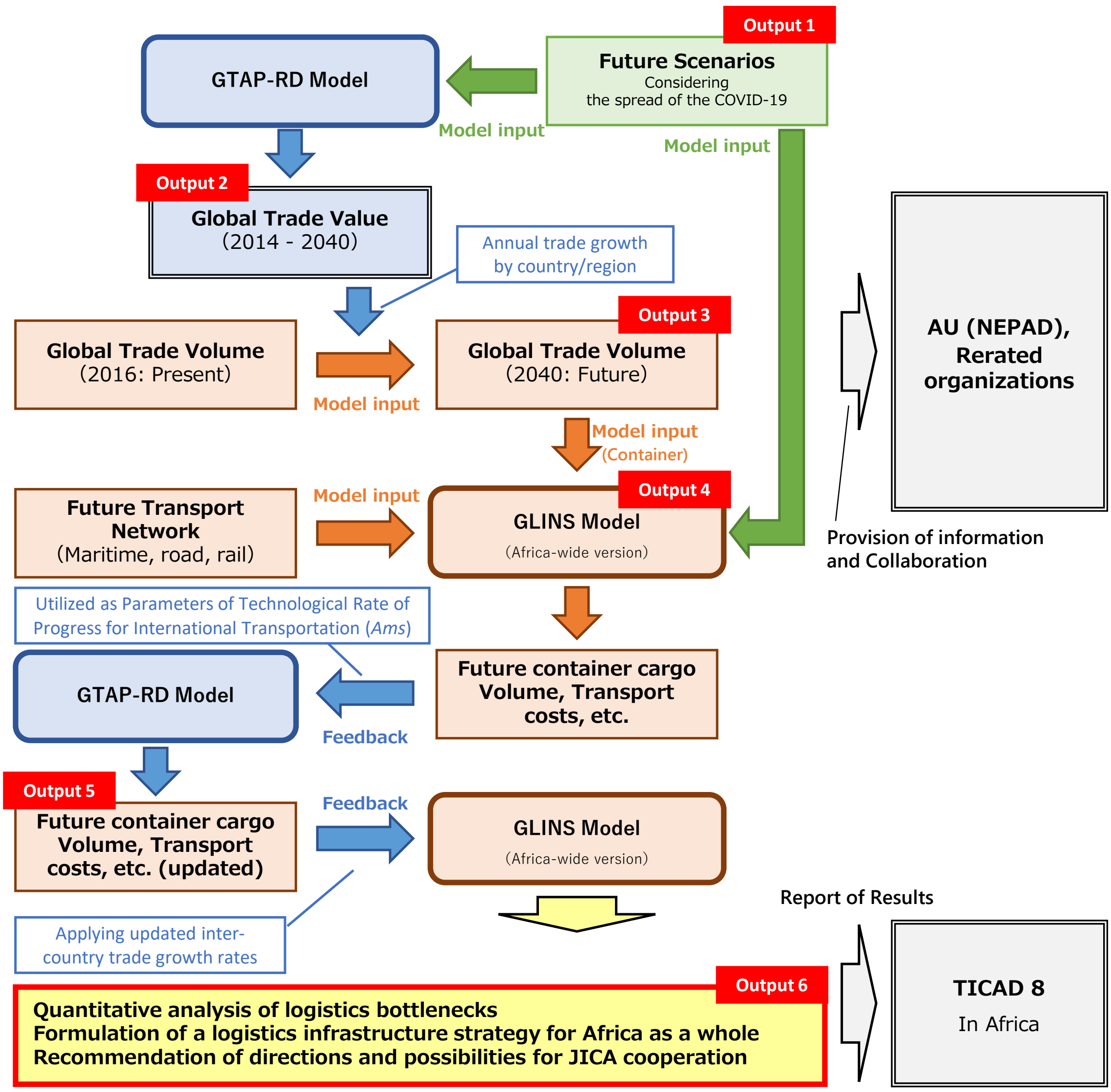
Output 1: Scenarios Formulated Considering Impact of Spread of COVID-19 Pandemic
After reviewing the previous study, multiple scenarios will be formulated which take into consideration the impact of the spread of the COVID-19 pandemic.
Output 2: Quantitative Analysis of Global trade Trends with GTAP Model (For Each Scenario)
Organize prediction results (for every 5 years from 2020 to 2040) for GDP growth rate / future trade amounts (for each industry type) using GTAP (Global Trade Analysis Project) model based on formulated scenarios.
Output 3: Estimation of Various OD Cargo Volumes (For Each Scenario: Ocean/Land Container, Bulk & RORO Cargo)
Based on the formulated scenarios, the OD cargo volume will be organized for the trade amounts for each industry type which are converted into ocean/land container cargo, bulk cargo (crude oil, LNG, iron ore, coal) and RoRo cargo (completed vehicles).
Output 4: Building of Global Logistics Intermodal Network Simulation (GLINS) Model Targeting Africa as a Whole
The model will be built by refining the current status of logistics facilities in each country in Africa, reproducing the current status of GLINS model in each country in Africa.

Output 5: Estimation of Transport Service Level/Cargo Volume for Each Route in Each Country in Africa (For Each Scenario)
The development plan for logistics facilities for each country in Africa will be refined, and the transport service level and cargo volume for each respective route between OD points in each African country will be clarified by entering data for the OD cargo volume into the intermodal global logistics model and making estimates.
Output 6: Formulation of Logistics Infrastructure Strategy and Recommendations Provided to Direction of JICA Cooperation (For Each Scenario)
The bottlenecks in the global logistics intermodal network will be identified, the logistics infrastructure strategy in Africa will be formulated, and the direction/ potential of JICA cooperation will be proposed.

(4) Study Methodology

In this study, multiple scenarios that are projected will first be set, an analysis of the global trade trends that considers the economic stratus, trade terms and other conditions in the 54 target countries/regions in Africa will be performed by using the GTAP-RD model (Global Trade Analysis Project - Recursive Dynamic Model) , which is an applied general equilibrium model.

Based on these results, global logistics trends will be analyzed using the GLINS model in order to review the future logistics infrastructure strategy for coastal countries and landlocked countries throughout Africa.



Flow of Analysis

Chapter 1 Infrastructure Development Trends in Africa

Information related to the plans and master plans for logistics infrastructure is gathered and organized in this chapter in order to make case settings for Global Logistics Intermodal Network Simulation (GLINS).

1-1. Logistics Infrastructure Development Trends

The current status of each logistics infrastructure and development trends were organized, with a focus on the ports, roads, railways, inland water transport, dry ports and One-Stop Border Posts (OSBP) that connect to the main corridors. An overview of the main development trends for each logistics infrastructure is described below.

(1) Ports

Container terminals and RORO terminals are being constructed and new projects are underway, mainly in ports connected to main corridors. On the East Coast of Africa, there are plans for Lamu Port in Kenya, Dar es Salaam Port and Mtwara Port in Tanzania, and Nacala Port in Mozambique, and on the West side of Africa, there are plans for Abidjan Port in Côte d'Ivoire and Tema Port in Ghana. In addition, plans for the development of new ports are proceeding for the Kenitra Atlantic New Port in Morocco and Ndayane Port in Senegal.

(2) Roads

Development of roads that connect the main ports with inland regions and coastal regions is proceeding, as well as for roads that connect missing links. Work on a coastal road from Abidjan (Côte d'Ivoire) to Lagos (Nigeria), Connectivity road that connects Cameroon, Democratic Republic of the Congo, Equatorial Guinea and Gabon, Highway connecting Lamu Port (Kenya) to Nadapal (Kenya) near the border with South Sudan and other such projects is proceeding.

(3) Railways

Railway development projects from the main ports to inland areas are being implemented. Work is proceeding on the Abidjan-Ouagadougou-Bamako Multimodal Transport Corridor, Beira-Nacala Multimodal Transport Corridor, Central Multimodal Transport Corridor, Dakar-Bamako-Niamey Multimodal Transport Corridor, and other such railway development projects.

(4) Inland Water Transport, Dry Ports

Inland water transport development is proceeding for the Djibouti (Djibouti) - Addis Ababa (Ethiopia) Transport Corridor, Northern Multimodal Transport Corridor and Multimodal

Transport Corridor from Pointe Noire (Republic of Congo) to N'Djamena (Chad).

(5) One-Stop Border Posts (OSBP)

After the Chirundu Border Post between Zambia and Zimbabwe was opened as a pilot OSBP, many OSBPs have been constructed, including Namanga between Kenya/Tanzania, Rusumo between Rwanda/Tanzania in East Africa, and Cinkassé in West Africa, etc. Currently, many development plans are proceeding on corridors that connect the African main ports with inland cities.

1-2. Field Study

Interviews of related organizations in African regions were conducted in order to determine the initial conditions for analysis with the GTAP model and GLINS model and use as reference for interpretation of the results. The countries visited and an overview of the results are described below.

Schedule	Country Visited	Overview
July 5 – 13	Côte d'Ivoire	Interviews of individual companies (16 locations)
July 12 – 13	Uganda	Interviews of individual companies (10 locations)
July 14 – 15	Rwanda	Interviews of individual companies (6 locations) Rwanda – Burundi border visited
July 18 – 19	Tanzania	Interviews of individual companies (8 locations)

Fig. 1.1 Countries Where Interviews Conducted

Table 1.1 Field Study Target Institutions

Cote d'Ivoire

Date of Survey	Place	Logi-stics	Port	Road	Rail	Agri-culture	Other
2022/7/6	Institut National de la Statistique, Department of Study, Research and Engineering						○
	Mitsubishi Corporation	○				○	○
	Abidjan Port Community (CPA)	○	○				
	CMA CGM	○	○	○	○		
2022/7/7	Ministry of Equipment and Road Maintenance			○	○		
	Ministry of Transport (MOT)			○			
	Ministère du Commerce	○				○	○
	Institute National des Statistiques					○	○
	Marubeni Corporation	○	○	○			○
2022/7/8	Ministry of Road Maintenance, National Office of Studies and Technical Development (MEER)			○			
	Abidjan Port Community (CPA)	○	○				○
	Chamber of Commerce and Industry (CCI)	○				○	○
2022/7/12	cfao	○					○
	Ministry of Planning and Development (MPD)	○				○	○
	Ministry of Agriculture (MoA)	○				○	
2022/7/13	Société Internationale de Transport Africain par Rail (SITARAIL), Société Ivoirienne de gestion du Patrimoine Ferroviaire (SIPF)				○		

Uganda

Date of Survey	Place	Logi-stics	Port	Road	Rail	Agri-culture	Other
2022/7/12	Ministry of Works and Transport (MoWT)	○		○	○		
	Uganda National Roads Authority (UNRA)	○		○			○
	Uganda Bureau of Statistics (UBOS)	○					○
	WHO Uganda Office	○		○	○		○
2022/7/13	Private Sector Foundation Uganda (PSFU)	○					○
	Uganda Road Fund (URF)			○			
	Uganda Revenue Authority (URA)	○					
	Uganda Railway Cooperation (URC)	○			○		○
	National Medical Store (NMS)	○					○
	SARAYA Manufacturing (U) Ltd			○			○

Rwanda

Date of Survey	Place	Logi-stics	Port	Road	Rail	Agri-culture	Other
2022/7/14	Rusumo verification office	○		○			
	JICA Rwanda Office	○		○	○		○
2022/7/15	Rwanda freight forwarding association (RWAFFA)	○		○			
	Akagera Business Group – Akagera Motor	○	○				○
	Bollore Headquarters Kigali	○		○			
2022/08/05*	Rwanda Medical Supplies LTD	○		○			○

Tanzania

Date of Survey	Place	Logi-stics	Port	Road	Rail	Agri-culture	Other
2022/7/18	Central Corridor Transit Transport Facilitation Agency (CCTTFA)	○		○			
	Tanzania National Roads Agency (TANROADS), Ministry of Works, Transport and Communications (MWTC)			○			
	Tanzania Trade Development Authority (TanTrade)						○
	Tanzania Railway Corporation (TRC)			○			
	Tanzania Revenue Authority (TRA)	○					
2022/7/19	Tanzania Port Authority (TPA)	○	○				
	Tanzania Zambia Railway Authority (TAZARA)				○		
	JICA Tanzania Office		○				○

* Online meeting

The indicators for the GTAP model and GLINS model obtained from the information and knowledge in this field study are described below.

Table 1.2 Implications Obtained from Field Study (GTAP Model)

	Model calculation verification / Check items	Model calculation result implications/ Considerations for interpretation
COVID-19	There are various levels of COVID-19 impact/recovery, and it was confirmed that the settings made for the difference in each level of recovery between scenarios was adequate from the perspective of the uncertainty of COVID-19.	The stable supply of medical products and vaccines has been impacted by currency exchange fluctuation and the rise in fuel prices. The possible increase in vulnerability of the response to COVID-19 and other infectious diseases in the future needs to be taken into consideration.
AfCFTA	Various opinions were voiced, including support for the promotion of AfCFTA, concerns about the smooth progress of AfCFTA and opinion that existing regional communities should be given priority. The respective viewpoints match the settings in scenarios S1, BAU and S2, and their relevancy was confirmed.	Although the overall scale of exports/imports will be increased by AfCFTA, it was confirmed that the scale of exports/imports may decrease in some cases depending on competition with other countries/regions/industries. The introduction of domestic industry policies etc. needs to be reviewed, taking these circumstances into consideration.
Carbon Neutral	While there was overall support for the concept of carbon neutral, activities towards achieving this have not been implemented, and the future is still uncertain. It was confirmed that the settings in scenarios S1, BAU and S2 compensate these uncertain conditions.	There were no parameters to directly achieve carbon neutral policies in the GTAP-RD model. It is hoped that more precise analysis can be performed by using the GTAP-RD-E or other such model that incorporates greenhouse gas emissions volume into the model.
ICT/IOT, DX	Smart phones are widely used in all the countries that were visited and are being used for car dispatch and other such services by start-ups. The high rate of technological progress set in the model was confirmed as appropriate.	While technology is being disseminated in large cities, whether or not dissemination will continue in Africa as a whole, including farming villages, on an ongoing basis will depend upon infrastructure development and upgrading the level of education, and these points need to be considered.

Table 1.3 Implications Obtained from Field Study (GLINS Model)

	Model calculation verification / Check items	Model calculation result implications/ Considerations for interpretation
Roads	The road network that was built with GIS reproduces the main roads for the most part, and it was confirmed that an overview of the flow of logistics on roads was created.	The road development status is reflected in the model, but in reality, upgrading is proceeding at a rapid pace, making it difficult to accurately obtain the latest status of roads.
Railways	It was confirmed that the parameters input into the model that consist of the speed / capacity (number of cars, train frequency) reflect reality to a certain extent.	The aging of railway facilities and operation capacity are issues, and it was stated that the number of trains is inadequate, and service is irregular. These service quality issues need to be considered.
Border Crossing Logistics	It was stated that the development of OSBPs dramatically shortens waiting time, confirming the appropriateness of economic corridor scenario settings (shorten time by 1/2).	A uniform level of border impediments and OSBPs were set in the model, but the fact that the quality of actual services at each border and country differ needs to be taken into consideration.
	It was confirmed that the transport conditions of cargo to hinterland countries were reproduced for the most part by comparing the figures with port statistics and customs statistics (to the extent that data could be obtained).	The fact that the selection of the port and route is affected considerably by not only economic rationality but also diplomatic relations, business practices (preference for transactions in common language) and security conditions needs to be considered.
Other	It was confirmed that the impact of the coronavirus pandemic on trade / logistics is temporary, and that trade volume and logistics operation are recovering.	DX is proceeding for port operations and supply chain management, and there is the possibility that cost reductions and increases in efficiency will proceed at a greater rate than assumed in the model.

1-3. Interviews with Relevant Stakeholders

Interviews and e-mail surveys (8 companies) were conducted for Japanese companies (shippers, marine/logistics operators, etc.) that have advanced into Africa or are conducting business to identify the material and immaterial needs for development of Africa. It was confirmed that there is a need for a strategy that considers a wide-area network connecting between ports and hinterland areas and efficient custom handling as a set, since logistics in Africa is faced with issues such as improving accessibility between ports and landlocked countries, and stable and prompt customs services.

Chapter 2 Analysis with GTAP-RD Model

In this chapter, multiple future scenarios were assembled, and a future analysis of the export/import volumes for each country/region/industrial sector in Africa with each scenario was conducted, with the objective of projecting the future volume of African imports and exports in light of uncertainties that are likely to affect the future, especially events that will hinder economic activity globally, such as the COVID-19 pandemic after 2020, and technological innovations that will result in a large shift of economic activities, including carbon neutrality.

2-1. Setting of Initial Conditions

The GTAP-RD model developed by the Global Trade Analysis Project at Purdue University which is used as the dynamic application general equilibrium model for simulation related to global trade and climate change was utilized for future analysis, and the GTAP Database version 10 (2014 data, hereinafter GTAP10) configured by the Global Trade Analysis Project at Purdue University was used.

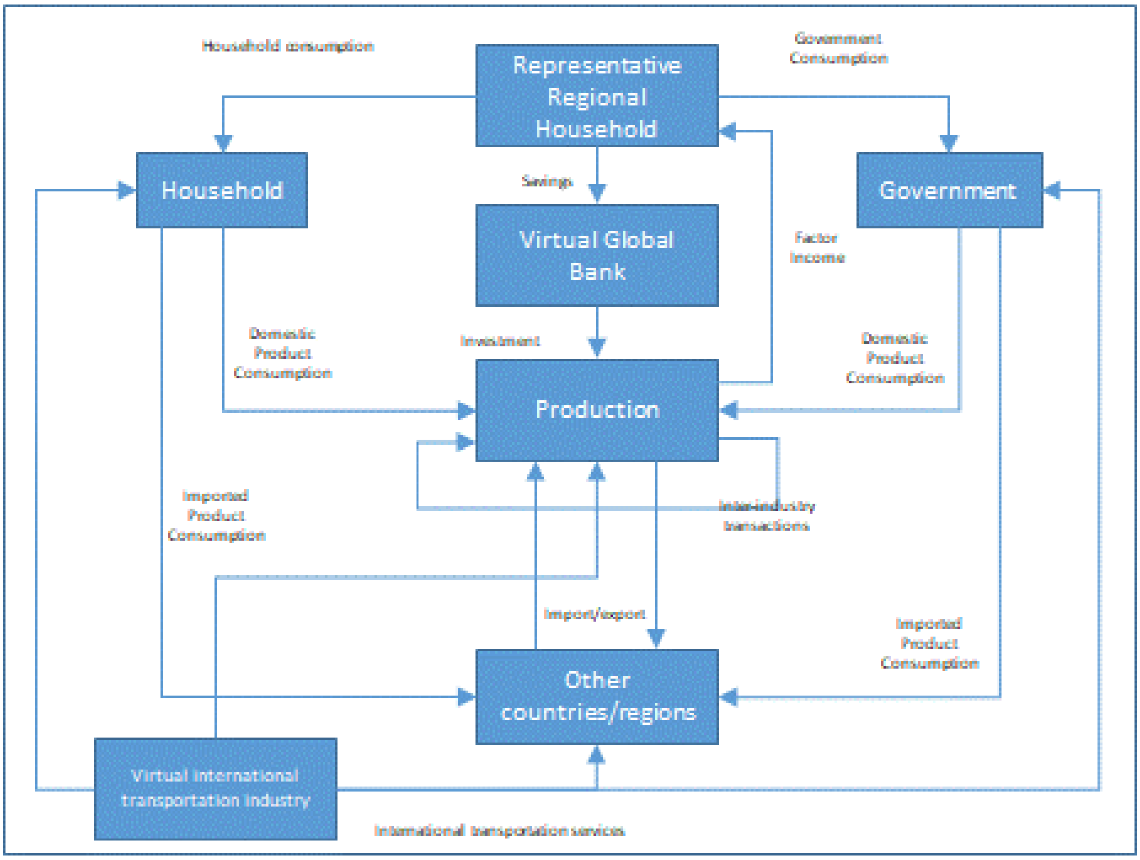


Fig. 2.1 Overview of GTAP-RD Model

In order to conduct a detailed analysis of the impact of Africa on the GTAP-RD model, Africa was classified as 30 countries/regions, which is close to the initial setting of GTAP 10, and the rest of the world was classified into 13 countries/regions (all 141 countries/regions in GTAP 10 were classified into 43 countries/regions). The 43 countries/regions were classified into "high-income (High income)," "middle income (Middle income)," and "low-income (Low income)" based on gross per capita income, and changes in parameter values according to income level were introduced in the future analysis.

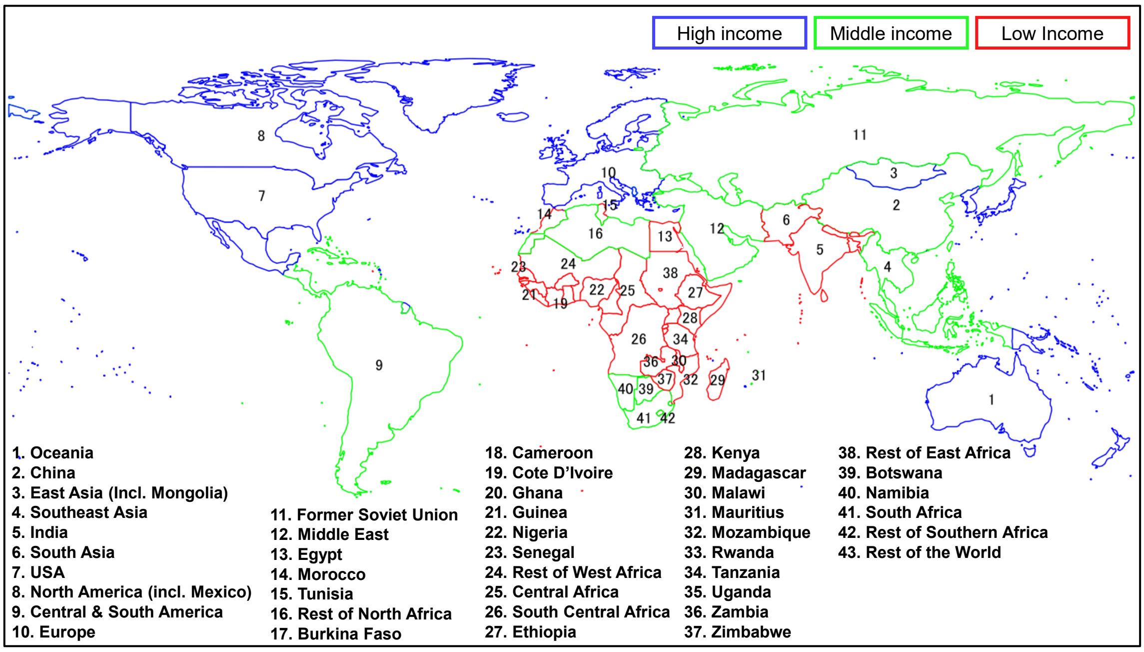


Fig. 2.2 Country/Region Classifications

Since this work utilizes the results of analysis related to the African economy and society and the analysis using the global logistics intermodal network simulation (GLINS) model mentioned later, the cereals sector, which is the main food self-sufficiency sector, and the high-GHG emitting industries sector, which is subject to the carbon border tax, were set as industrial segments in the GTAP-RD model, and the sectors subject to container cargo transport and bulk transport were set separately. As a result, a total of 65 industrial sectors were consolidated into 14 industrial segments (9 sectors are non-service sectors).

Table 2.1 Industrial Sectors/Goods Classification Setting

Setting in this study			GTAP 10 original classification		
No	Code	Classification	No	Code	Classification
1	Cer	Cereals	1	pdr	Paddy rice
			2	wht	Wheat
			3	gro	Cereal grains nec
			5	osd	Oil seeds
2	Oea	Other edible agri products	4	v_f	Vegetables, fruit, nuts
			6	c_b	Sugar cane, sugar beet
			8	ocr	Crops nec
			9	ctl	Bovine cattle, sheep and goats, horses
			10	oap	Animal products nec
			11	rmk	Raw milk
3	Opi	Other primary industries	7	pfb	Plant-based fibers
			12	wol	Wool, silk-worm cocoons
			13	frs	Forestry
			14	fsh	Fishing
4	Dbp	Dry bulk products (Coal, Minerals)	15	coa	Coal
			18	oxt	Other Extraction
5	Lbp	Liquid bulk products (Oil, Natural gas)	16	oil	Oil
			17	gas	Gas
6	Foo	Food industries	19	cmt	Bovine meat products
			20	omt	Meat products nec
			21	vol	Vegetable oils and fats
			22	mil	Dairy products
			23	pcr	Processed rice
			24	sgr	Sugar
			25	ofd	Food products nec
			26	b_t	Beverages and tobacco products
7	Lig	Light industries	27	tex	Textiles
			28	wap	Wearing apparel
			29	lea	Leather products
			30	lum	Wood products
8	Bas	Basic industrial material products	31	ppp	Paper products, publishing
			32	p_c	Petroleum, coal products
			34	bph	Basic pharmaceutical products
			35	rpp	Rubber and plastic products
			39	fmp	Metal products

Setting in this study			GTAP 10 original classification		
No	Code	Classification	No	Code	Classification
9	Ghg	High GHG emission industries	33	chm	Chemical products
			36	nmm	Mineral products nec
			37	i_s	Ferrous metals
			38	nfm	Metals nec
			46	ely	Electricity
10	Pro	Processing and assembling industries	40	ele	Computer,electronic and optical products
			41	eeq	Electrical equipment
			42	ome	Machinery and equipment nec
			44	otn	Transport equipment nec
			45	omf	Manufactures nec
11	Mvh	Motor vehicles and parts industries	43	mvh	Motor vehicles and parts
12	Tra	Transport services	52	otp	Transport nec
			53	wtp	Water transport
			54	atp	Air transport
13	Cts	Cutting-edge technological services	56	cmn	Communication
			57	ofi	Financial services nec
			58	ins	Insurance (formerly isr)
			59	rsa	Real estate activities
			60	obs	Business services nec
14	Oth	Other Services	47	gdt	Gas manufacture, distribution
			48	wtr	Water
			49	cns	Construction
			50	trd	Trade
			51	afs	Accommodation, Food and service activities
			55	whs	Warehousing and support activities
			61	ros	Recreational and other services
			62	osg	Public Administration and defense
			63	edu	Education
			64	hht	Human health and social work activities
			65	dwe	Dwellings

2-2. Formulation of Future Scenarios

The impact of the COVID-19 pandemic, regional conflicts, climate change and other events that cross borders on economies and societies will change dramatically depending upon the extent of the maintenance and strengthening of global collaborative networks in order to reduce and eliminate this impact.

In this study, 12 “common axes” which may have an impact on the mid to long-term growth of Africa were set, and it was deemed that we are in the midst of a process which will determine whether the quality of the response to COVID-19 based on the prospects at this point in time will result in a “Desirable future” with sustainable economic growth due to the benefits of “opportunities” on the common axes, or an “Undesirable future” in which regional disparities that inhibit economic growth will expand as a result of “risks”.

In the end, three scenarios were created; “S1 scenario” which assumes a “Desirable future” in which the world cooperatively tackles the COVID-19 pandemic and the international community becomes stable and harmonious on all common axes, “S2 scenario” which assumes an “Undesirable future” in which risks become apparent in response to the COVID-19 pandemic, regional disparities widen, and international cooperation is lost on all common axes, and the “BAU scenario” which is a middle-of-the-road scenario positioned between the S1 scenario and S2 scenario, in which the opportunities and risks created by the COVID-19 response are mixed.

Table 2.2 Corresponding Relationship between the Common Axes of Each Scenario and the SDGs

Common axis	S1 scenario: Stable/harmonious international/domestic society	BAU scenario: International/domestic society with latent opportunities/risks	S2 scenario International/domestic society where risks are realized
1 Technological innovation (SDG No.4 and 7)	Technological innovation progresses in all kinds of industries in developed countries/developing countries	Technological innovation progresses mainly in developed countries. In developing countries, technological innovation progresses only in some industries, such as services industries and agriculture.	Technological innovation progresses mainly in developed countries. Technological innovation in developing countries stagnates due to unstable social environment, etc.
2. Access to cutting-edge technology (SDG No. 4, 7, 8, 9, 13, 14, 15, 16)	International rules relating to IP are enhanced to facilitate access to cutting-edge technology in developed countries and developing countries.	Cutting-edge technology is accessible mainly to developed countries and coastal developing countries (difficulties for landlocked countries).	Developing countries are unable to use the cutting-edge technology of developed countries because of the lack of international IP rules, the risk of military appropriation, and insufficient infrastructure, etc.

Common axis	S1 scenario: Stable/harmonious international/domestic society	BAU scenario: International/domestic society with latent opportunities/risks	S2 scenario International/domestic society where risks are realized
3. Balanced industry policy and free trade policy (SDG No.1, 8, 9)	Policies that balance domestic industry development and free trade are achieved in both developed and developing countries.	Policies give excess weighting to free trade and domestic industry development is limited to certain industries.	Protectionist policy becomes the main policy, and free trade is curtailed. Domestic industry protectionist policy inhibits production efficiency.
4. Access to financial assistance (SDG No.1, 2, 8, 11)	Appropriate assistance with consideration for financial discipline is provided mainly by countries and IMF. Regional development banks and ESG funds provide support to the private sector in a way that promotes sustainability.	While assistance is received from countries/IMF, there is a risk of a slump depending if the target country becomes insolvent and depending on the economic situation of the donor country, etc.	Developing countries, primarily, become insolvent, and financial support cannot be received due to support for terrorism, human rights violations and political corruption, etc.
5. Elimination of disparities in access to vaccines, medicine and social welfare (SDG No.1, 3, 6, 10)	When infectious diseases like COVID-19 suddenly break out, vaccines, masks and other medical resources are provided worldwide primarily by WHO.	Vaccines, masks and other medical resources are provided worldwide, but it is also used as a means of diplomacy, and there are certain limitations from within international governance.	Due to a lack of cooperation, information about the outbreak of infectious diseases is not shared, and pandemics occur. While medical resources are provided through humanitarian assistance, time is needed due to political corruption and conflicts.
6. Education that promotes innovation, and long-term perspective and altruistic education (SDG No.4, 5, 10, 12, 17)	With the expansion of higher education opportunities and the reduction in disparities, education that promotes technological innovation, long-term perspectives and altruistic activities becomes more widespread.	The disparity between developed countries and developing countries with regard to higher education continues unabated.	Due to social instability, education does not become more widespread, which means that there is no escape from the vicious circle wherein no progress is made in industry development or the elimination of poverty.
7. Energy (Green Energy, Blue Energy) (SDG No.7, 13)	Not only is the use of renewable energy promoted but also existing energy sources derived from fossil fuels become carbon neutral, so that energy becomes more abundant globally, including in traditionally resource-rich countries.	The promotion of renewable energy does not keep pace with the use of existing energy sources derived from fossil fuels, and the efficient use of energy resources is partially lacking.	While there is progress in developed countries, state-managed resource companies in developing countries continue to be inefficient, and existing energy sources derived from fossil fuels and charcoal continue to be used.

Common axis	S1 scenario: Stable/harmonious international/domestic society	BAU scenario: International/domestic society with latent opportunities/risks	S2 scenario International/domestic society where risks are realized
8. Natural resource management (SDG No.6, 12, 13, 14, 15)	The international joint management of underground resources, forests and marine resources, etc., progresses, and usage becomes optimized and sustainable.	International joint management frameworks are maintained, but some countries take the lead, and there continues to be some injustice.	Developing countries oppose international joint management led by developed countries and international rules are not observed.
9. Climate change (SDG No.13)	Cost-efficient and fair measures are taken in international cooperation at an almost marginal cost. Appropriate countermeasures against disasters caused by climate change are also taken based on international cooperation.	Measures continue to be partially inefficient due to actions taken by US, compulsory reductions in China and India, and risks from the development of reduction/adaptation technologies.	Frameworks covering both developed countries/developing countries are not established, and developed countries mainly take inefficient measures on their own. The scale is small, and the cost of cutting-edge technology is not reduced.
10. Stable supply of labor (SDG No.5, 8, 10, 11)	Women and minority ethnic groups make progress in terms of social advancement and improved status, and labor productivity is improved.	Although women in developed countries make progress in terms of social advancement and improved status, in some developing countries, they are held back for religious reasons, etc., and there continues to be an excess supply of labor in rural areas.	In addition to women and minority ethnic groups, there is a reduction in the scale and quality of labor supply due to migration between urban and rural areas and low levels of education.
11 Infrastructure development (SDG No. 9, 16)	Based on financial assistance from the international community, infrastructure investment is promoted. However, inefficient infrastructure investment and investment that goes against financial discipline is rejected.	Infrastructure investment is promoted but there is the risk of a reduction on the investment-side in the case of an economic crisis, etc.	Due to unstable social conditions and poor governance, infrastructure projects are not financed, and new and maintenance projects are not sufficient.
12. Start-ups (SDG No. 8, 9)	With the assistance of private companies and improved access to cutting-edge technology, start-ups in each country are founded and their activities are promoted, becoming a means of eliminating excess labor in rural areas.	Due to differences in access to cutting-edge technology, business is promoted in developed countries and start-ups from developed countries are active in developing country markets.	Start-ups flourish in developed countries but there are hurdles to advancement in other countries. Business development in developing countries makes no progress.

Based on the three future scenarios that were prepared, “shocks” to the parameters for the GTAP-RD model were set.

The shocks applied to achieve the status as of 2040 assumed in each future scenario were set for “high income countries/regions”, “middle income countries/regions” and “low-income countries/ regions”, and the difference in the impact on each income level was expressed. In other words, in the S1 scenario which assumes that regional disparities will decrease, there are no differences depending on the income levels, so the impact of shocks is the same for all income levels, while for the BAU scenario and S2 scenario a lower shock value was set for low-income countries/regions / middle income countries/regions to which many countries in Africa belong than for high income countries/regions, expressing the difference in the economic environment.

Table 2.3 GTAP Model Settings Policy and Key Points

Common axis	GTAP Model settings policy and key point
1. Technological innovation (SGDs 4, 7)	Technological innovation parameter *afeall* settings Cutting-edge technological services technological innovation parameters *afeall* settings (technological innovation is assumed to be at a higher rate than other industries)
2. Access to cutting-edge technology (SDGs 4, 7, 8, 9, 13, 14, 15, 16)	
3. Balanced industry policy and free trade policy (SDGs 1, 8, 9)	Customs *tms* reduction/abolition Technological innovation parameter *afeall* settings
4. Access to financial assistance (SDGs 1, 2, 8, 11)	Cutting-edge technological services technological innovation parameter *afeall* settings (technological innovation is assumed to be at a higher rate than other industries)
5. Elimination of disparities in access to vaccines, medical care, and social welfare (SDGs 1, 3, 6, 10)	Population growth rate *pop* settings (Population increase curve assumed in SSP1-3 are maintained in each scenario) SSP1: Sustainable=S1, SSP2: Middle of the road=BAU, SSP3: Regional divisions/disparity=S2
6. Education that promotes innovation, and education from a long-term/altruistic viewpoint (SDGs.4, 5, 10, 12, 17)	Labor endowment (skilled) *SkLab* settings (labor endowment increase curve assumed in SSP1-3) are maintained in each scenario and adjusted for rate of growth by incorporating the rate of enrollment in higher education) SSP1: Sustainable=S1, SSP2: Middle of the road=BAU, SSP3: Regional divisions/disparity=S2
7. Energy (Green Energy, Blue Energy) (SDGs.7, 13)	Technological innovation parameters for cereals production industry *Afeall* settings (Use of World Bank yield forecast) Real GDP growth rate per capita parameter *Gcp*, Population growth rate parameter *Pop*, Labor endowment parameter (*SkLab, UskLab*) settings (growth rate curves
8. Natural resource management (SDGs 6, 12, 13, 14, 15)	

Common axis	GTAP Model settings policy and key point
9. Climate change (SDG 13)	based on climate change measures assumed in SSP1-3 are maintained in each scenario) SSP1: Sustainable=S1, SSP2: Middle of the road=BAU, SSP3: Regional divisions/disparity=S2 Introduction of carbon border tax (Carbon border tax of 5% is added to the tax *tms* when high income countries import GHG high-emission products from low- and middle-income countries)
10. Stable supply of labor (SDGs 5, 8, 10, 11)	Labor endowment (unskilled) *UskLab* settings (labor endowment increase curve assumed in SSP1-3 are maintained in each scenario and adjusted for rate of growth by incorporating the rate of enrollment in secondary education) SSP1: Sustainable=S1, SSP2: Middle of the road=BAU, SSP3: Regional divisions/disparity=S2
11. Infrastructure development (SDGs 9, 16)	Transportation technological innovation parameter settings (Not set in the first term; GLINS Model output is set as technological innovation parameter *Ams* relating to international transactions, with calculations implemented in second term)
12. Start-ups (SDGs 8, 9)	Communications and finance sector technological innovation parameter *Afeall* settings (technological innovation is assumed to be at a higher rate than other industries)

2-3. Estimation of Future Trade Amounts

Sequential dynamic simulation from 2014 to 2040 was performed with the GTAP-RD model, and future trade amounts were estimated for each of 43 countries/regions and each of 14 industrial segments (including 9 non-service industrial sectors). Furthermore, price fluctuations in 2014 and after having been excluded from the estimated future trade amounts. Therefore, strictly speaking, the absolute values are “Trade amounts evaluated with 2014 prices”, and the change can be interpreted as the “Change in trade volume”.

The estimated future trade amounts include the total of normal “International trade with entire world” for all transactions with other countries/regions. In addition, in this study, there was a focus on African countries/regions, with a comparative analysis performed by separating “Extra-African trade” (Trade amounts between countries/regions within Africa and countries/regions outside of Africa) and “Intra-African trade” (Trade amounts between countries/regions within Africa). Furthermore, the sector self-sufficiency of cereals and other edible agri products were estimated in order to verify the extent of the impact that the uncertainty caused by COVID-19 and other events has on food self-sufficiency.

2-4. International Trade with Entire World

Estimated values for the export/import amounts for the total of 9 non-service sectors and balance of exports/imports for each scenario are shown below as representative results. Furthermore, refer to Chapter 2 and the attached reference materials for the estimates for each country/region/industrial sector.

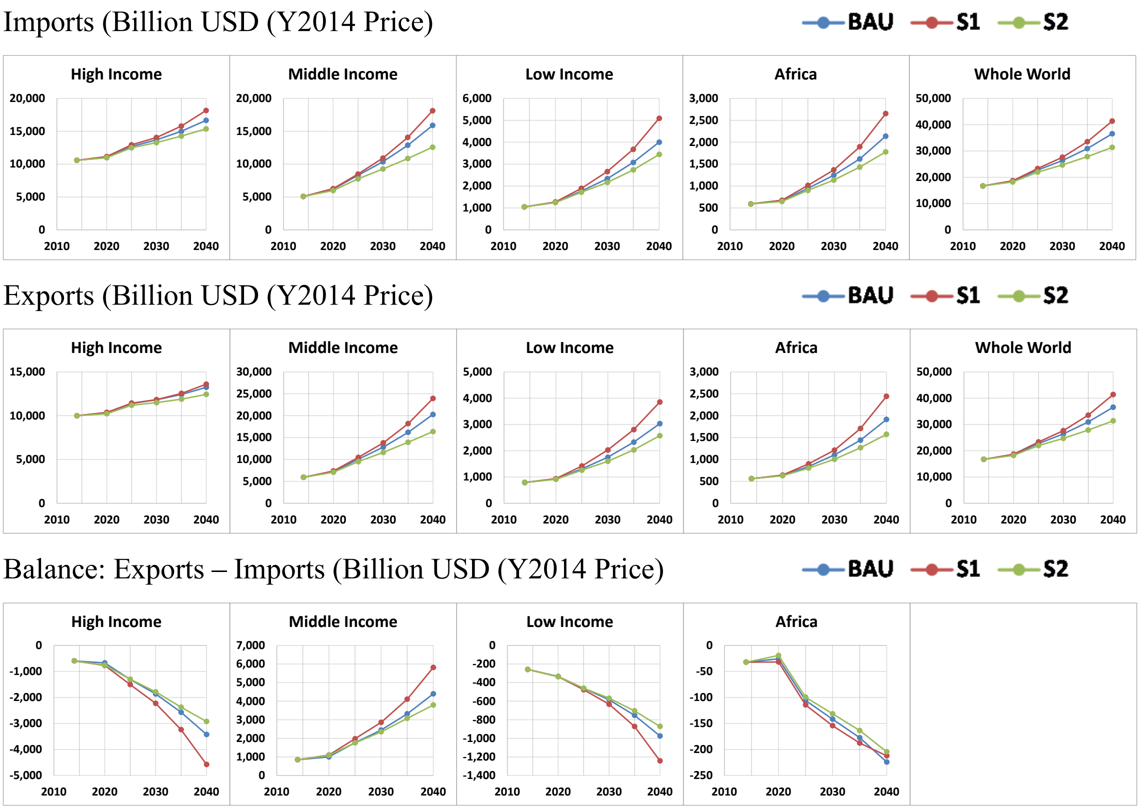


Fig. 2.3 International Trade with the Whole World: All Sectors (Non-Service)

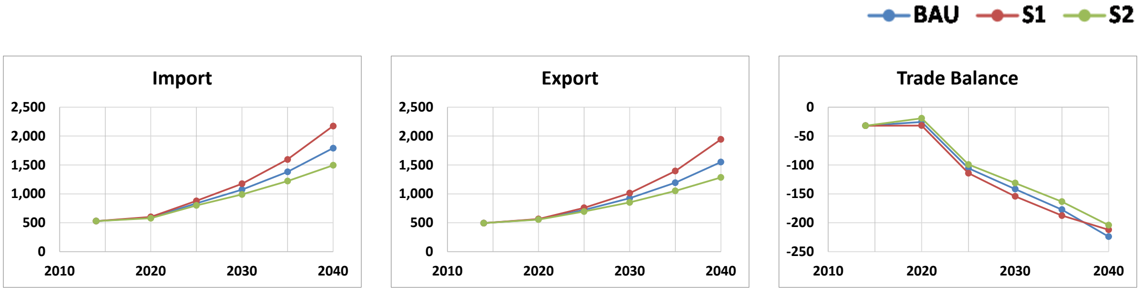
Exports/imports from/to countries/regions in Africa will substantially increase during the period toward 2040 for all industries. In particular, there will be high growth in imports of consumable goods due to the population growth rate, as well as high growth of exports in the natural resource sector due to the high demand in regions outside of Africa. The trade balance results differ depending upon the industry, but, overall, Africa's trade deficit is commonly persisted in all scenarios.

In Africa as a whole, there has been an excess of imports (trade deficit) since 2014 for all sectors other than other edible agri products (vegetables, livestock, etc.) and natural resources, and these amounts will tend to increase until 2040. If the status of covering the import and consumption of consumable goods with the increase in income brought about by resource exports continues, there is the concern it will result in "Dutch disease", where the high price of the local currency caused by the increase in resource exports inhibits the development of high value-added industry in Africa, lowering its competitive edge. In order to prevent this from happening, export industry needs to be created in Africa, and measures strengthened to alleviate currency turmoil due to an increased trade deficit.

(1) International Trade with Non-African Trading Partners (Extra-African Trade)

The estimated values for the export/import amounts for the total of 9 non-service sectors and balance of exports/imports for each scenario are shown below as representative results. Furthermore, refer to Chapter 2 and the attached reference materials for the estimates for each country/region/industrial sector.

Unit: Billion USD (Y2014 Price)



Imports Exports Trade Balance

Fig. 2.4 International Trade between Africa and Non-Africa: All Sectors (Non-Service)

The trends for trade between African countries/regions and non-African countries/regions (i.e. when trade within Africa is excluded) will not dramatically change on the whole since most of the trading partner countries for African countries/regions are non-African countries/regions.

When individual countries/regions are examined, there are some different trends than for Africa as a whole, but almost all countries/regions in common depend on resource exports and industrial product imports, and from the perspective of scale, it would most likely be difficult to change this status with the promotion of trade within Africa alone. Therefore, although the importance of initiatives like AfCFTA cannot be doubted, this indicates that further support is needed in order to facilitate the development of infrastructure and high value-added industry.

(2) International Trade Within Africa (Intra-African Trade)

The estimated values for the export/import amounts for the total of 9 non-service sectors and balance of exports/imports for each scenario are shown below as representative results. Furthermore, refer to Chapter 2 and the attached reference materials for the estimates for each country/region/industrial sector.

Unit: Million USD (Y2014 Price)

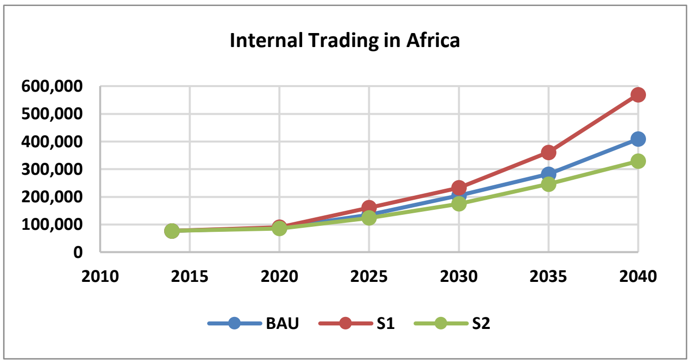


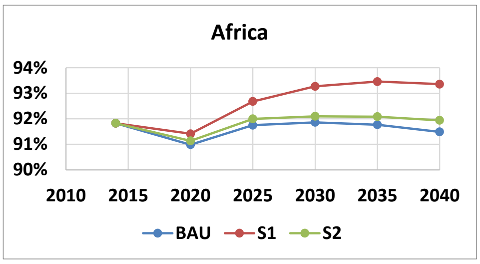
Fig. 2.5 Intra-African Trade: All Sectors (Non-Service), Africa (Exports = Imports)

Although the ratio of trade within Africa is small out of all trade, in the S1 scenario, the scale of trade is expanding dramatically more than for other scenarios in all African countries/regions. This indicates the large impact that AfCFTA has on this region. In addition, in the S1 scenario, imports in many countries/regions are expanding in the same manner as for exports, which can be interpreted as an expansion of imports through the increase in consumption brought about by the higher income from a large volume of exports.

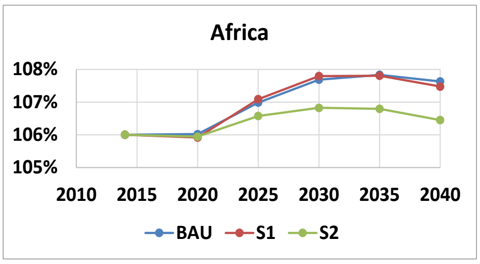
However, when the impact of each industrial sector is considered, it is an indication at the same time that the benefits of increased exports are received to a larger extent by a portion of countries, requiring that additional suitable industrial policies be executed. For example, in the Motor vehicle and parts sector in Zimbabwe, the amount of increase with the S1 scenario is small, and grows the most with the S2 scenario, and there is the same trend for the processing and assembling industries in Botswana, Guinea and Ghana. Accordingly, in the transition period after AfCFTA is achieved, support should be considered for industries that will not benefit under the S1 scenario.

2-5. Food Self-Sufficiency

The changes in the food self-sufficiency rate (cereals, other edible agri product sectors) in African countries/regions for each scenario until 2040 as a result of future projections with the GTAP-RD model for this study are shown below.



Cereals



Other Edible Agri Product Sector

Fig. 2.6 Food Self-Sufficiency Rate (Africa, in Monetary Terms)

Self-sufficiency in the Cereals in Africa as a whole dropped temporarily in 2020 from the level of about 92% in 2014 due to the impact of COVID-19, but with the S1 scenario, it recovers after that, reaching about 94% as of 2040. On the other hand, although self-sufficiency will recover a certain extent between 2020 and 2030, it will decrease again after peaking in 2030, going below the 2014 level.

In other edible agri products sector, self-sufficiency will remain at the same level in Africa as a whole until 2020 but will rapidly increase between 2030 and 2035 for all other scenarios. After that, there will be a slight decreasing trend until 2040, but self-sufficiency will be maintained at 100% or more.

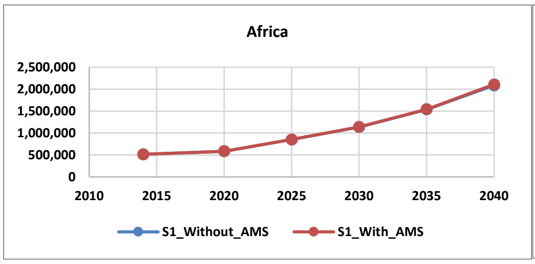
The backdrop for the S1 scenario values being the highest consists of the highest level of domestic production value with the S1 scenario, and a substantial decrease in dependence on imports. The direct cause of this is considered to be the ability to satisfy the high increase in demand with the higher level of domestic supply by means of the technological rate of progress *Afeall* for which a particularly high value was set for the Cereals to cover the increase in the demand due to the high economic growth rate in the S1 scenario. In other words, dependence on imports increases by simply stimulating economic growth, and since this results in a larger possibility that food self-sufficiency will deteriorate, it indicates that efforts to improve productivity in the domestic agricultural sector are important.

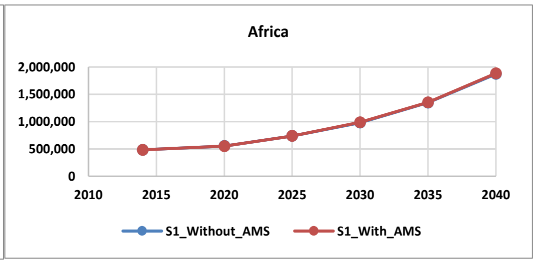
2-6. Feedback Calculation of Future Analysis Results with GLINS Model

The results of future analysis (effects of reducing transportation costs) with the Global Logistics Intermodal Network Simulation (GLINS) Model in the next chapter were set (fed back) to the Global Transportation Technological Progress Parameter *Ams* in the GTAP-RD model, estimation was performed again, and the change in the consequence was analyzed. Furthermore, comparative analysis was performed with the S1 scenario which was the premise for future analysis using GLINS Model. In addition, since the transportation cost reduction effect is related to only container cargo transport, the dry bulk product sector (coal, minerals) and liquid bulk product sector (petroleum, natural gas) are not subject to the analysis.

The total export/import amounts for 7 sectors in Africa as a whole (container transport target sectors) are shown below as representative estimation results, divided into the amounts of export/import between African and non-African countries/regions, and amounts of export/import between countries/regions within Africa. Refer to chapter 2 and the attached reference materials for the estimated values for each country/region/industrial sector.

Unit: Million USD (Y2014 Price)





Imports Exports

Fig. 2.7 Imports /Exports with Non-African Countries and Regions
(All Container Transport Sectors, Africa)

Unit: Million USD (Y2014 Price)

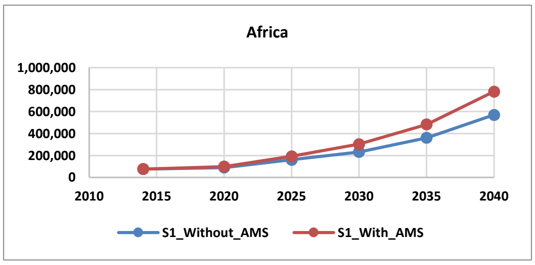


Fig. 2.8 Imports /Exports with African Countries and Regions (All Container Transport Sectors)
(Imports = Exports for total Africa)

There was not a large change in Africa as a whole in exports between countries/regions within Africa and countries/regions outside of Africa depending on whether or not there was an *Ams* setting (With/ Without). This general trend is the same for many individual countries/regions, but for the With case indicated by a small number of countries/regions shown in red such as Guinea and Ethiopia, there are more imports for the with case than the Without case, and conversely, for countries such as Ghana and Zimbabwe, there are less imports for the With case than the Without case. In addition, for exports, there were many countries for which the level of exports was higher for the with case in the same manner as for imports, and a small number of countries/regions that the level was higher for the Without case.

On the other hand, regarding trade within Africa, it was clear that the scale of imports/exports was higher for the *Ams* setting with case than for the Without case, and even when individual countries/ regions were examined, it was found that exports/imports expanded further for the with case in many countries. In particular, it was found that the with case resulted in nearly twice the level of the Without case as of 2040 in Ghana, Nigeria, Guinea, Burkina Faso, Rwanda and other such countries.

These results indicate that development of the inland transport network is effective in intensifying trade within Africa, and that the skewing of export/import prices represents a large impediment in general for current trade within Africa. Other than transportation costs, non-tariff barriers such as time required for cross-border customs clearance, tariff rates, and import/export restrictions can be raised. The inland transport network needs to be developed, and improvements to all elements that inhibit trade within the region are required.

Chapter 3 Analysis Using Global Logistics Intermodal Network Simulation Model

In this chapter, the Global Logistics Intermodal Network Simulation Model (GLINS Model) being developed by Associate Professor Shibasaki of the University of Tokyo and others in order to obtain an indication of the issues and strategy for infrastructure development in Africa has been applied to the African continent as a whole to conduct an analysis of the reproducibility of the current status and future prospects of cargo transport on the actual ocean/land transport network in this region.

3-1. Setting of Initial Conditions

A total of 249 ports were designated as the target ports for this model, consisting of the major container ports around the world with an annual volume of at least 500,000 TEU, with ports in Africa and the surrounding waters added.

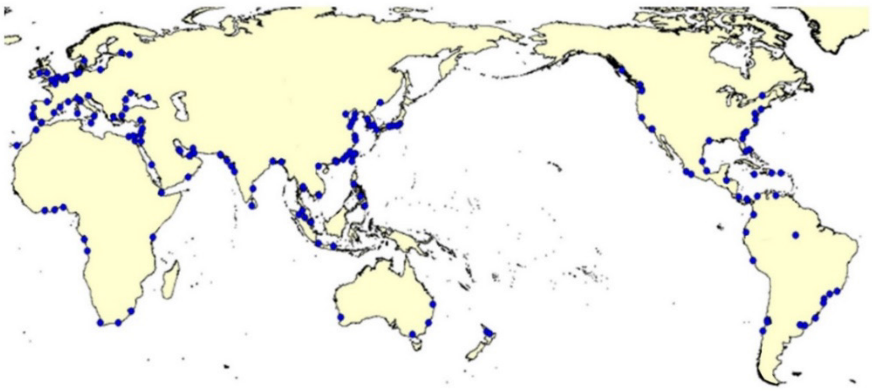


Fig. 3.1 Ports Set in International Ocean Container Transport Model

The land transport network on the African continent is shown below. The ADC World Map was used for the road and railway networks and link distances, and the road network / railway network shown below were incorporated into the model.

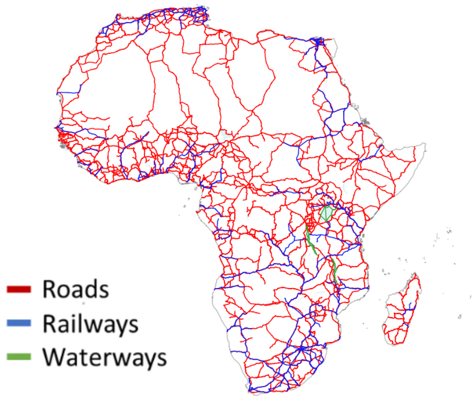


Fig. 3.2 Setting of Land Transport Network for Logistics Model

3-2. Calculation of Current Status Reproduction Model

(1) Setting of Parameters

The parameters set for calculation with this model are principally based on the results of research by Shibasaki et al. On the other hand, the speed and capacity of roads and railways, charges and loading/unloading time for land transport, and cross-border costs and time were set separately.

(2) Reproducibility of Current Status of the Model

Regarding the final calculation results for the overall model, as the first step, comparison with the actual value was performed for the export/import container cargo handling volume at each port on the African continent (Transshipment cargo, empty containers excluded), which is the convergence decision reference value.

In order to confirm the reproducibility, the actual values (port statistics) and model estimation values were compared for the hinterland cargo handling volumes. Since the ability to obtain port statistics in Africa is generally limited, a comparison was performed based on the hinterland area handling share for Port Mombasa in Kenya (2015 statistics) and Port Abidjan in Côte d'Ivoire (2018 statistics). Since statistics are based on weight, a simple comparison cannot be performed, but a large portion of the cargo in Port Mombasa arrives in or departs from Uganda, with a low ratio of the cargo coming from/going to Tanzania (Tanzania uses its own port), and it can be confirmed that this was reproduced in the model.

3-3. Estimation of OD Cargo Volume

In this section, the OD cargo volume for container cargo, bulk cargo (crude oil, LNG, iron ore, coal) and RORO cargo (completed motor vehicles) are estimated. The container OD cargo volume estimation results are shown below. Global container cargo volume is expected to increase to about 3 times the 2016 level in 2040. In addition, exports/imports from/to each region in Africa are also expected to grow at a high rate, increasing by approximately three times or more.

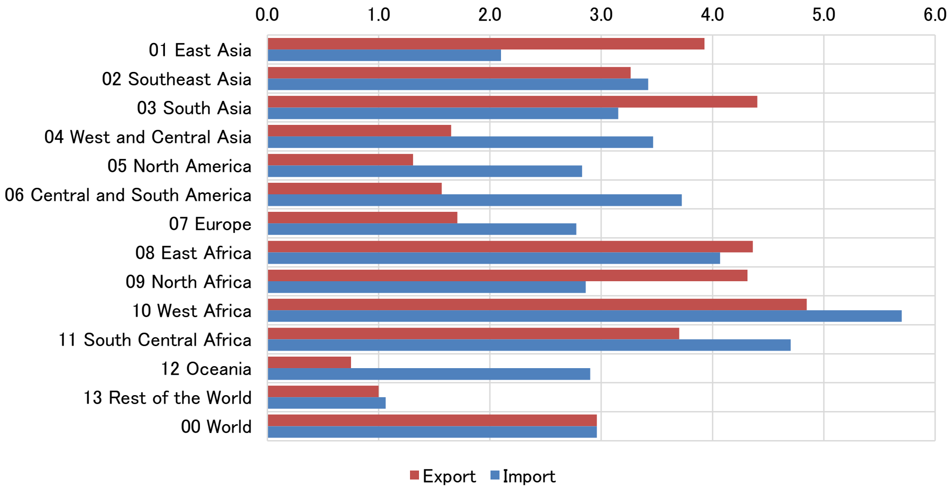


Fig. 3.3 Growth in OD Cargo Volume from 2016 to 2040 (Container Cargo)

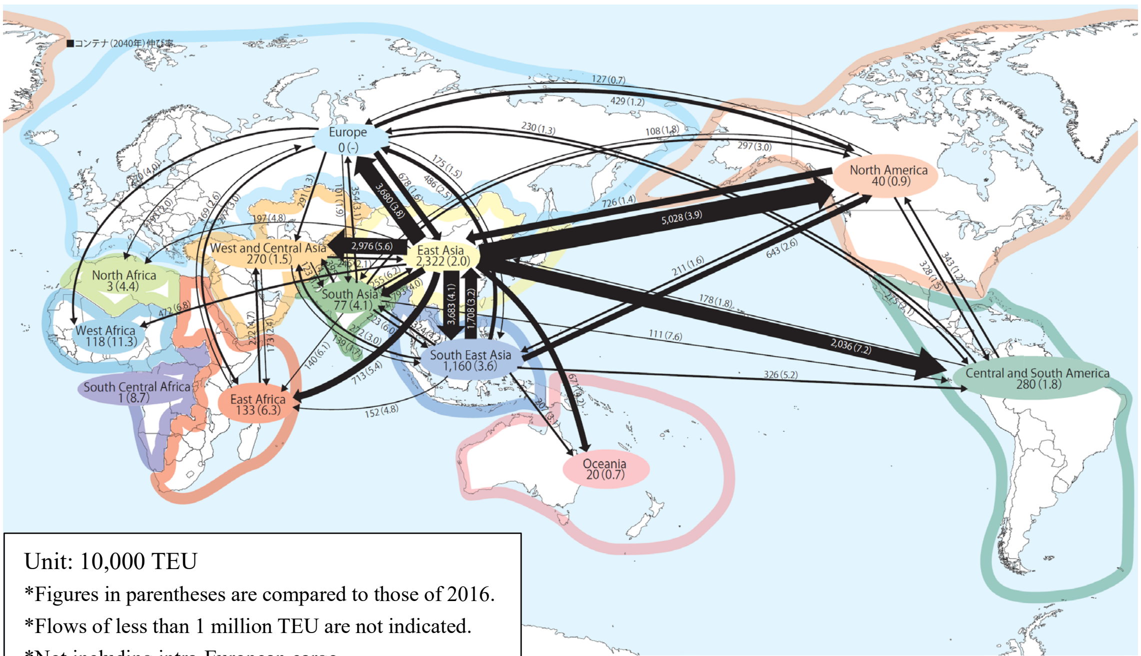


Fig. 3.4 Cargo Flow Diagram (Container Cargo)

3-4. Policy Analysis Using Future Model

(1) Evaluation of the Impact and Effectiveness of Ports Connected to Economic Corridors

In order to evaluate the impact and effectiveness of ports which function as economic corridor gateways, the hinterland regions were analyzed for 29 main ports which connect to economic corridors. The selectivity of the 29 ports in each region, namely the share for the hinterland of 29 ports, is shown in the diagram below. The selectivity of the 29 ports is higher the darker the red color for the region, with lighter shades (closer to white) indicating that the selectivity for 34 ports other than the 29 ports is higher for that region.

When the cargo handling volume at the ports is analyzed, it was clarified that these 29 ports handled 82.3% of the container cargo departing from and arriving on the African continent.

In addition, when the selectivity per region is multiplied by the population distribution per region, it was roughly estimated that 78.1% of the entire population on the African continent lived in regions covered by the 29 ports.

These estimation results indicate that these ports have a wide-ranging impact as the gateways for the economic corridors and are highly significant for the people on the African continent and their daily lives.

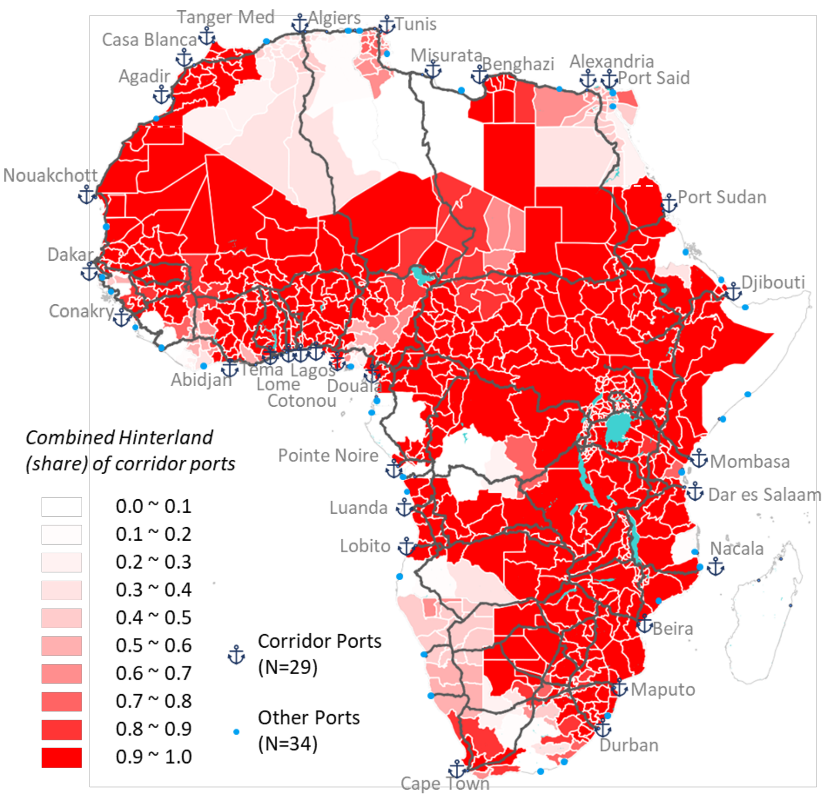


Fig. 3.5 Model Estimation Results for Impact Range of Main Ports in Africa

(2) Features of Current Transport Costs

The extra-African and intra-African trade costs in the small regions in each country in Africa were added up, and the variation in landlocked countries/coastal countries was analyzed by comparing the average cargo transportation cost unit price in each respective region. The diagram below indicates the standardized variate in the average cargo transportation cost unit price in each respective region (average for continent deducted from transportation cost in each region, divided by standardized variate for transportation cost in each region) for the current model estimation results.

The estimation results indicate that this trend is particularly conspicuous for landlocked countries. In countries such as South Sudan and Botswana which have a "high ratio of intra-African trade", there is a relative trend for "intra-regional transport costs" to be lower than the intra-regional average. On the other hand, in "countries which are geographically isolated" such as Ethiopia and Madagascar which is an island nation, there is a trend to have a high level of dependence on extra-African trade. Therefore, "intra-regional transport costs" tend to be relatively high compared to the intra-regional average.

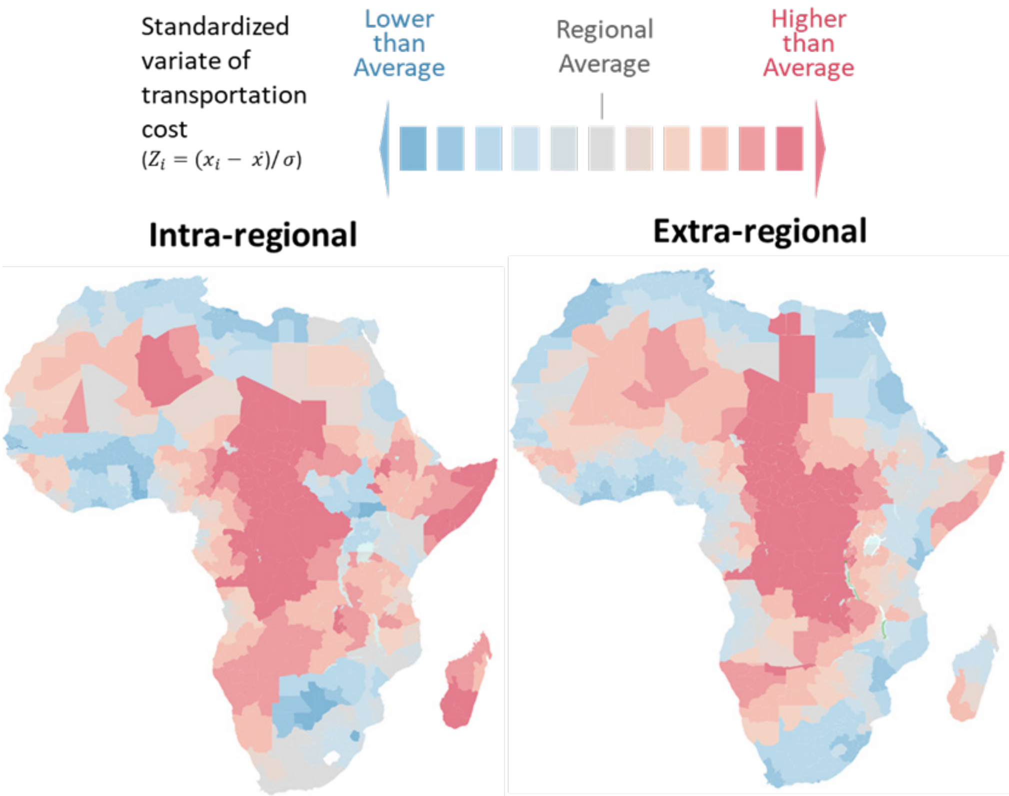


Fig. 3.6 Standardized Variate for Cargo Transport Cost for Intra-Regional / Extra-Regional Trade on African Continent

(3) Road and Railway Bottlenecks

When the cargo flow volume forecast in 2040 is overlaid onto the road status for each corridor as of 2009 organized by PIDA, it is expected that the current status of existing roads is good while there is a high flow of cargo and that no special problems will emerge for ports along the Mediterranean coast, and the close hinterland areas for the Port of Mombasa and Port of Dar es Salaam. On the other hand, the current status of roads for corridors towards areas that are further inland is either poor or unknown.

In addition, long-distance / large-volume transport can be performed with the railway infrastructure, and this consists of a means of transport with low carbon dioxide emissions compared to trucks, but it has been pointed out that the facilities on the whole have deteriorated, and huge investments in infrastructure are needed in order to utilize the transport and environmental potential of the railway networks.

These analysis results indicate that the appropriate development is important for roads and railways for which the condition is bad yet have a large cargo flow volume.

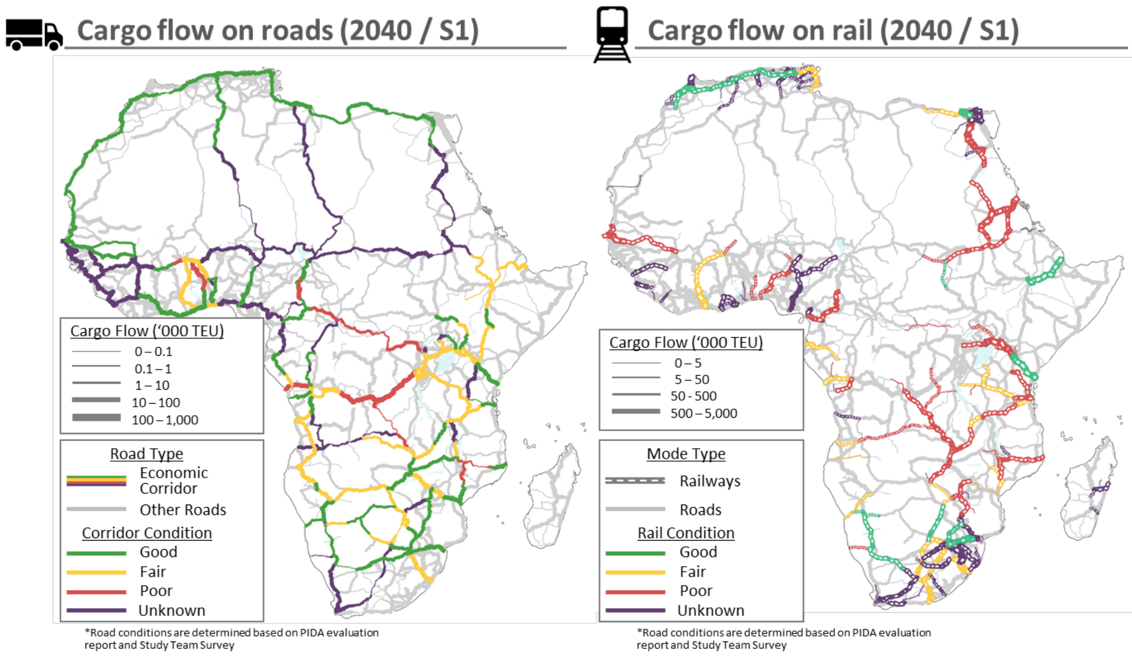


Fig. 3.7 Current Status of Road Network/Railway Network for Cargo Transport and Future Estimates of Cargo Flow

(4) Bottlenecks at Ports

The future cargo transport demand estimated using the model and future handling capacity based on the current handling capacity/future plans for the main ports in Africa were compared in order to check whether ports could become bottlenecks due to overflow of international ocean container cargo transport demand that will increase in the future.

The port cargo handling demand is expected to increase an average of 4.2 times in 2040 from 2016 with the S1 scenario. In particular, high growth is expected in Abidjan, Lagos and other ports in West Africa.

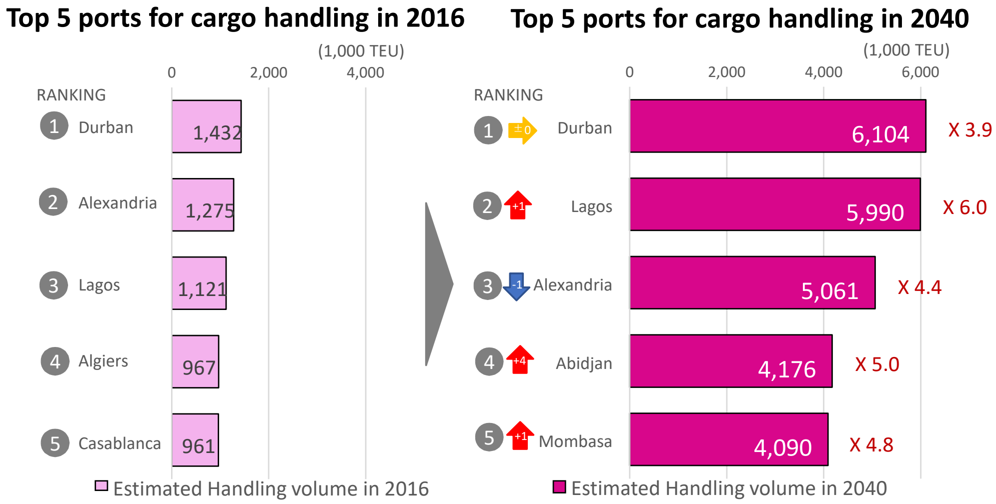


Fig. 3.8 Current Status of Top 5 Cargo Handling Demand Ports (2016) and Future Estimates (2040)

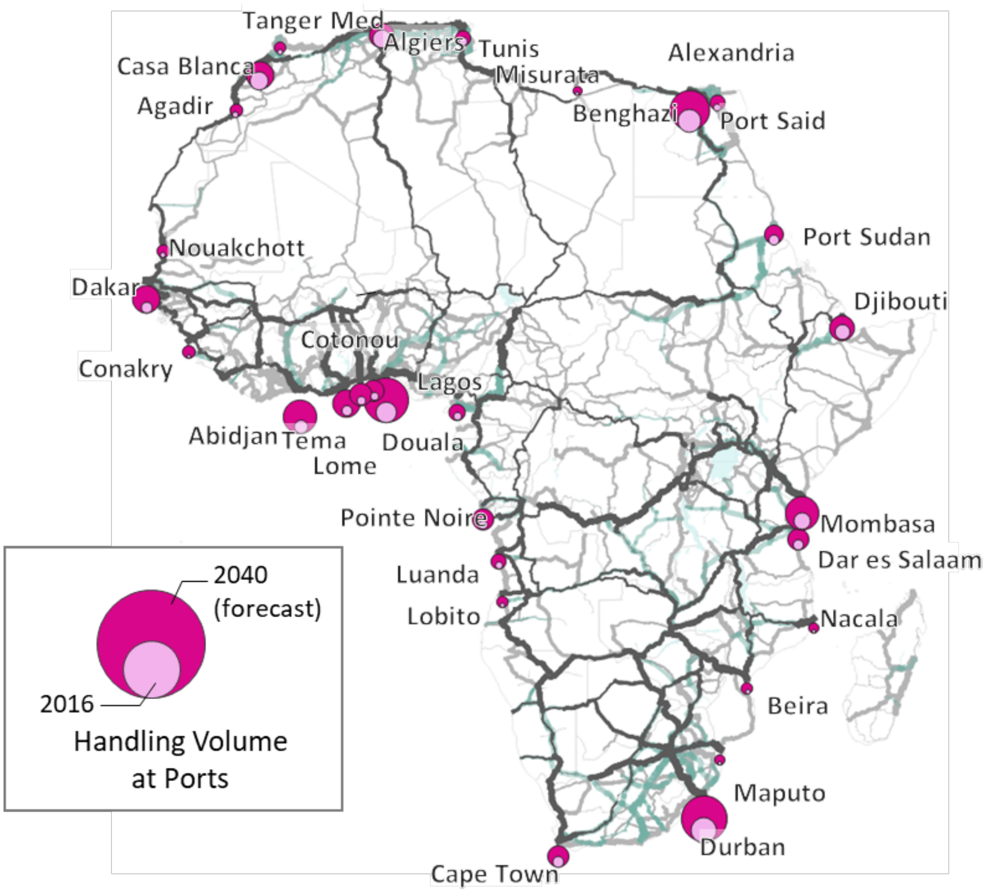


Fig. 3.9 Current (2016)/ Future Estimates (2040) for Cargo Handling Demand at Ports

(5) Contribution to Transportation Cost Reduction

It was clarified that economic corridor development and implementation of OSBP development is expected to decrease the average land transport unit price for Africa as a whole by 1.3% as of 2030 and by 5.4% as of 2040.

When the increase/decrease in landlocked countries which need to cross borders in order to use ports is compared with coastal countries that have ports, it was found that while the costs for coastal countries will decrease by 0.9% in 2030 and 4.4% in 2040, the transport costs in landlocked countries will decrease by 4.3% in 2030 and 13.8% in 2040.

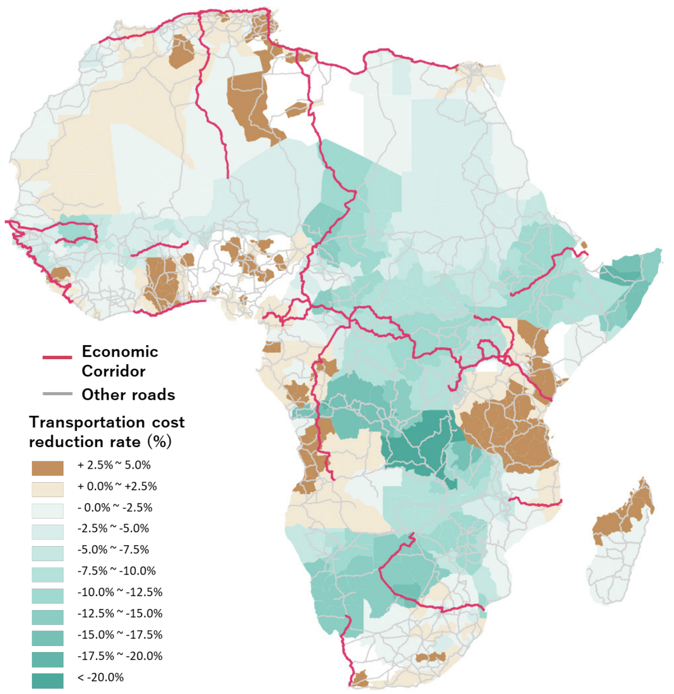
On the other hand, there will be a gap between planned transport capacity and future carto transport demand as of 2030 in some regions of coastal countries in particular, causing congestion due to concentration of cargo, indicating the possibility of an increase in the average land transport cost unit price.

Thus, if development of the economic corridors on the African continent as a whole proceeds as planned in PIDA-PAP2, it is expected that this will benefit a large number of people. In addition, projections indicate these benefits will be larger for landlocked countries than coastal countries.

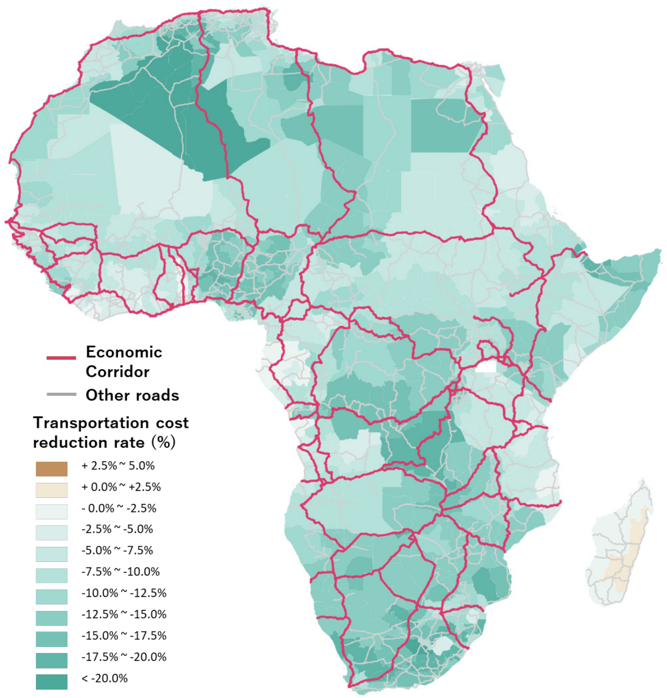
Table 3.1 Reduction Rate in Average Transport Cost in Economic Corridor (Left: As of 2030, Right: As of 2040)

Reduction Rate in Transport Cost for Each Region

Economic Corridor With – Without as of 2030



Economic Corridor With – Without as of 2040



Red. Rate

As of 2030:

	Total trade	Extra-African Trade	Intra-African Trade
Africa as a whole	-1.3%	-0.4%	-3.9%
Coastal country	-0.9%	-0.1%	-3.6%
Landlocked country	-4.3%	-3.7%	-4.9%

As of 2040:

	Total trade	Extra-African Trade	Intra-African Trade
Africa as a whole	-5.4%	-3.4%	-11.3%
Coastal country	-4.4%	-2.9%	-9.7%
Landlocked country	-13.8%	-10.2%	-17.2%

(6) Infrastructure Gaps at Ports

Comparisons of the future handling capacity of the future upper-level ports based on the future estimated cargo volume in the S1 scenario are shown in Fig. 3.10 and Fig. 3.11.

The results of this review indicate that the port handling capacity in 2040 will be inadequate for the future upper-level demand ports of Lagos (Nigeria), Alexandria (Egypt), Abidjan (Ivory Coast), Mombasa (Kenya) and Dakar (Senegal).

Since these ports serve as hubs for cargo transport to landlocked countries, it is vital that future demand in hinterland areas be considered when conducting port development.

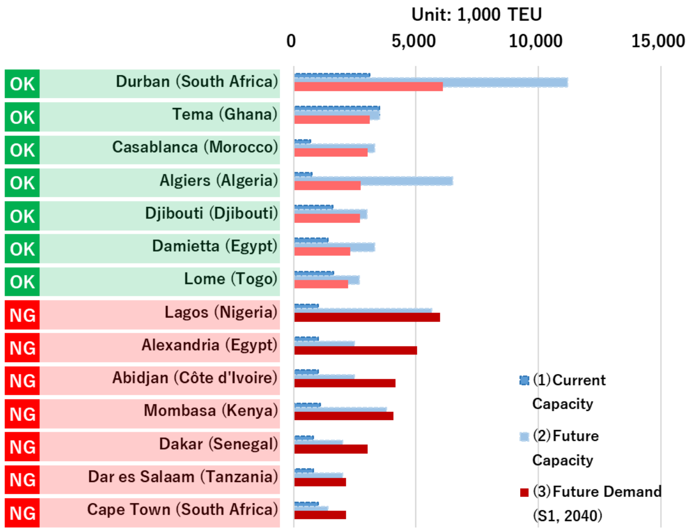


Fig. 3.10 Future Estimates of Port Cargo Handling Demand and Current/Future Port Handling Capacity

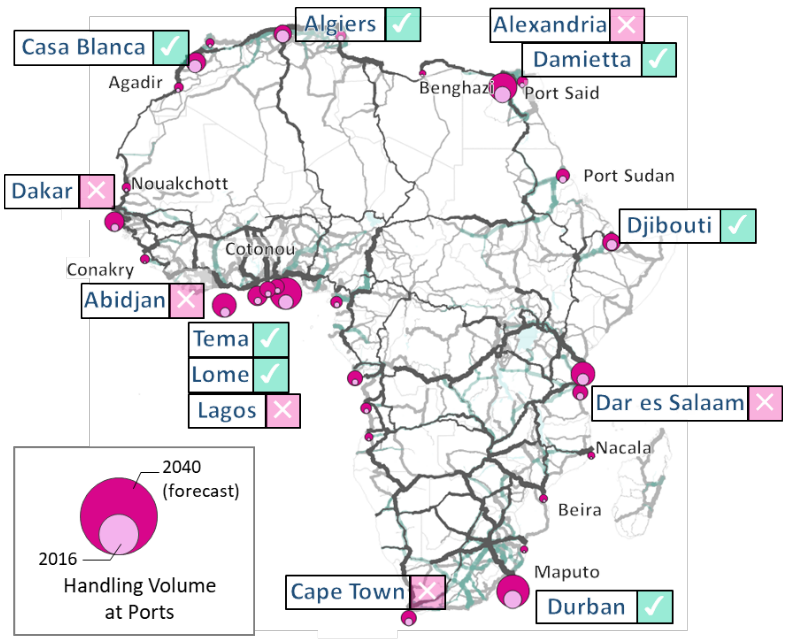


Fig. 3.11 Evaluation Results of Sufficiency of Planned Port Capacity

Chapter 4 Logistics Infrastructure Strategy in Africa

In this chapter, the results of logistics model simulation in the previous chapter were taken into consideration in order to identify the logistics bottlenecks that occur in the ports and roads (economic corridors) due to the concentration of cargo and cross-border cargo volume.

4-1. Identification of Logistics Infrastructure Bottlenecks

(1) Ports

Comparison results of the current facility capacity at each port and future cargo demand at each port (2040) are shown in the diagram below.

The analysis results project that future cargo demand at the major top 14 cargo handling ports in Africa will exceed the capacity of facilities.

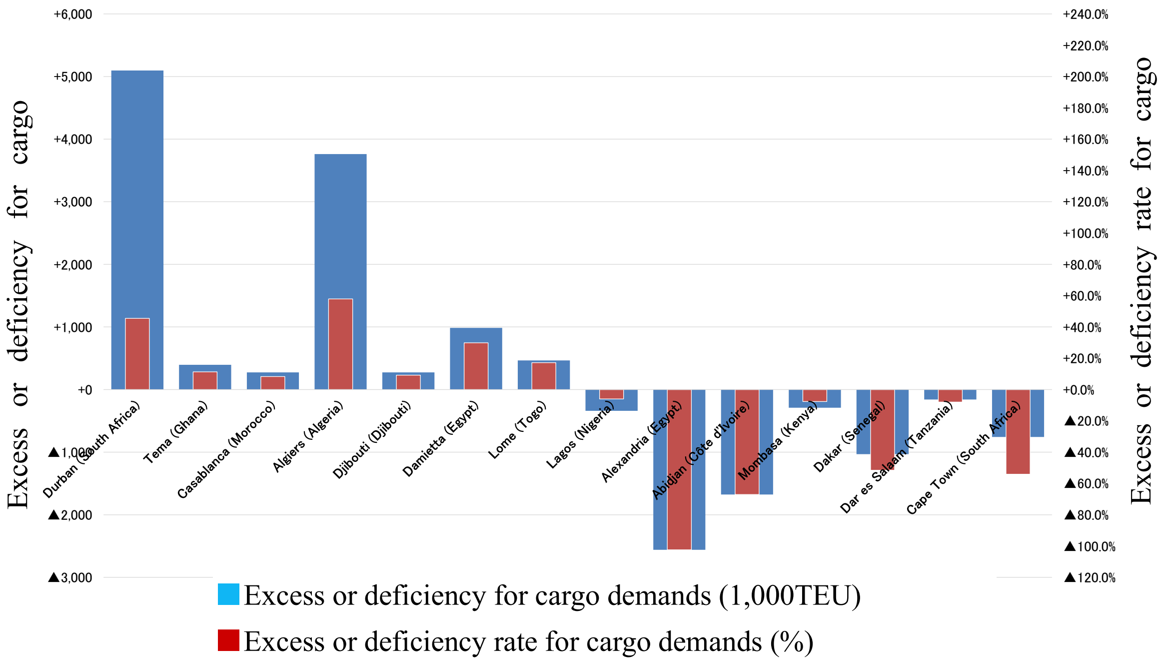


Fig. 4.1 Capacity Gap of Port Facilities (2040)

(2) Roads/Railways

The comparison results for the current status and estimated future cargo demand for the cargo transport road network and railway network are shown in the diagram below.

The West Africa Growth Ring is the location that has the highest transport cargo volume, followed by the Trans-Maghreb Corridor, South-North Corridor and Northern Corridor. In sections which connect ports and large cities in particular, large cargo volumes are predicted, which will require steady development. Furthermore, since there may be changes in cargo transport capacity resulting from railway development, railway development trends need to be taken into consideration.

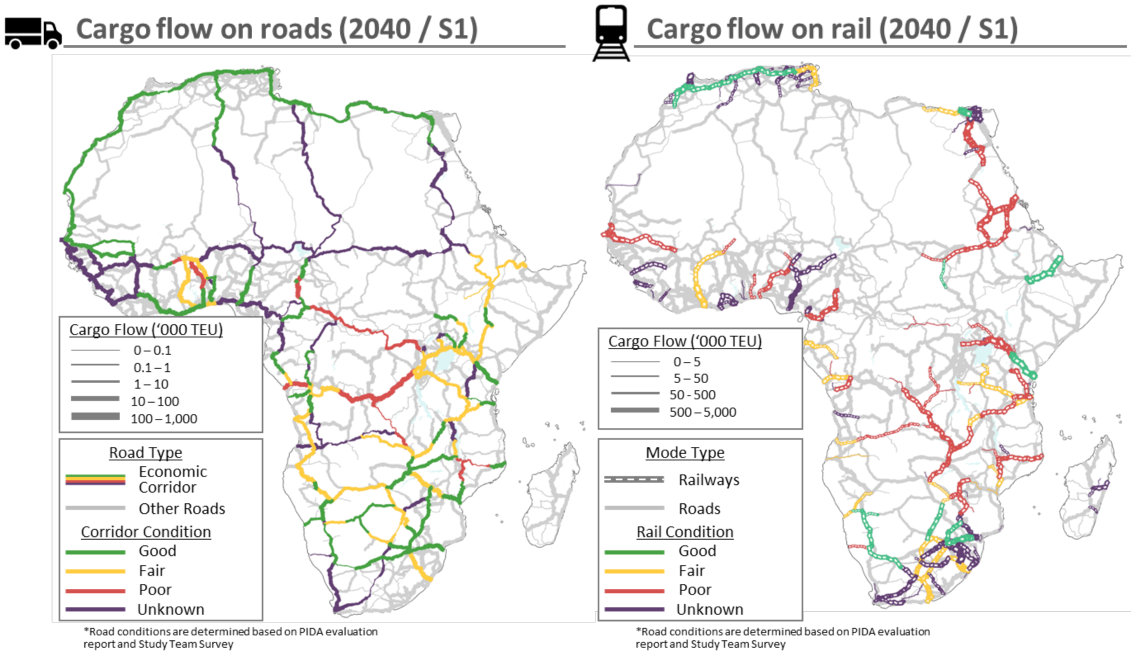


Fig. 4.2 Current Status of Cargo Transport Road Network & Railway Network and Future Estimate of Cargo Flow Volume (Reprint)

4-2. Formulation of Logistics Infrastructure Strategy (Recommendations provided with regard to the direction/potential of JICA cooperation)

The direction/potential of JICA cooperation in the future are described below as the logistics infrastructure strategy for the African region, based on the results of this study.

(1) Respond to Increased Trade by Achieving Desirable Future Scenario

In order to respond to the future increase in demand and global goals to combat climate change, it is necessary to implement measures to enhance the efficiency of transport by truck, ship and other modes, and drive the green transition, in addition to improving the logistics infrastructure and promoting a modal shift (shift from roads to railways).

- ✓ Desirable future scenario (S1) dramatically increases exports/imports from/to Africa.
- ✓ In addition, increase trade of agricultural products within Africa. This will further improve the balance of supply and demand for agricultural products, contributing to a rise in the self-sufficiency of food in Africa as a whole.

(2) Give Priority to Support for Bottleneck Infrastructure

Priority support needs to be implemented for a portion of the infrastructure which can become logistics bottlenecks due to the future increase in demand.

- ✓ Logistics bottlenecks can inhibit economic growth in each country.
- ✓ Even for ports with upper-level handling capacity, there will be ports where managing capabilities become insufficient for the future demand (Scenario S1) in 2040.
- ✓ It is important that cargo railways that are not adequately functioning be improved, and functions expanded, and that corridors (road/railway) planned under PIDA-PAP2 being steadily developed in response to the increase in cargo volume for roads that are not in good condition.

(3) Contribute to Reducing Disparities Through Integrated Corridor Development

The transport time / transport cost for landlocked countries and other areas are being reduced through integrated corridor development which includes OSBP and other border facilities, port development and logistics points (ICD, SEZ, etc.), benefitting many people and contributing to a reduction in disparities.

- ✓ It is necessary to proceed with development while considering future demand predictions and investments effects from the long-term broad perspective for the cargo transport demand within and outside of Africa which is rapidly growing.
- ✓ In the long run, the minimum necessary social infrastructure needs to be considered as a

national minimum, using the road density and other indicators in North America, Europe, Asia, and other regions.

(4) Support for Industry Development by Creating a Competitive Logistics Environment

In order to drive development of the African economy, support is needed for creation of a logistics environment where the competition principle functions as well as for industrial development by means of measures to increase added value for agriculture, forestry and fisheries.

- ✓ For example, there are competing routes in Uganda and Luanda which can use the port of Mombasa via the northern corridor or the port of Dar es Salaam via the central corridor, providing shippers with a choice of routes.
- ✓ The analysis in this study indicates that there will not be a large change in the trend of an excess in imports in Africa even when the elimination of tariffs by AfCFTA and technological progress rate are considered, and it is necessary that more concrete powerful support measures be taken to support industry.

(5) Upgrade Logistics Services Through Utilization/Demonstration of New Technologies

It is necessary that steady progress be made for main line transport through integrated corridor development, a cold chain be established with a view to the future, and demonstrations be implemented to upgrade/expand branch line transport such as last mile transport by using drones, automated driving, and other new technologies.

- ✓ In order to upgrade the added value of agricultural & fishery products and food, it is necessary to establish a cold chain in the distribution process which includes all steps from production through transport, storage and sales.
- ✓ Drones, automated driving, and other new technologies need to be used from the perspectives of reducing logistics costs in farming villages that are far from cities and improving the work environment for drivers.

(6) Reduce Environmental Load by Using Green Energy

In order to contribute to the achievement of global goals to combat climate change, the utilization of renewable energy such as solar and wind needs to be promoted in port/road/ railway/other logistics infrastructure, as well as on ships, transport vehicles, logistics and other facilities.

- ✓ When promoting integrated corridor development, the introduction of new technologies to reduce the environmental load needs to be considered.
- ✓ At the same time, it is expected that the potential of regional industry can be upgraded through autonomous distributed energy supply and contributions can be made to reduce disparities through regional vitalization.