Analysis of Future International Trade and Logistics in Africa: Considering Major Risks and Opportunities in the Post COVID-19 World

FUKUSHIMA Hiroyuki – Japan International Cooperation Agency (JICA)

ABE Masahiro – PACIFIC CONSULTANTS CO., LTD.

SHIBASAKI Ryuichi – The University of Tokyo

ALVES Lucas – PACIFIC CONSULTANTS CO., LTD.

TAKADA Yuki – PACIFIC CONSULTANTS CO., LTD.

ONODERA Hitoshi – PACIFIC CONSULTANTS CO., LTD.

FURUICHI Masahiko – International Association of Ports and Harbors (IAPH)

1. Overview: Background

Africa, one of the most attractive markets:
Infra., agri., energy, ICT, finance, etc., AfCFTA coming into force in January 2021

Financial and tech assistance for Africa:
JICA (and other agencies) in the infra development

Covid-19 pandemic

Year 2021

Year 2022

Year 2040

Africa could be the future world's prime investment destination?

Africa's Future International and Intra-regional Trade considering Risks and Opportunities

1. Overview: Structure of this study

1. Build future scenarios for estimation by the GTAP-RD model

   Set the model's structure and various parameters.

2. Estimate the scale of international trade from 2014 to 2040 in Africa under each of the future scenarios

3. Estimate the logistics cost reduction rate by country/region when logistics infrastructures are developed

   Interaction with the GLINS model.

4. Feedback the results of the GLINS model to the GTAP-RD model

   Set parameter "AMS"

   Run a comparative analysis of the estimation results before and after "AMS" is set.

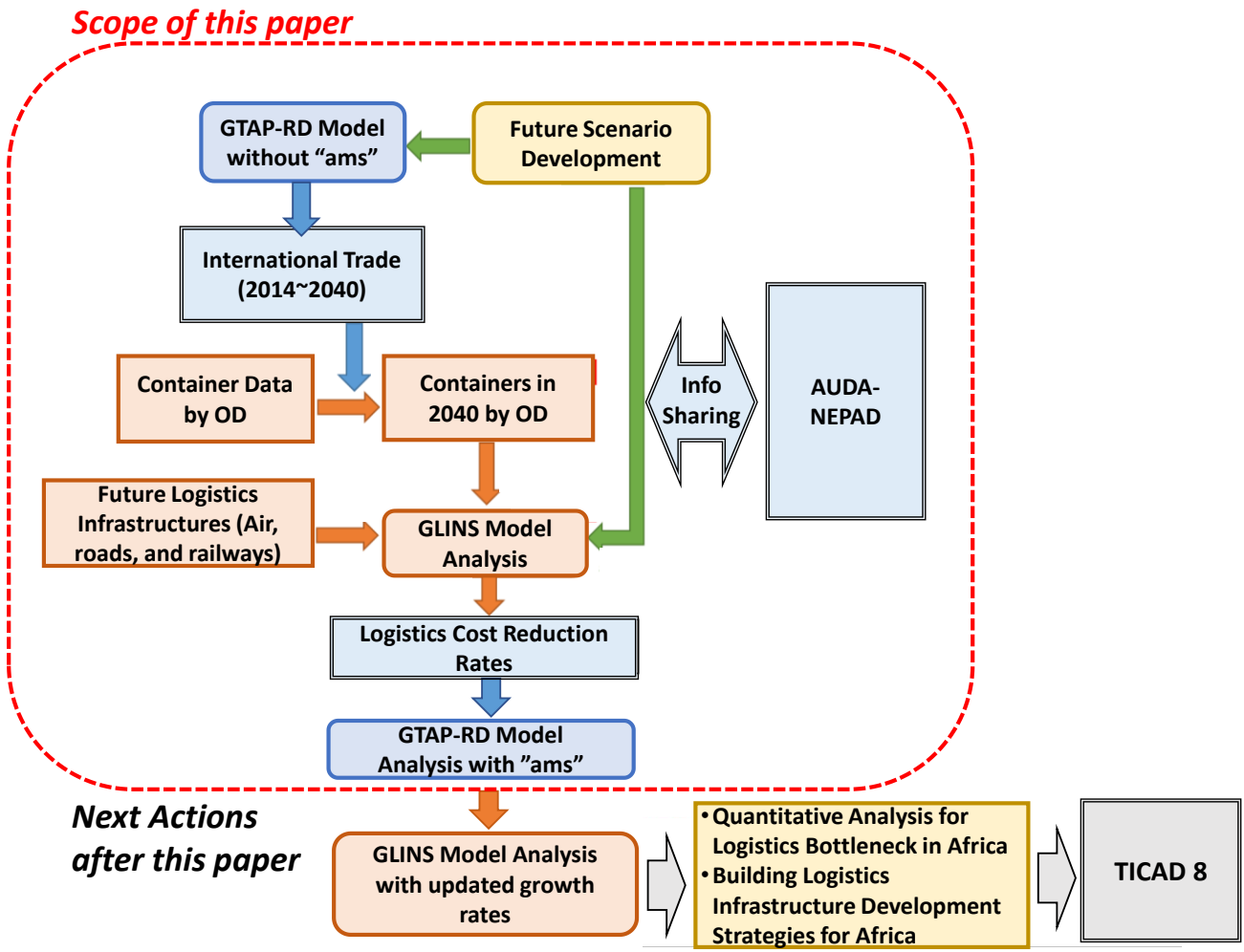


Figure. Study Flow

2. Previous Studies Review

- **Some future estimates of the impact of COVID-19: World Bank (2020), International Monetary Fund (2020), Rakha et al (2020), etc. → Those previous studies are about short-term forecasts**
  - Authors found a lack of models that can be used to predict future performance in situations such as the disruption of demand and supply chains, etc.
  - Duration and pattern of anti-cyclical covid-19 measures have asymmetric effects not only between countries but also between industrial sectors and on the supply-demand chain within countries
  - Developing multiple future under the assumption of COVID-19 uncertainty, scenarios developed in the high case, low case, and middle case on multiple common axes in the socio-economy, and the differences among the scenarios in the estimation results, in addition to the results of each estimation

Our study adds to the literature of impacts of covid-19 by focusing on long-term forecasts
We follow the approach of differentiating countries and industries, as well as possible future scenarios

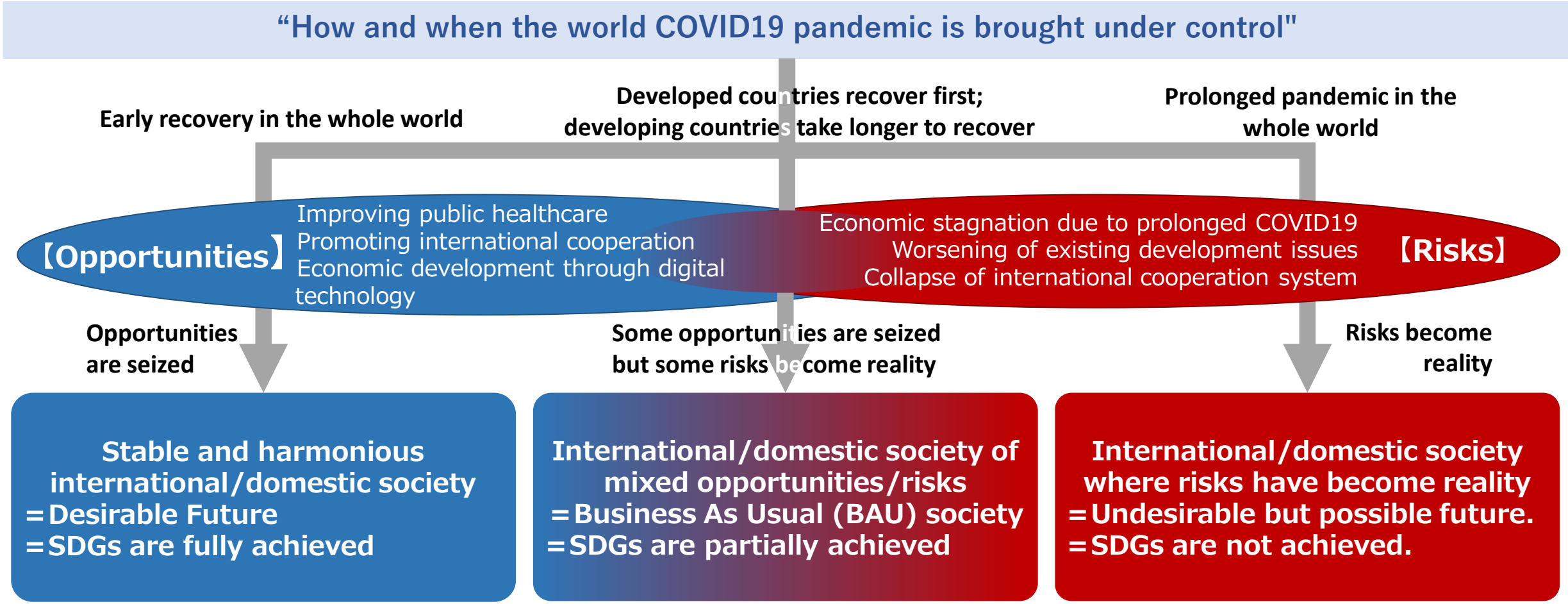
- **Some previous studies used "AMS" for NTMs/NTBs: Hertel et al (2001), Fox et al (2003), Francois et al (2005), Fugazza and Maur (2008), Abe and Wilson (2008)**

This study emphasizes cross-border inefficiencies: long waits and congestion at the border customs clearance, elements of NTM, and logistics infrastructure development, such as economic corridor development.

AMS: Best variable for our purpose of retro-feeding the reduction in transportation costs -> Tridimensional (Origin, Destination, Commodity)

3. Methodology: Scenario Development

- Discussion in the JICA project's expert committee (consisting mainly of logistics-related researchers and private sector practitioners
- "opportunities (positive)" and "risks (negative)", can diverge into three different futures: a "desirable future," and "undesirable but possible future".



3. Methodology: Scenario Development

Common axes and each situational configuration by scenario

common axis	Scenario S1:. Stable and harmonious international/domestic society	Scenario BAU:. International/domestic society of mixed opportunities/risks	Scenario S2 International/domestic communities where risks have become apparent
1. Technological Innovation	Technological innovation will progress in all industries in developed and developing countries.	Technological innovation will progress mainly in developed countries. In developing countries, technological innovation will progress in some industries such as service industry and agriculture.	Technological innovation progresses mainly in developed countries. Technological innovation in developing countries stagnates due to social unrest, etc.
2. Access to cutting-edge technology	International rules on intellectual property will be thoroughly enforced, facilitating access to the latest technology regardless of whether a country is developed or developing.	The latest technology is accessible mainly in developed countries and in coastal developing countries (in landlocked countries). (Access is difficult).	Developing countries are unable to use the latest technology from developed countries due to the lack of international rules for intellectual property, risk of military diversion, inadequate infrastructure, etc.
3. Balanced industrial and free trade policies	A policy that balances domestic industry development and free trade will be achieved in both developed and developing countries.	Policies are weighted heavily toward free trade, and domestic industrial development is limited to a few industries.	Protectionist policies dominate and free trade recedes. In addition, protectionist policies for domestic industry inhibit production efficiency.
4. Access to financial assistance	Appropriate support will be provided mainly by countries and the IMF, taking fiscal discipline into account. Regional development banks and ESG funds will provide support to the private sector in a way that promotes sustainability.	Although support from the countries and the IMF is available, risks remain, such as the occurrence of excessive debt in the recipient country and a slowdown in support due to economic conditions in the donor country.	Financial support is not available due to insolvency, support for terrorism, human rights abuses, and political corruption, especially in developing countries.
5. Eliminating disparities in access to vaccines, medical care, and social welfare	In the event of a sudden outbreak of infectious diseases such as COVID19, medical resources such as vaccines and masks will be flexible around the world, mainly through the WHO.	Medical resources, such as vaccines and masks, are flexible around the world, but they are also used as a diplomatic tool and are subject to certain restrictions in international politics.	Lack of coordination delays the sharing of information on infectious disease outbreaks, resulting in pandemics. Humanitarian aid provides medical resources, but it takes time due to political corruption and conflict.
6. Education that encourages innovation, long-term perspective, and altruism	Expanding opportunities and narrowing gaps in higher education will promote the spread of education that encourages innovation, long-term vision, and altruistic activities.	Disparities in higher education still exist between developed and developing countries.	Social instability prevents the expansion of education, which in turn prevents progress in industrial development and poverty reduction, a negative cycle that cannot be broken.

3. Methodology: Scenario Development

■ Common axes and each situational configuration by scenario

common axis	Scenario S1: Stable and harmonious international/domestic society	Scenario BAU: International/domestic society of mixed opportunities/risks	Scenario S2: International/domestic communities where risks have become apparent
7. Energy (Green Energy, Blue Energy)	Not only will the use of renewable energy sources be promoted, but carbon neutrality of existing fossil fuel-derived energy sources will also spread, increasing energy availability worldwide, including in the old resource-rich countries.	The promotion of renewable energy and the use of existing fossil fuel-derived energy are not aligned, and some progress is not being made in the efficient use of energy resources.	While progress is being made in developed countries, inefficiencies in state-owned resource companies remain in developing countries, and the use of old fossil fuel-derived energy, charcoal, etc. also remains.
8. Natural resource management	International joint management of underground resources, forests, fisheries resources, etc. will progress for optimal and sustainable use.	The international co-management framework will be maintained, but will be led by a few countries and remain unfair.	Developing countries are opposed to international co-management led by developed countries, and international rules are not adhered to.
9. Climate change	Cost-effective and equitable responses that are close to marginal costs will be taken in the context of international cooperation. Appropriate responses to climate change-related disasters will also be taken in international cooperation.	Partial inefficiencies remain in the response due to trends in the U.S., reduction mandates in China and India, and risks to the development of reduction and adaptation technologies.	No framework encompassing both developed and developing countries has been established, and each country, especially developed countries, has responded inefficiently on an individual basis. The scale of the project is small, and the low cost of advanced technology is not achieved.
10. Stable supply of labor	The social advancement and status of women and ethnic minorities will increase, and labor productivity will improve.	While women are advancing in society and improving their status in developed countries, in some developing countries they are inhibited by religious and other reasons, and an oversupply of labor in rural areas remains.	In addition to women and ethnic minorities, migration between urban and rural areas and low levels of education reduce both the size and quality of the labor supply.
11. Infrastructure Development	Infrastructure will be developed with financial support from the international community. Inefficient investment and investment that violates fiscal discipline will be eliminated.	Infrastructure investment will be promoted, but the risk remains that it will be scaled back due to the economic crisis on the investment side, etc.	Due to unstable social conditions and poor governance, infrastructure projects are not financed and new and maintenance projects are inadequate.
12. start-up	Support for private companies and improved access to advanced technology will increase start-up company entrepreneurship and activity in many countries. Become a source of absorption of excess labor in rural areas.	Differences in accessibility to advanced technology will stimulate entrepreneurship in developed countries, and developed country startups will operate in developing country markets.	Startups emerge in developed countries, but the hurdles to expansion into other countries are high, and business development in developing countries is not progressing.

3. Methodology: GTAP- RD Model

- Recursive Dynamic (RD) version of the GTAP model developed by Hertel (1997)
- In this study, future projections are conducted using the basic GTAP-RD model described in Aguiar et al (2019).
- Dataset: GTAP ver. 10
- Calculation Period: 2014 – 2040 (26 years)
- Countries/Regions: Aggregated 34 from 141 in the original classification
- Industrial Sectors: Aggregated 16 from 65 in the original classification

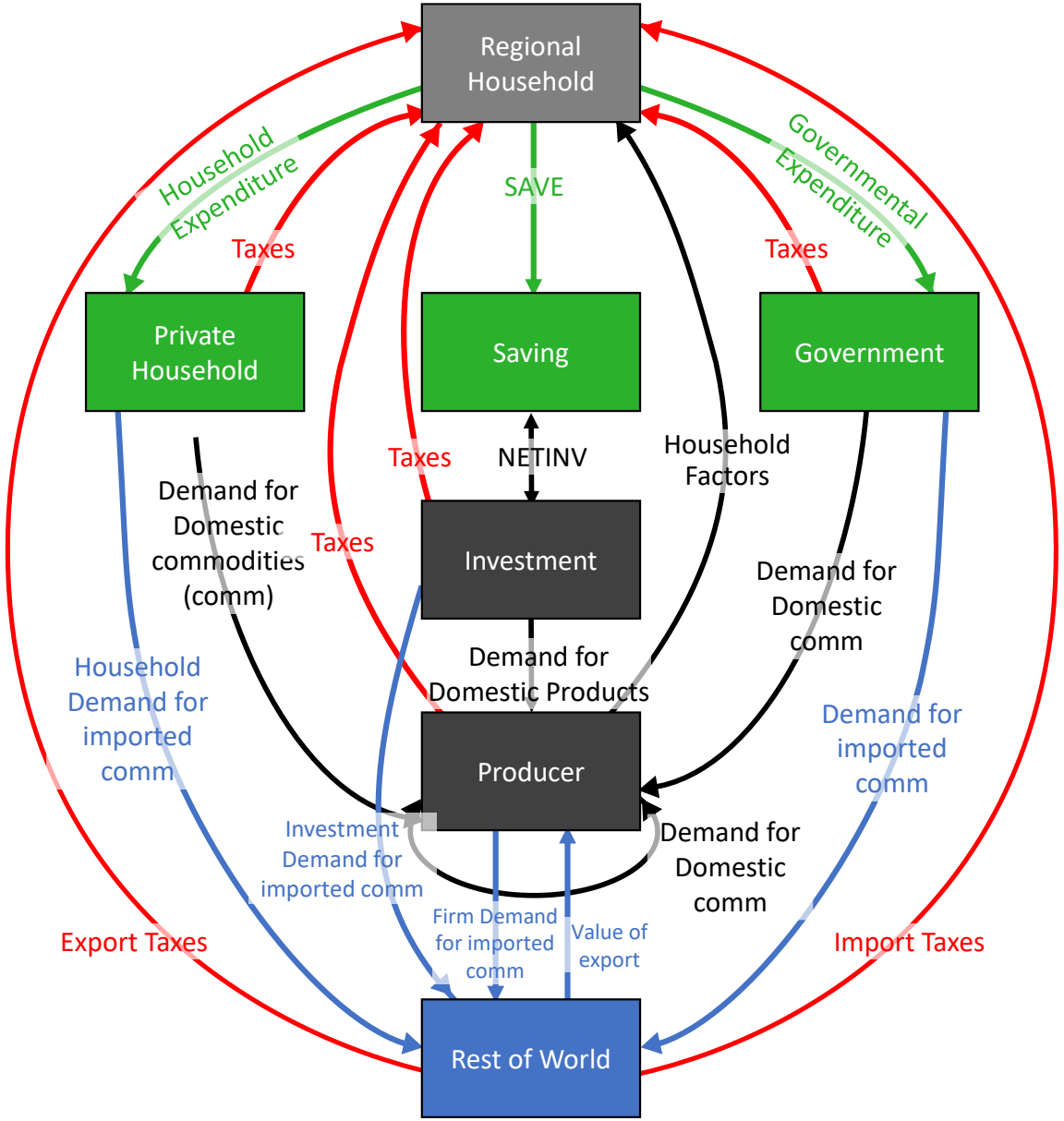


Figure. GTAP model Concept (prepared based on Aguiar et al (2019))

3. Methodology: GTAP- RD Model

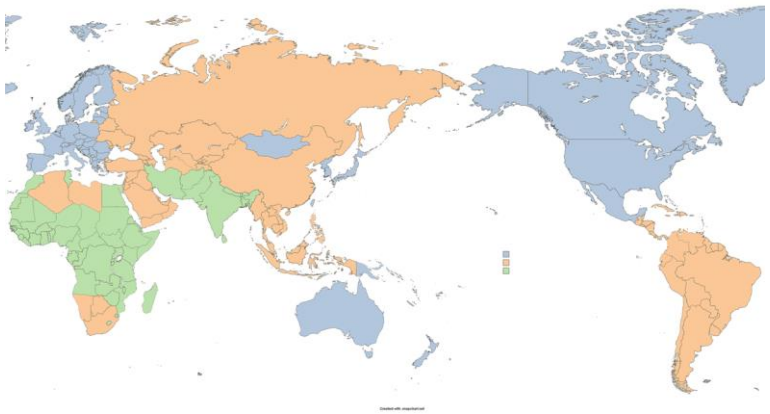
Countries/Regions

- In principle, Africa is classified as a single country unit
- China, India, and the U.S. are classified as a single country unit
- Policy shocks according to income levels

Regional Classification

* Income range is based on WB definition

Classification	Income Range	Countries and Regions Included
High-income countries/regions (H)	12,535 USD – High Income *	Oceania, East Asia (excluding China), North America (excluding the U.S.), the U.S., Europe
Mid-income countries/regions (M)	4,046-12,535 USD Upper-middle Income *	China, Southeast Asia, Latin America, former Soviet Union countries, Middle East, Mauritius, other North African countries, Botswana, Namibia, South Africa
Low-income countries/regions (L)	- 4,045 USD Low income, Lower-middle Income *	South Asia (excluding India), India, other African countries/regions



Industrial sectors

- In order to assess **food self-sufficiency**, cereals and other edible agricultural products sectors were set independently.
- To take into account the **impact of climate change**, a rate of technological progress based on projected unit yields under climate change impact was established for Cereals sector.
- Steel, cement, fertilizer, and aluminum were taken out of the basic industrial materials sector, and the electricity sector was added to the list of five sectors that were aggregated to be subject to the **border carbon tax.**
- Telecommunications and financial services sectors, where advanced technologies (5G telecommunications, Fintech, etc.) are expected to be utilized, were aggregated and set up as independent sectors.

Industrial Sector Classification

No.	Non Services	No.	Services
1	Cereals (Cer)	10	Motor Vehicles and Parts (Mvh)
2	Other Edible Agriproducts (Oea)	11	Land Transport (Tla)
3	Fishing (Fis)	12	Water Transport (TWA)
4	Other Agriproducts and Forestry (Oaf)	13	Air Transport (Tai)
5	Natural Resources (Nat)	14	Communication (Com)
6	Household Consumer Products (Hou)	15	Financial Services (Fin)
7	Basic Industrial Materials (Bas)	16	Other Services (Oth)
8	High GHG Emission Products (Ghg)		
9	Processing /Assembling (Pro)		

3. Methodology: GTAP- RD Model

■ Parameter settings in the GTAP-RD model

common axis	Setup policy and points in the GTAP model	common axis	Draft policy for setting up in the GTAP model
1.Technological Innovation	• Technological progress parameter (AFEALL) • Higher AFEALL value for Communication and Financial Services	7.Energy (Green Energy, Blue Energy)	• Setting the rate of technological progress parameter for Cereals sector to a value that takes climate change into account • Taking climate change into account in GDP per capita growth rate, population growth rate, and labor force growth rate,. • Introduce a border carbon tax CBAM (high-income countries add a 5% border carbon tax to their tariffs)
2.Access to cutting-edge technology		8.Natural resource management	
3.Balanced industrial and free trade policies	• Tariff (TMS) reduction/elimination	9.Climate change	
4.Access to financial assistance	• Higher AFEALL value for Communication and Financial Services	10.Stable supply of labor	• Unskilled labor force growth rate according to scenarios
5.Eliminating disparities in access to vaccines, medical care, and social welfare	• Set a growth rate that will achieve a V-shaped recovery in GDP per capita • Population growth rates according to scenarios	11.Infrastructure Development	• Transportation technological progress parameter (AMS) (for the phase after the first GLINS model analysis)
6.Education that encourages innovation, long-term perspective, and altruism	• Skilled labor growth rate according to scenarios	12.Start-up	• Higher AFEALL value for Communication and Financial Services

3. Methodology: GTAP- RD Model (Parameter Setting)

■ GDP per capita growth rate (for baseline calculation)

	Assumed Situation	High-income countries/regions (H)	Mid-income countries/regions (M)	Low-income countries/regions (L)
S1	Based on SSP1 (Sustainable Society) ・Climate Change: Global Efforts ・COVID-19: V-shaped recovery Worldwide	・Based on SSP1 growth path ・2020-22: Replace WB forecast ・2023: V-shaped recovery	・Based on SSP1 growth path ・2020-22: Replace WB forecast ・2023: V-shaped recovery	・Based on SSP1 growth path ・2020-22: Replace WB forecast ・2023: V-shaped recovery
BAU	Based on SSP2 (middle-of-the-road society) ・Climate change: Difference in efforts ・COVID-19: Difference in recovery	・Based on SSP2 growth path ・2020-22: Replace WB forecast ・2023: V-shaped recovery	・Based on SSP2 growth path ・2020-22: Replace WB forecast ・2023: V-shaped recovery	・Based on SSP2 growth path ・2020-22: Replace WB forecast ・2023: No V-shaped recovery
S2	Based on SSP3 (Disparities) ・Climate change: large differences in efforts ・COVID-19: large difference in recovery	・Based on SSP3 growth path ・2020-22: Replace WB forecast ・2023: V-shaped recovery	・Based on SSP3 growth path ・2020-22: Replace WB forecast ・2023: No V-shaped recovery	・Based on SSP3 growth path ・2020-22: Replace WB forecast ・2023: No V-shaped recovery

Table: Real GDP Growth Projections under COVID-19

	2020	2021	2022	2023
Advanced economies	-4.7%	5.4%	4.0%	2.2%
Emerging markets and developing economies	-1.7%	6.0%	4.7%	4.4%
East Asia and Pacific	1.2%	7.7%	5.3%	5.2%
Europe and Central Asia	-2.1%	3.9%	3.9%	3.5%
Latin America and the Caribbean	-6.5%	5.2%	2.9%	2.5%
Middle East and North Africa	-3.9%	2.4%	3.5%	3.2%
South Asia	-5.4%	6.8%	6.8%	5.2%
Sub-Saharan Africa	-2.4%	2.8%	3.3%	3.8%
Nigeria	-1.8%	1.8%	2.1%	2.4%
South Africa	-7.0%	3.5%	2.1%	1.5%
Angola	-5.2%	0.5%	3.3%	3.5%

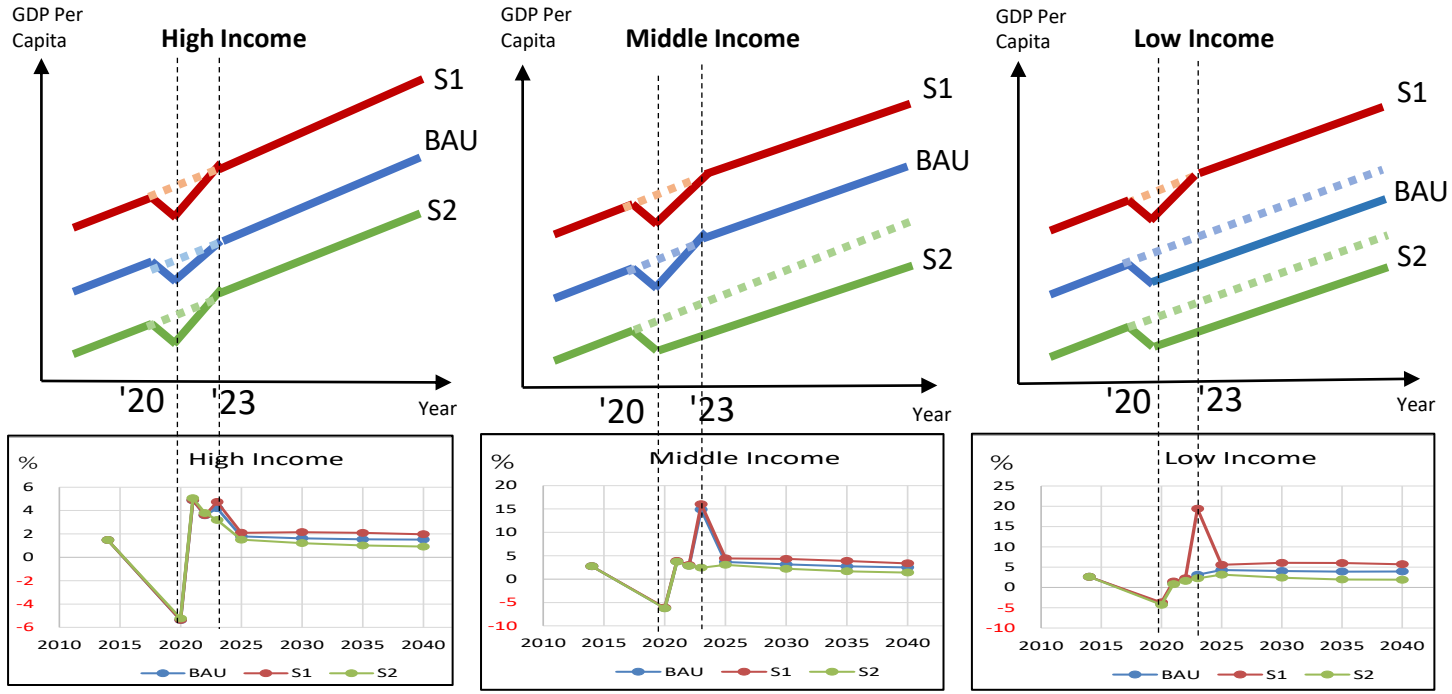


Figure GDP per capita growth path images

3. Methodology: GTAP- RD Model (Parameter Setting)

- **Shared Socio-economic Pathways (SSPs)**

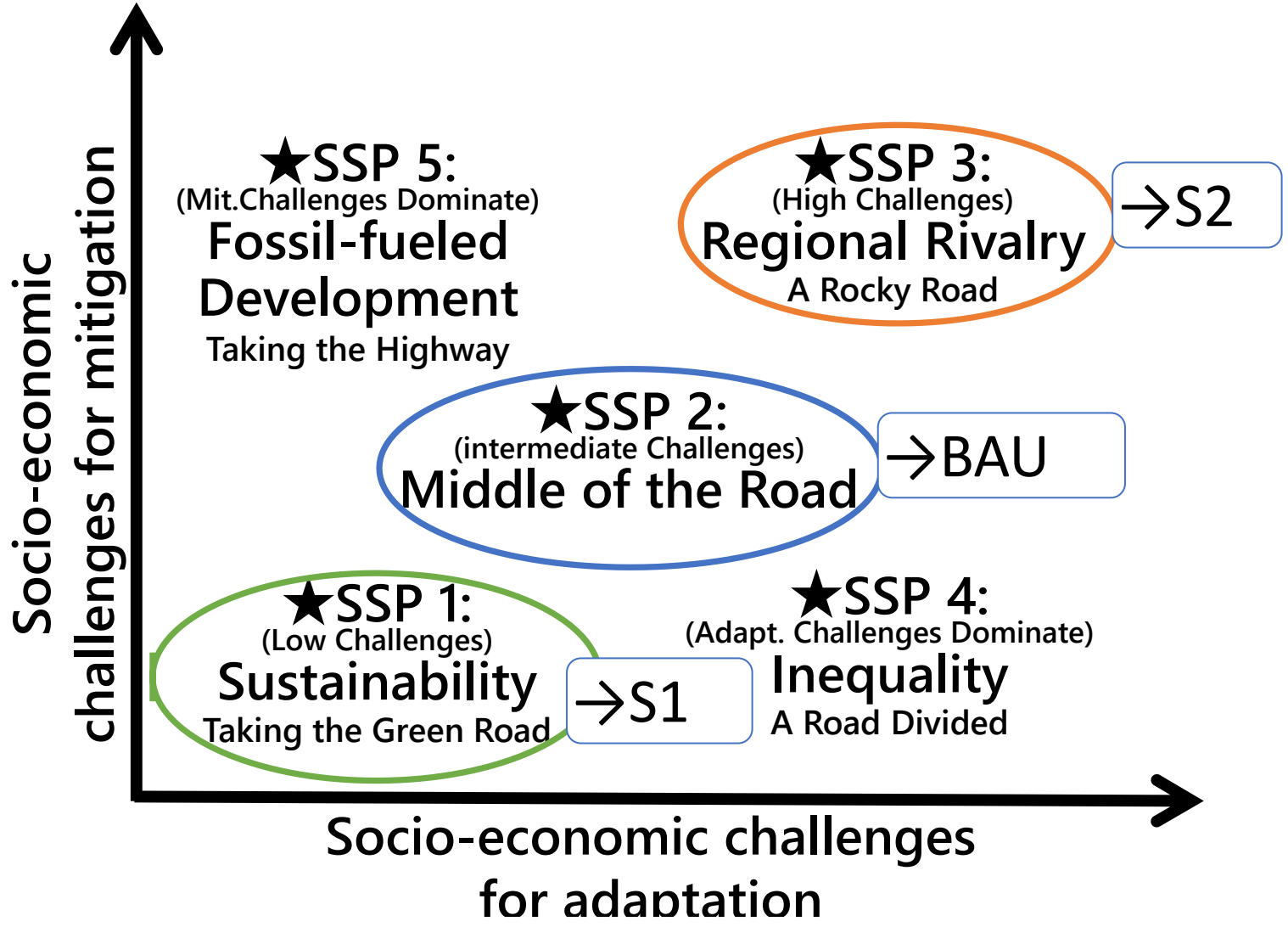


Figure. SSPs Concept

3. Methodology: GTAP- RD Model (Parameter Setting)

■ Population growth rate

* UN World Population Prospects 2019

	Assumed Situation	High-income countries/regions (H)	Middle-income countries/regions (M)	Low-income countries/regions (L)
S1	Consider the UN projection and SSP1 High economic growth in low- and middle-income countries ➡ Decrease in outflow of migrants to high-income countries	・S1 x UN Projection ・migrants: -0.47%/year → pop decrease	・S1 x UN Projection ・migrants: +0.10%/year → pop increase	・S1 x UN Projection ・migrants: +0.10%/year → pop increase
BAU	Based on the UN Projection (Positioned in the same way as the SSP2 growth path) Migration: no change in outflow/receipt	・UN Projection ・migrants: no change	・UN Projection ・migrants: no change	・UN Projection ・migrants: no change
S2	Consider the UN projection and SSP3 Slowing economic growth in low- and middle-income countries ➡ Increased outflow of migrants to high-income countries	・S2 x UN Projection ・migrants: 0.47%/year → pop increase	・S2 x UN Projection ・migrants: -0.10%/year → pop decrease	・S2 x UN Projection ・migrants: -0.10%/year → pop decrease

■ BAU population is set based on the mid-level estimate (UN Future Population Projections (2019))(Positioned in the same way as the SSP2 growth path)

- S1 and S2 populations are set by multiplying the BAU population by a ratio to maintain the difference in SSP
  - ✓ S1 x UN Projections = (UN future estimated population) x (SSP1 population/SSP2 population)
  - ✓ S2 x UN Projections = (UN future estimated population) x (SSP3 population/SSP2 population)

■ Consideration of migration status

- OECD countries migration (inflow) in 2018: 0.47% of the population
- Non-OECD countries migration (outflow) in 2018: 0.10% of the population

3. Methodology: GTAP- RD Model (Parameter Setting)

■ Skilled/Unskilled Labor growth rate

	Assumed Situation	High-income countries/regions (H)	Middle-income countries/regions (M)	Low-income countries/regions (L)
S1	Consider the UN projection and SSP1 *Progress in higher and secondary education worldwide	・S1xUN Projection ・Skilled: +0.31%/year ・Unskilled: +0.08%/year	・S1xUN Projection ・Skilled: +2.22%/year ・Unskilled: +0.23%/year	・S1xUN Projection ・Skilled: +2.22%/year ・Unskilled: +0.23%/year
BAU	Based on the UN future population projection (Positioned in the same way as the SSP2 growth path) *Progress in higher and secondary education in high- and middle-income countries	・UN Projection ・Skilled: +0.31%/year ・Unskilled: +0.08%/year	・UN Projection ・Skilled: +2.22%/year ・Unskilled: +0.23%/year	・UN Projection ・Skilled: No additional settings ・Unskilled: No additional settings
S2	Consider the UN projection and SSP3 *Only high-income countries have made progress in higher and secondary education.	・S2xUN Projection ・Skilled: +0.31%/year ・Unskilled: +0.08%/year	・S2xUN Projection ・Skilled: No additional settings ・Unskilled: No additional settings	・S2xUN Projection ・Skilled: No additional settings ・Unskilled: No additional settings

■ The labor endowment growth rate common to skilled and unskilled labor in BAU (UN labor endowment growth rate) is The growth rate of the working population (15-64 years) in the UN Population Projections (2019) is utilized.

- ➢ Percentage increase in S1 and S2 labor allocation is multiplied by a ratio to maintain the difference between BAU and SSP.
  - ✓ S1 x UN Projection = (UN labor intensity growth rate) x (SSP1 productive population/SSP2 productive population)
  - ✓ S2 x UN Projection = (UN labor intensity growth rate) x (SSP3 productive population/SSP2 productive population)

■ Add the percentage increase that takes into account the rate of advancement to higher education for each of skilled and unskilled labor (Skilled: higher education advancement rate, unskilled: secondary education advancement rate)

- ➢ High-income countries (H): skilled: +0.31%/year (higher education attainment rate), unskilled: +0.08%/year (secondary education attainment rate)
- ➢ Low- and middle-income countries (M, L): skilled: +2.22%/year (higher education attainment rate), unskilled: +0.23%/year (secondary education attainment rate)

3. Methodology: GTAP- RD Model (Parameter Setting)

Technological Progress (AFEALL) in Cereals Sector

	Assumed Situation	High-income countries/regions (H)	Middle-income countries/regions (M)	Low-income countries/regions (L)
S1	Climate change measures are fully implemented worldwide, with minimal impact on cereal production	·WB max percent change in unit yield (+0.18%/year)	·WB max percent change in unit yield (+0.18%/year)	·WB max percent change in unit yield (+0.18%/year)
BAU	Climate change measures are being implemented mainly in middle- and high-income countries, and the impact on cereal production is in line with WB projections.	·WB average percent change in unit yield	·WB average percent change in unit yield	·WB average percent change in unit yield
S2	Insufficient action on climate change has had a significant impact on cereal production.	·WB min average percent change in unit yield (- 0.65%/year)	·WB min average percent change in unit yield (- 0.65%/year)	·WB min average percent change in unit yield (- 0.65%/year)

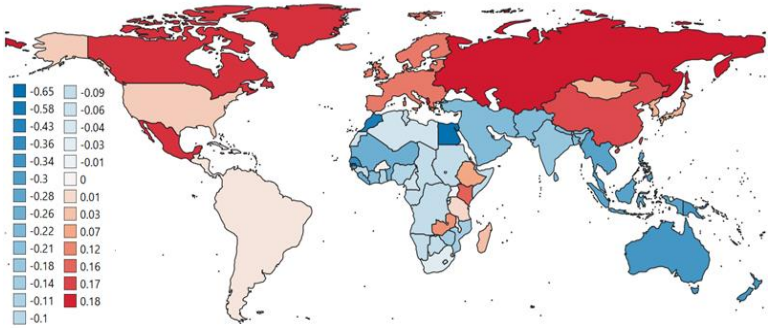
The AFEALLs for Cereals Sector are based on the World Development Report 2010 (WB) average unit yield change over 2010-50 (WB average unit yield change: by country/region).

- Unit sales are expected to increase in North America, Europe, and East Asia.
- In Africa, the yield is expected to increase in Ethiopia, Kenya, Tanzania, Zambia, and Madagascar are expected to increase their yield.
- Expect lower unit yields in Southeast Asia, Oceania, the Middle East, and Africa.

The AFEALLs for S1 and S2 are the maximum and minimum values of WB

- S1: WB max average single yield change (+ 0.18%/year)
- S2: WB min average unit yield change (-0.65%/year)

Average percent change in unit yield



2010-50 average change in yield: maximum +0.18%/year, minimum -0.65%/year

3. Methodology: GTAP- RD Model (Parameter Setting)

■ Technological Progress except for Cereals Sectors

	Assumed Situation	High-income countries/regions (H)	Middle-income countries/regions (M)	Low-income countries/regions (L)
S1	Worldwide progress in innovation and advanced technologies in production High accessible	・PCI increase rate: +0.70%/year (+3.45%/year for communication and financial service)	・PCI increase rate: +0.95%/year (+5.2%/year for communication and financial service)	・PCI increase rate: +0.93%/year (+4.71%/year for communication and financial service)
BAU	Worldwide progress in innovation and advanced technologies in production Middle accessible	・PCI increase rate: +0.40%/year (+1.04%/year for communication and financial service)	・PCI increase rate: +0.72%/year (+3.53%/year for communication and financial service)	・PCI increase rate: +0.86%/year (+4.67%/year for communication and financial service)
S2	Worldwide progress in innovation and advanced technologies in production Low accessible	・PCI increase rate: +0.39%/year (+1.83%/year for communication and financial service)	・PCI increase rate: +0.60%/year (+2.76%/year for communication and financial service)	・PCI increase rate: +0.70%/year (+3.31%/year for communication and financial service)

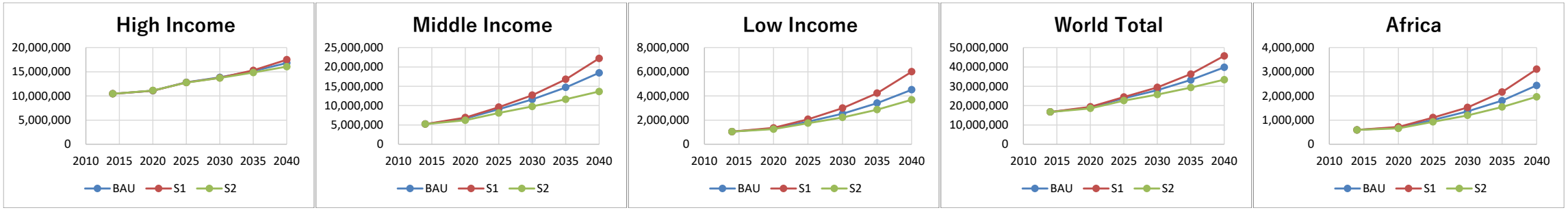
■ The technological progress except for Cereals Sector are based on UNCTAD's Productive Capacities Index (PCI).

- PCI is the geometric mean of 46 indicators for human capital, natural capital, energy, transportation, ICT, government agencies, private sector, and social structural change
- BAU: average for 2009-2018 (10 years) / S1: average for 2000-2018 (19 years) / S2: average for 2014-2018 (5 years)

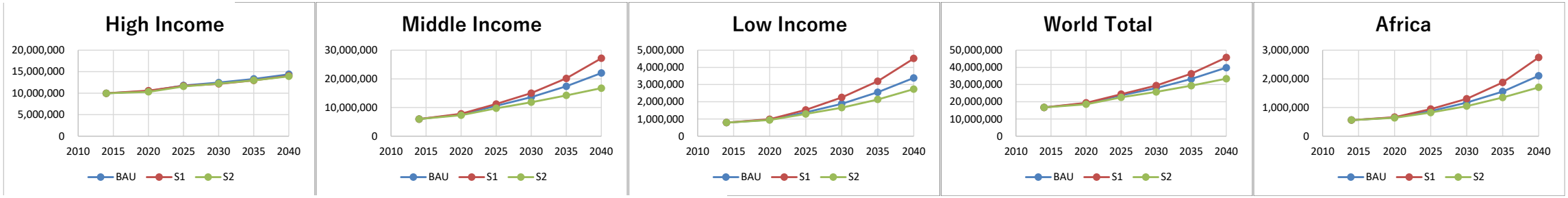
■ For communications and financial services, the geometric mean of PCI's ICT data is applied (higher increase than the overall mean)

4. Estimation results

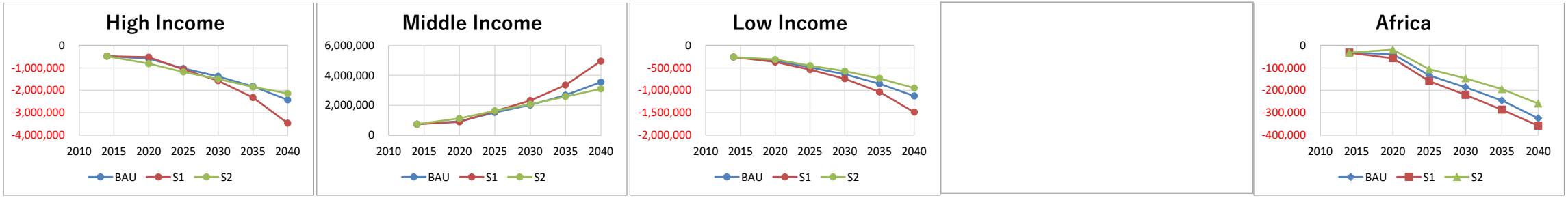
Import



Export



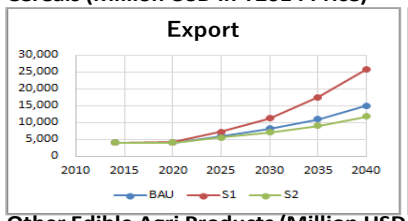
Trade Balance (Export – Import)

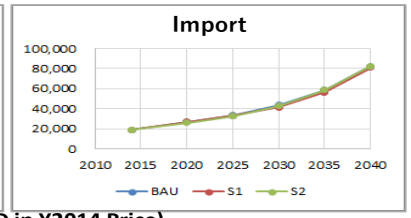


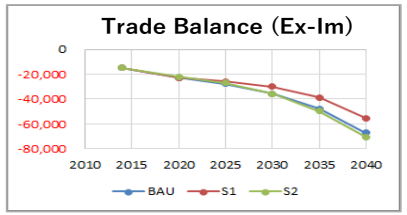
Africa's trade expands significantly through the term until 2040, and the expansion of the trade deficit become largest under the S1 scenario, which assumes the most desirable future including COVID-19 policy.

4. Estimation results

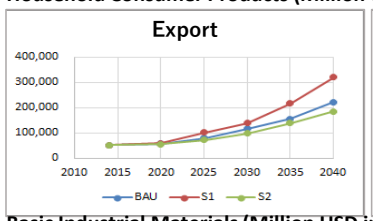
Cereals (Million USD in Y2014 Price)

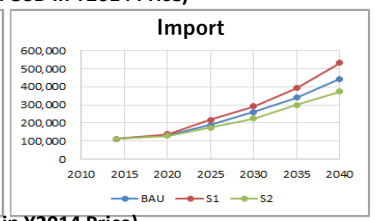


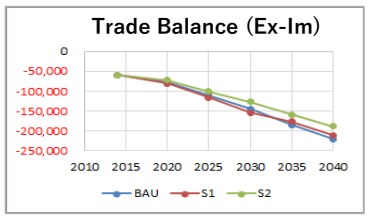




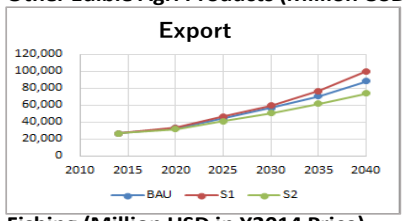
Household Consumer Products (Million USD in Y2014 Price)

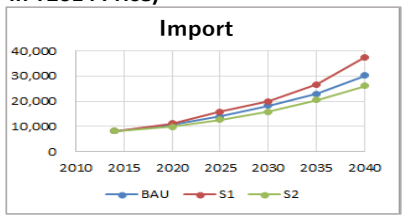


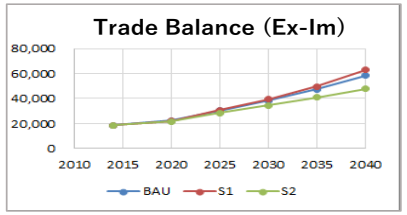




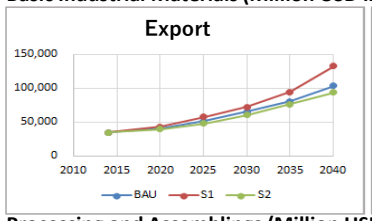
Other Edible Agri Products (Million USD in Y2014 Price)

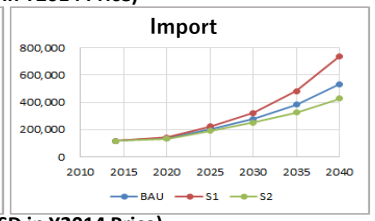


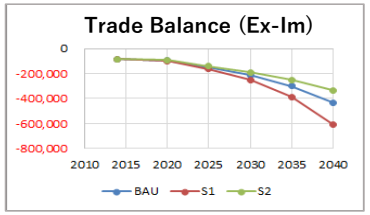




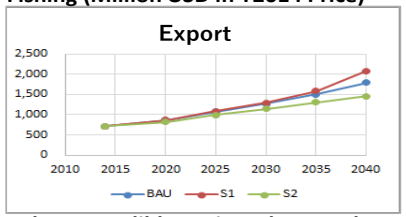
Basic Industrial Materials (Million USD in Y2014 Price)

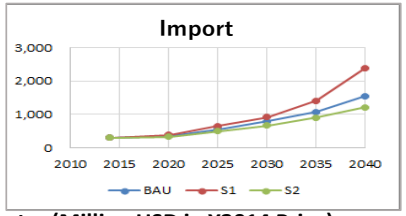


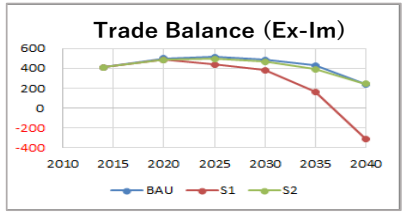




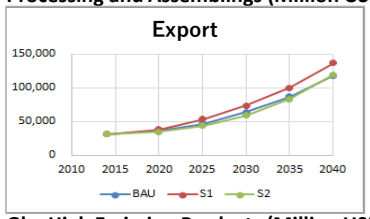
Fishing (Million USD in Y2014 Price)

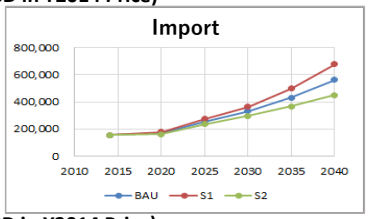


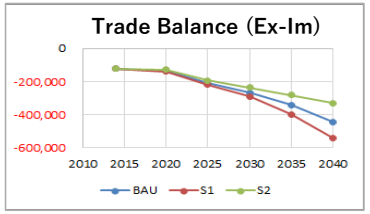




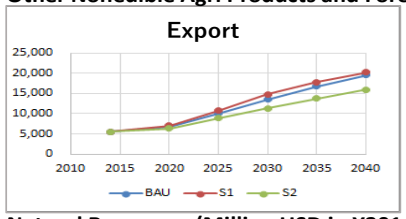
Processing and Assemblings (Million USD in Y2014 Price)

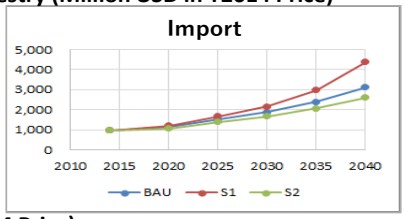


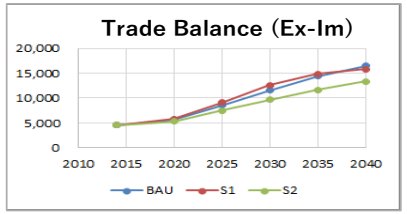




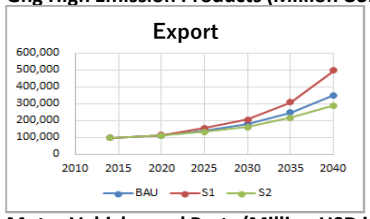
Other Nonedible Agri Products and Forestry (Million USD in Y2014 Price)

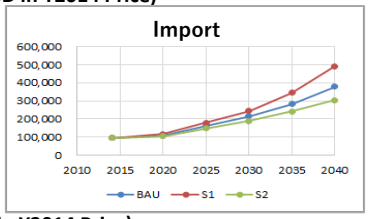


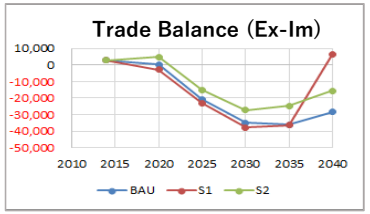




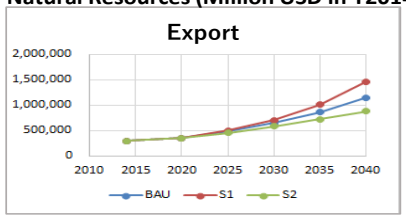
Ghg High Emission Products (Million USD in Y2014 Price)

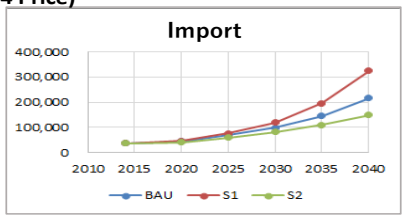


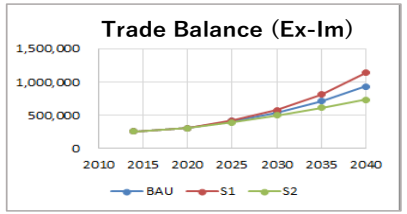




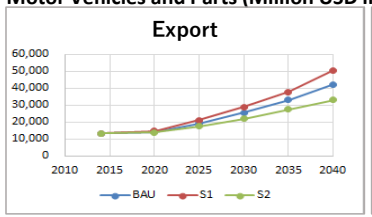
Natural Resources (Million USD in Y2014 Price)

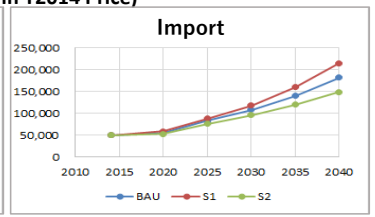


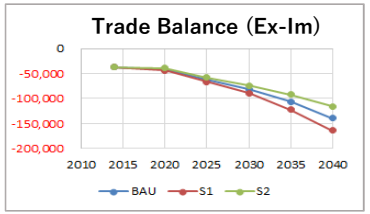




Motor Vehicles and Parts (Million USD in Y2014 Price)



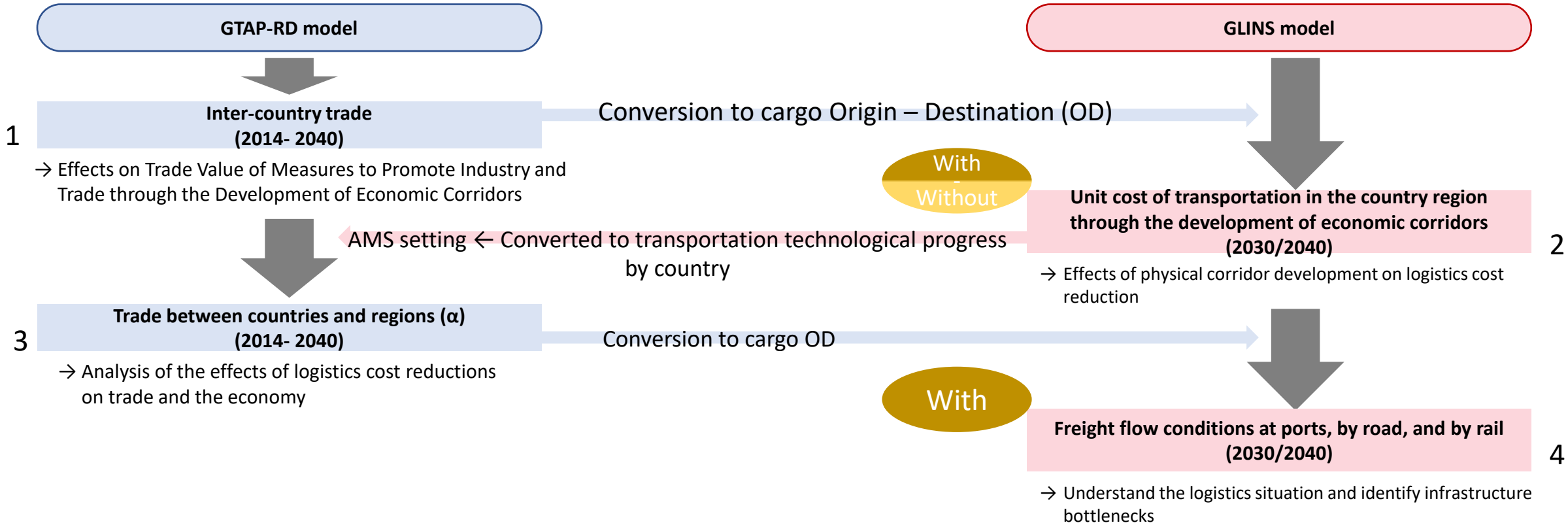




Different industrial sectors will have different transitions for each scenario, and some sectors will not have the best results under the S1 scenario.

5. GLINS Model Analysis

■ Utilize calculation results from the Global intermodal Logistics Network Simulation (GLINS) model (linkage of GTAP-RD model and GLINS model)



■ The transportation technological progress due to infrastructure development is set by AMS in the GTAP-RD model.

- AMS is a 3-dimensional parameter of "exporting country, importing country, goods
- AMS can be set as a shock to exogenously reduce international transaction costs due to advances in transportation technology, etc.

5. GLINS Model Analysis

■ This GLINS model is a transportation mode selection and allocation model

- ➢ The inter-regional transportation demand volume (in the form of cargo Origin - Destination) is considered
- ➢ The maritime and land transportation network are a given condition,
  - ✓ Transportation modes and routes of the cargo are selected individually.
- ➢ Assumes a set capacity for each of the transportation modes (ships, road, rail, and inland waterway)
  - ✓ Congestion occurs when approaching the upper limit of capacity.

■ For the future estimation using the GLINS model:

- ➢ a logistics network consisting of ship, road, and rail transport networks was first constructed following the actual logistics infrastructure network,
- ➢ A “current” model was built and calibrated
  - ✓ Ensure reproducibility using available empirical data (as of 2016) such as trade data, port statistics, customs statistics, and data acquired from logistics service operators.

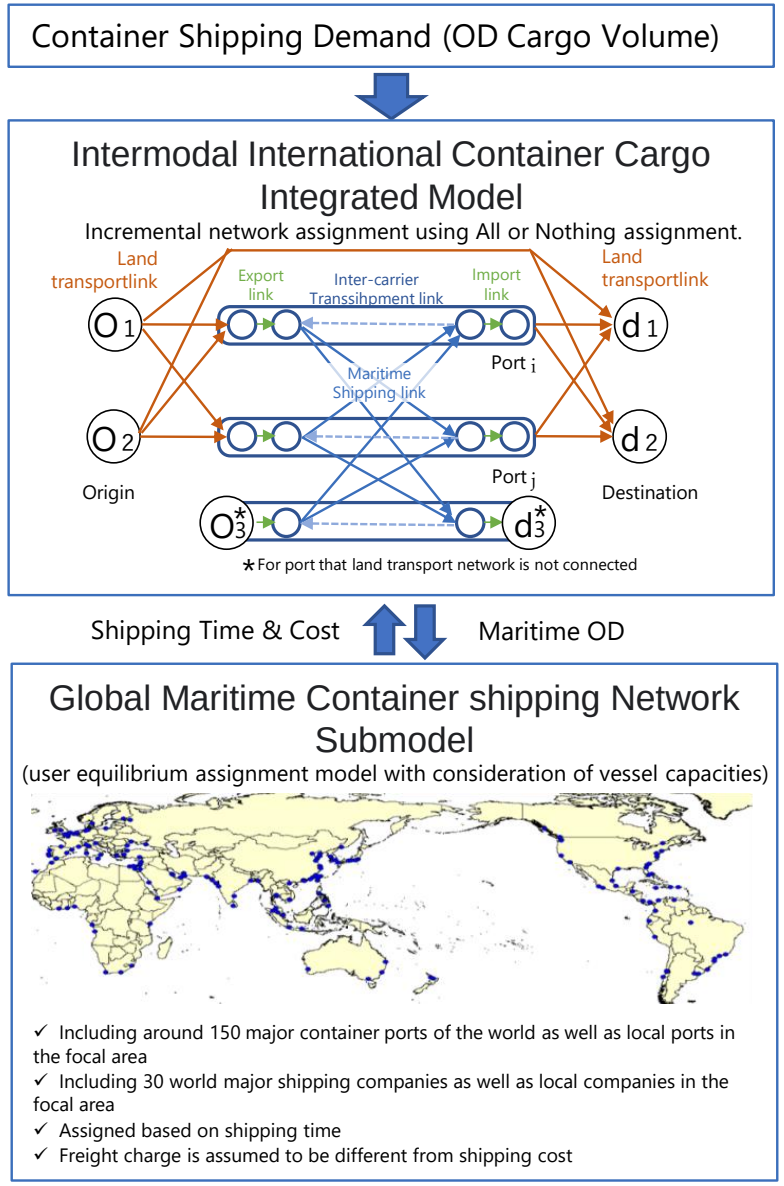


Figure. GLINS Model Structure

5. GLINS Model Analysis

- **Effect of the logistics infrastructure development (e.g. economic corridor development) was examined by conducting a comparative analysis**

Treated:
Economic Corridor Network Dataset and Parameter Settings

Vs

Untreated:
Without Economic Corridor Settings

Corridor infrastructure development (physical development)

+

Cross-border trade facilitation through OSBP development (operational improvement measures)

Does not manipulate these factors.

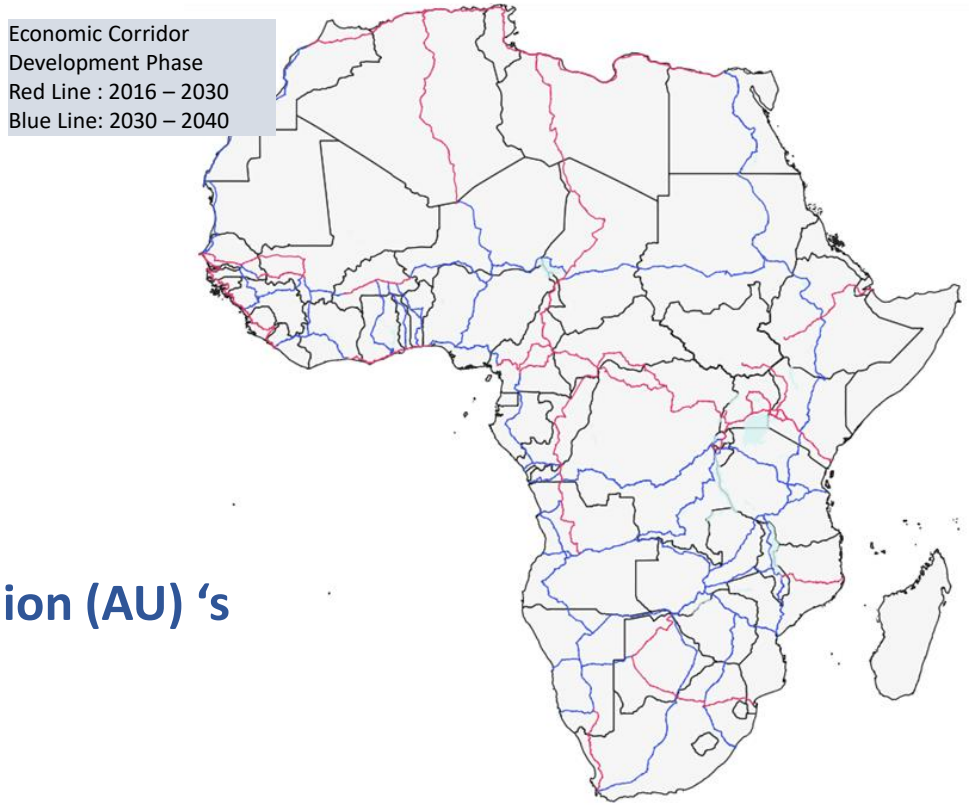


Figure. Economic Corridor Setting in the GLINS Model

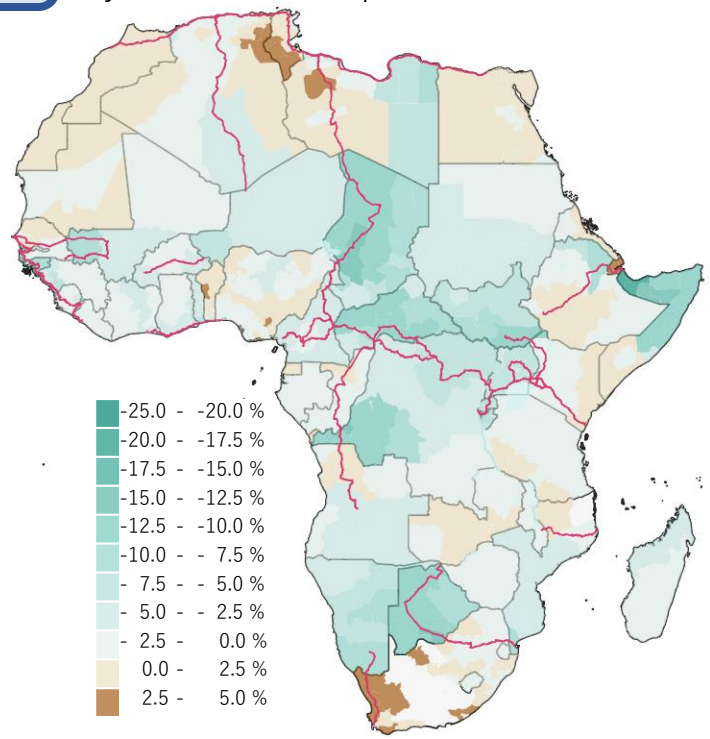
- **The dataset and the parameters: field interviews and African Union (AU) 's Programme for Infrastructure Development in Africa (PIDA).**

5. GLINS Model Analysis

Logistics cost reduction rate:

-24.7% to 22.9%
(-2.00% to 1.49% per year)

Y2016→'Y2030 Cost Reduction Rate
by Corridor Development on red lines



Y2030→'Y2040 Cost Reduction Rate
by Corridor Development on blue lines

-25.2% to 33.6%
(-2.86% to 2.94% per year)

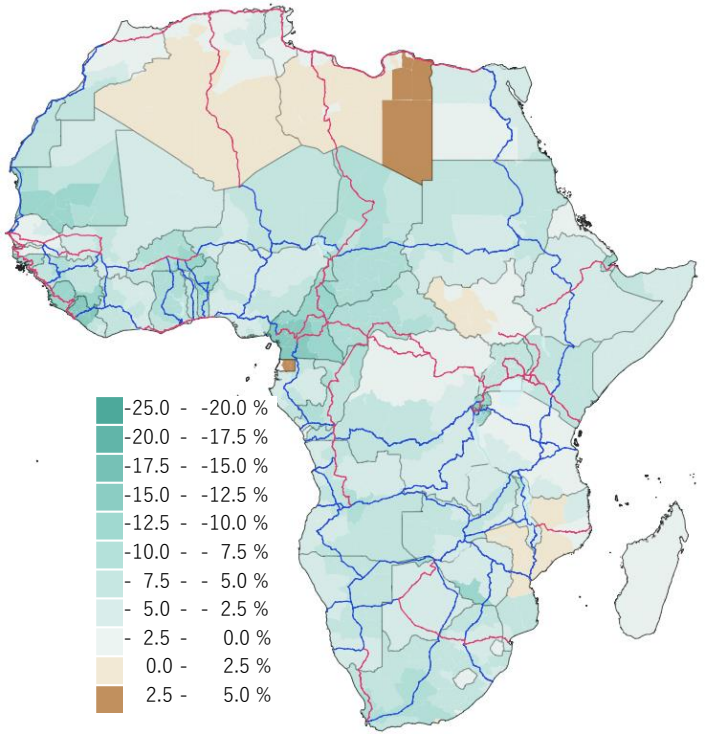
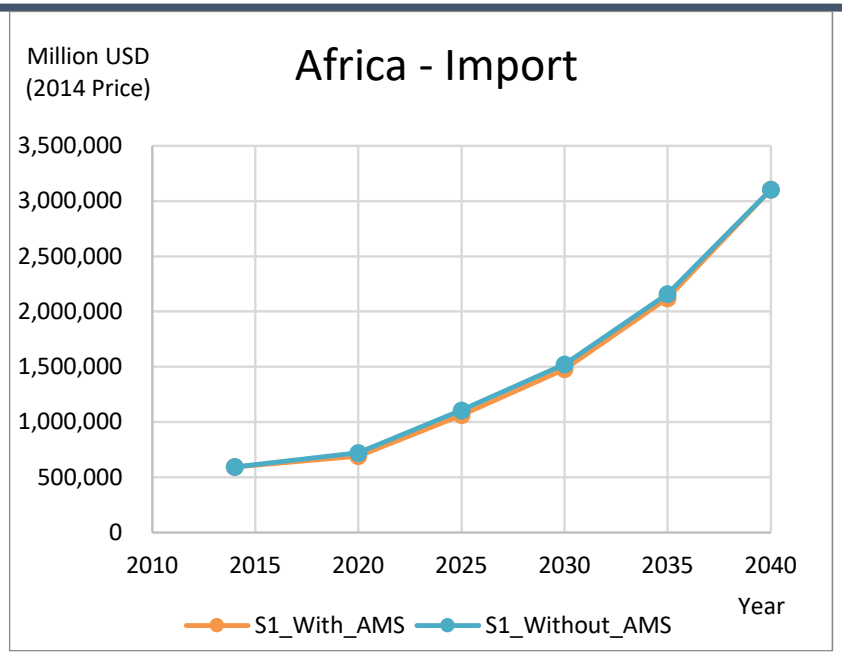
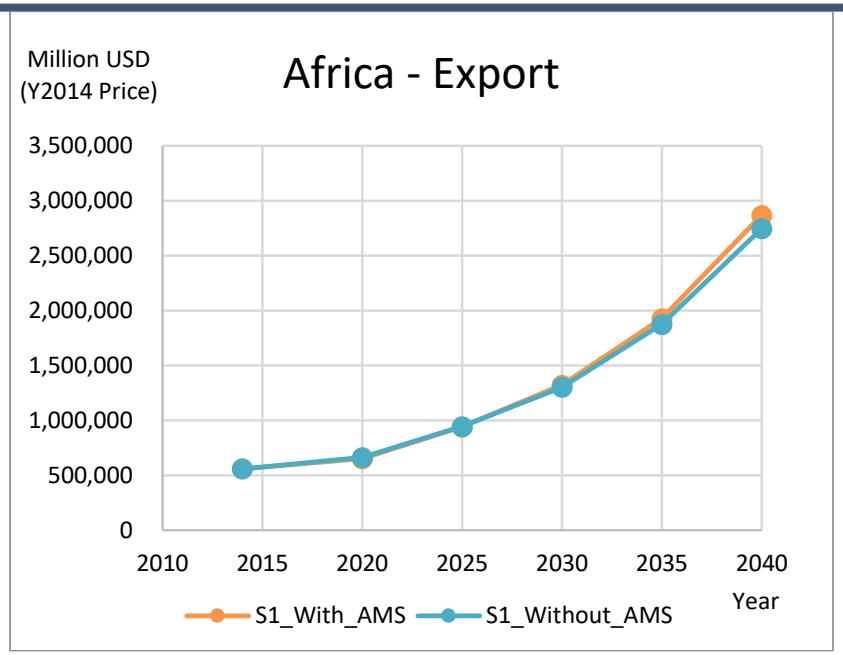


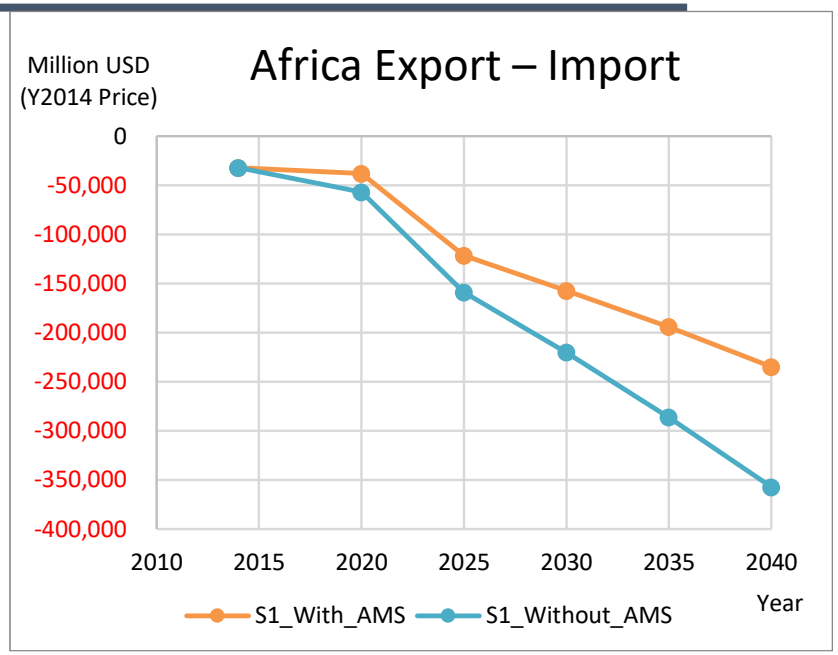
Figure. GLINS model estimation results

Corridor development in 2016-2030 lowers transportation costs mainly for countries along the corridor within Africa, while corridor development in 2030-2040 covers countries and regions where economic corridors were absent until 2030, lowering logistics costs across Africa.

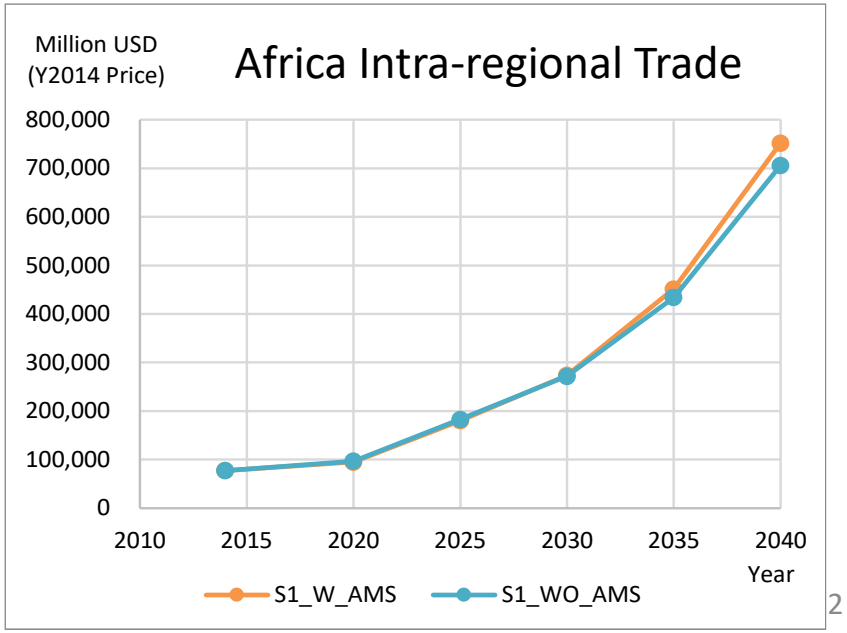
6. Results of the GTAP-RD model analysis with AMS setting







- Africa's exports with AMS are higher in 2040 than that without AMS, while imports with AMS are slightly lower than that without AMS.
- Africa's internal trading with AMS is higher in 2040 than that without.



7. Conclusion

- **The GTAP-RD model estimates showed that Africa's international trade expands the most under the S1 scenario, which assumes a V-shaped recovery from COVID-19.**
  - However, some industrial sectors and countries/regions reversed between scenarios (expanding most in the S2 and BAU scenarios). This is indicating that the impact of COVID-19 and other factors is not necessarily uniform across regions and industries through international trade.
  - The expanded import-surplus can be interpreted as an indication of the need for policies to strengthen Africa's export competitiveness so that it can participate in the global supply chain on more favorable terms, and investment in logistics infrastructure is one such policy.

- **The GTAP-RD model with the GLINS model estimates set to the AMS parameter indicates that exports higher in 2040 than they would have been without the AMS parameter, while imports are lower than before the AMS parameter was set.**
  - This result can first be interpreted as an indication that Africa's trade deficit could be improved by economic corridor development.

7. Conclusion

- **Finally, the findings are expected to be used to improve and prioritize plans for the development of logistics infrastructure such as economic corridors. However, the following issues remain.**

➢ A detailed analysis is needed to interpret the fact that while exports increased as a result of the AMS, imports did not increase compared to the estimation done before AMS was set.

➢ We estimated the future using the GLINS model and the GTAP-RD model using the results for the S1 scenario only, but the current global situation includes several risks not only COVID-19. Since risks appear to be more apparent and destabilizing, we recognize the need to conduct similar estimations for other BAU scenarios and S2 scenarios in the future.

Thank you for your attention.

Please email masahiro.abe@ss.pacific.co.jp
if you have any questions on this paper and presentation.