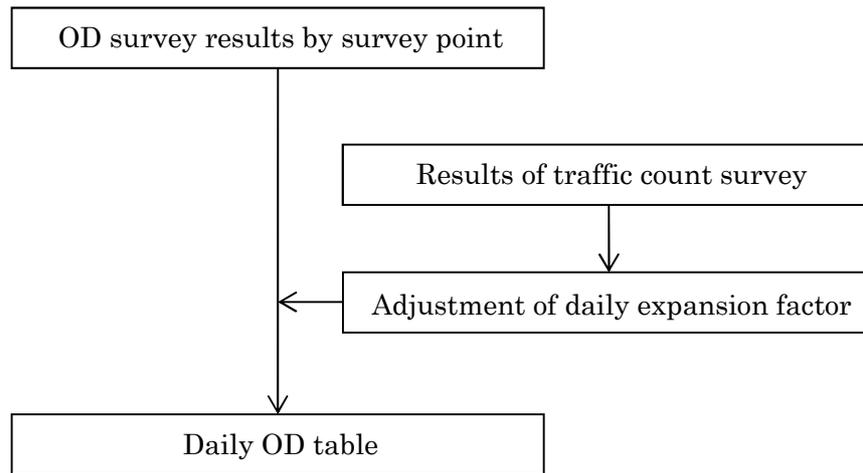


8.3 OD Survey Results

8.3.1 Basic concept of the Preparation of Daily OD table

As the data collected by the OD survey is the sampling data, we organized the expanded results obtained by the following procedure, using the daily traffic volume based on the results of traffic count survey.



Source : JICA Study team

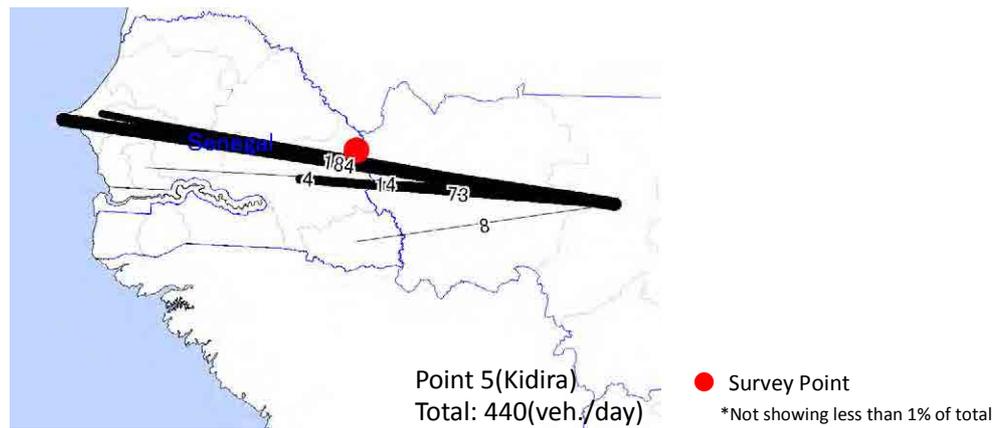
Figure 8-7 Steps for preparation of the daily OD table

8.3.2 Results of Roadside OD Survey

(1) Trip distribution (desire line diagram)

An trip distribution of daily traffic volume is drawn for points that are located on the corridor between landlocked countries and coastal countries.

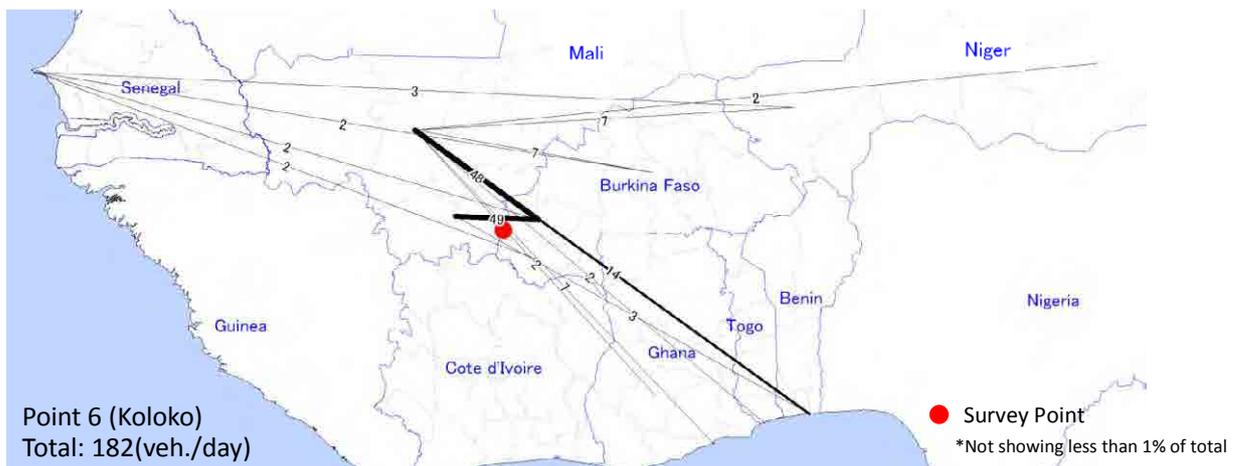
Concerning point 5 (Kidira; Border point Senegal-Mali), there is a great deal of flow between Senegal and Mali. Flow to Burkina Faso and further east cannot be seen.



Source : JICA Study team

Figure 8-8 OD Distribution at the border point Senegal -Mali (veh. /day)

At point 6 (Koloko; Border point Mali-Burkina Faso), there was a great deal of flow between Mali and Benin, following the flow between Mali and Burkina Faso.

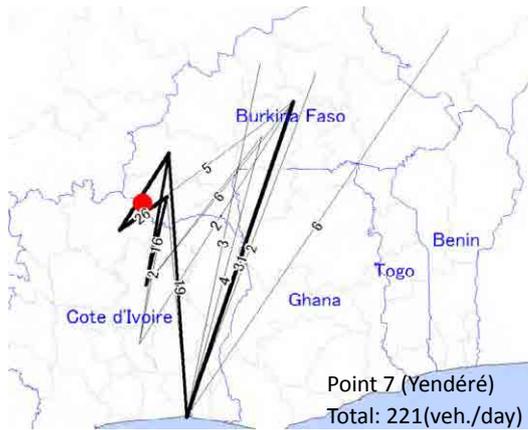


Source : JICA Study team

Figure 8-9 OD Distribution at the border point Mali- Burkina Faso (veh. /day)

At the surveyed point 7 (Yendéré; Border of Burkina Faso-Cote d'Ivoire), and point 8 (Dakola; Border of Burkina Faso-Ghana), most of the flow is between Burkina Faso and Cote d'Ivoire or Burkina Faso and Ghana. For the latter, flow between Mali and Ghana is remarkable.

At point 9 (Cinkansé; Border of Burkina Faso-Togo), most of the flow occur between Burkina Faso and Togo, followed by that between Niger and Togo.



Source : JICA Study team

Figure 8-10 OD Distribution at the border point Burkina Faso-Cote d'Ivoire (veh. /day)

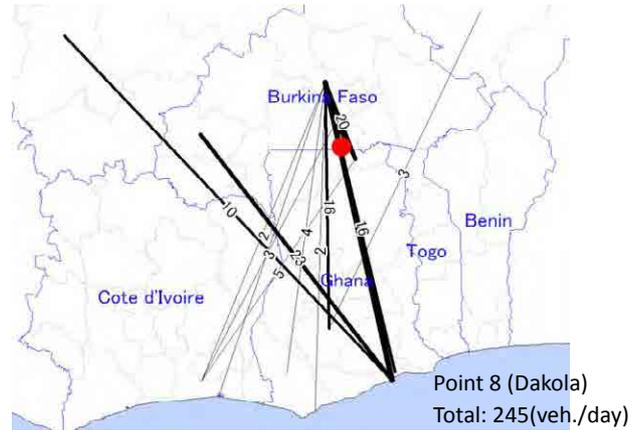
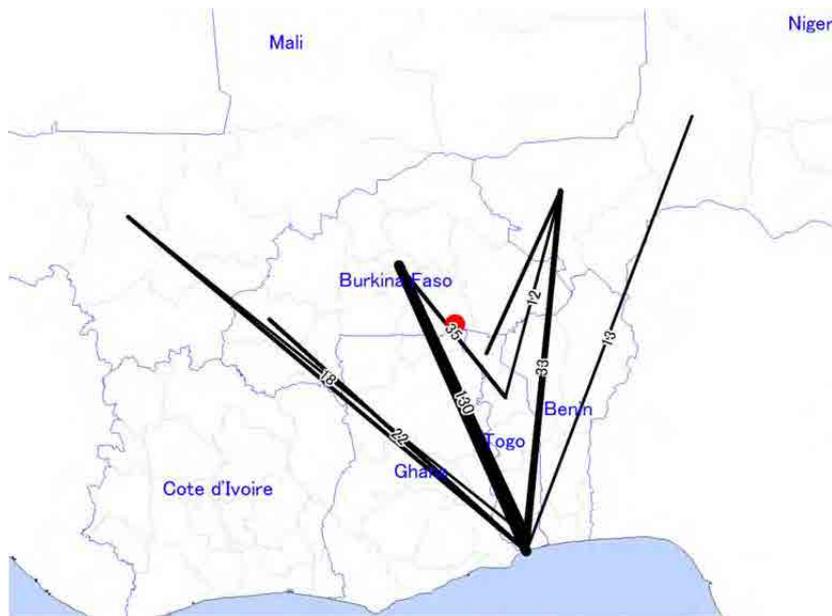


Figure 8-11 OD Distribution at the border point Burkina Faso-Ghana (veh. /day)



● Survey Point
*Not showing less than 1% of total

Point 9 (Cinkansé)
Total: 598(veh./day)

Source : JICA Study team

Figure 8-12 OD Distribution at the border point Burkina Faso - Togo (veh. /day)

At point 10 (Kantchari; Border of Burkina Faso-Niger), there was a great deal of flow between Niger and Togo. Following the flow between Niger and Burkina Faso, there is a relatively great deal of flow to Ghana and Cote d'Ivoire.

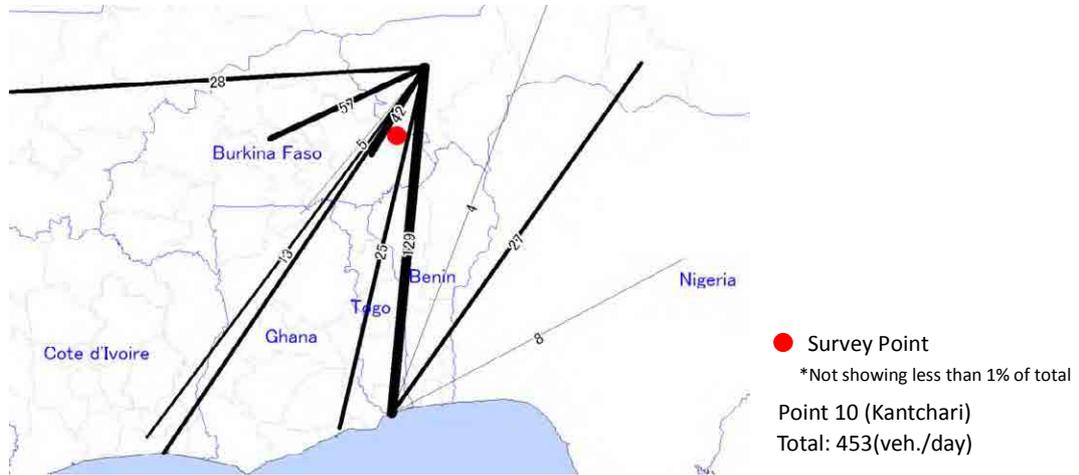
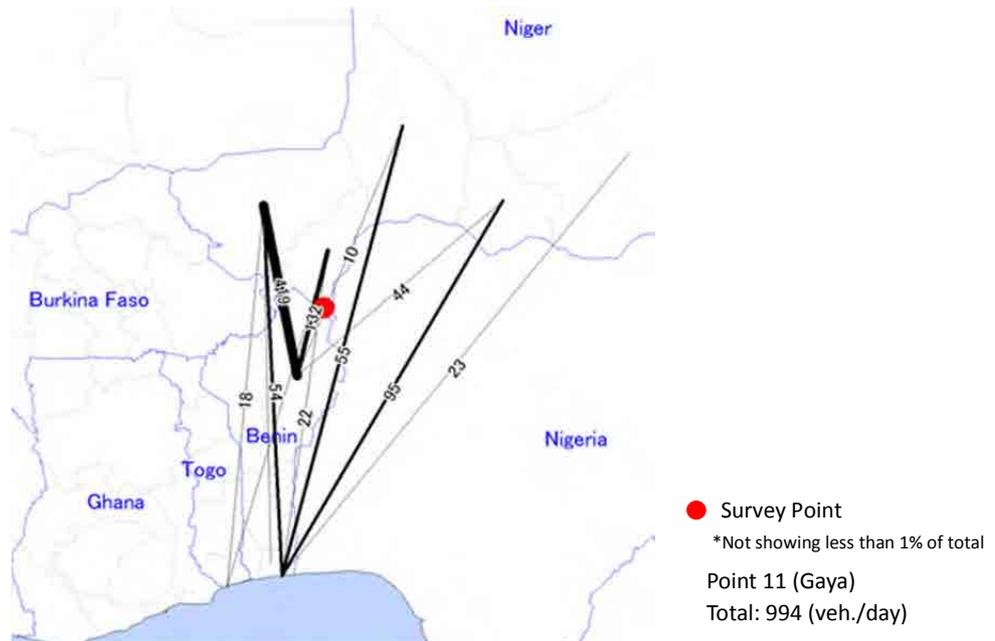


Figure 8-13 OD Distribution at the border point Burkina Faso – Niger (veh. /day)

At point 11 (Gaya; Border of Niger-Benin), most of the flow occur between Niger and Benin, followed by that between Niger and Togo. The flow between East Niger and Cotonou was notable as well.

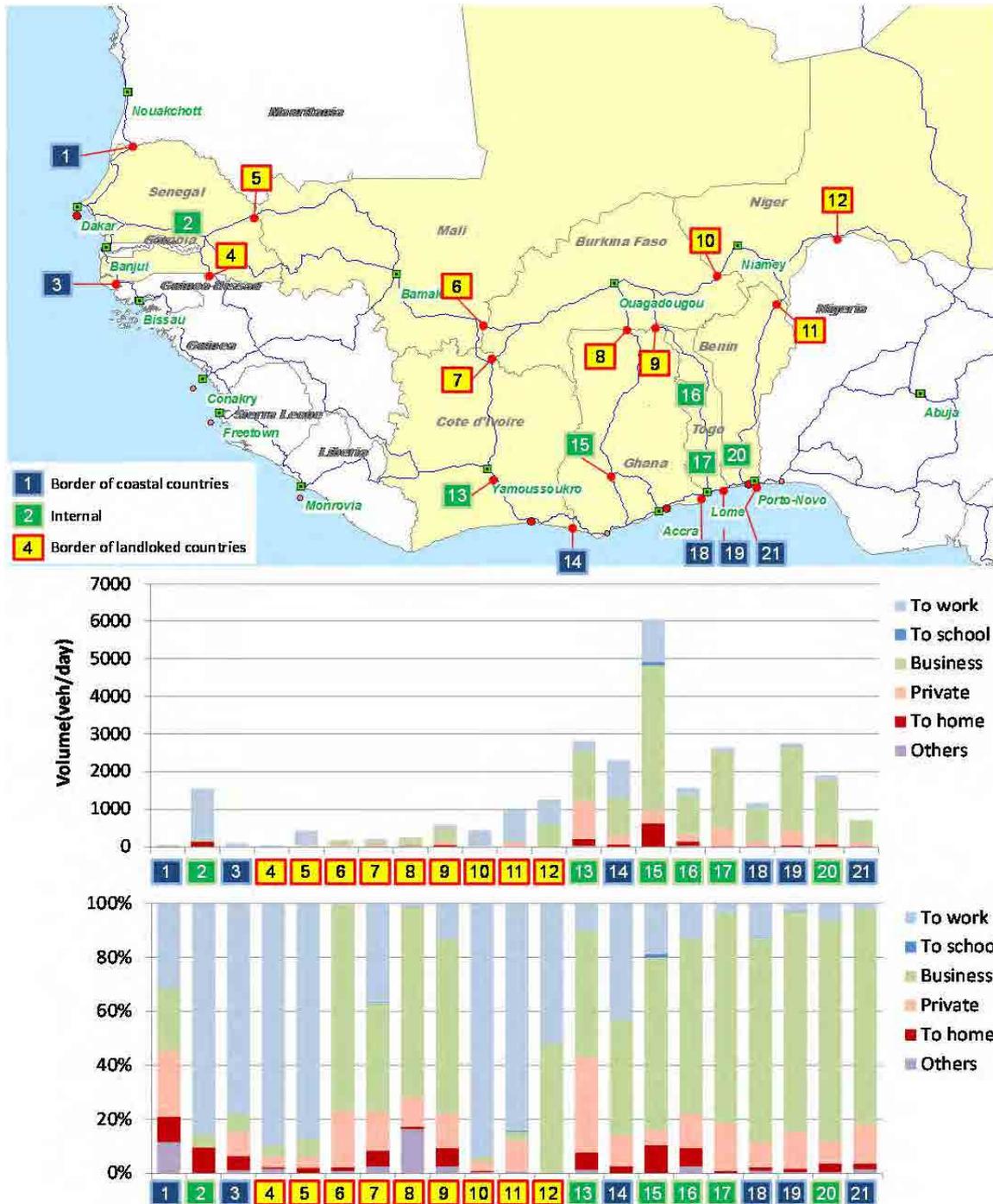


Source : JICA Study team

Figure 8-14 OD Distribution at the border point Niger - Benin (veh./day)

(2) Trip Purpose

By number of cars, trips for business purposes were the most numerous, and, by share, work purpose is the prevailing purpose on the borders of Senegal and Niger (Survey Point 5, 10 and 11). The private trip is limited on the borders.



Note: Daily average volume after expansion of OD samples
 Source : JICA Study team

Figure 8-15 Trip purpose

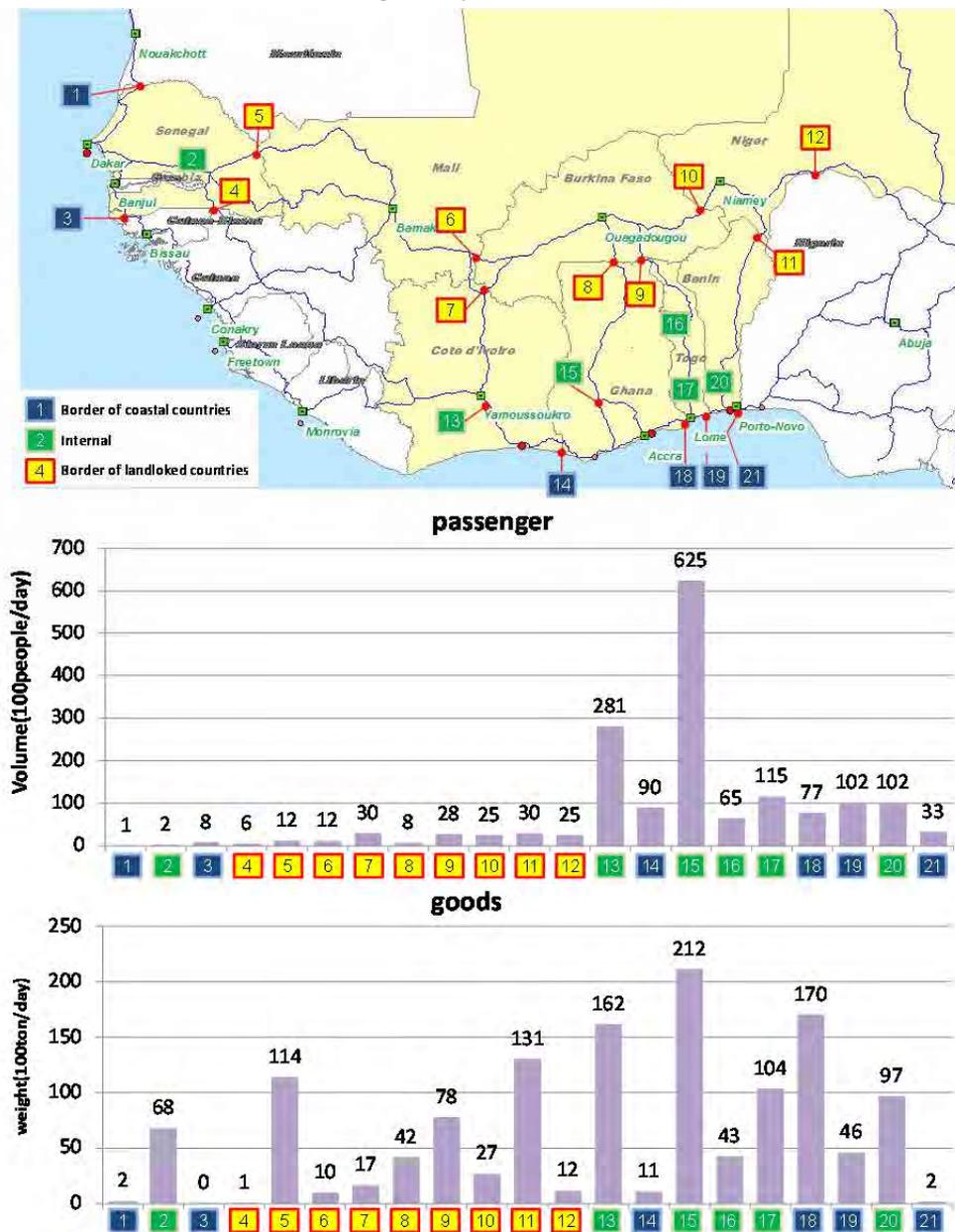
(3) Number of passengers and freight volume weight basis

1) Number of passengers

There were many passengers at points 15 and 13 where are on the internal. South coastal points 14 and 18 had many passengers, but there were not many at others.

2) Freight volume weight basis

The transportation volume is large at point 15 in the Ghana. The cross-border transportation is great at point 18 between Ghana and Togo, at survey point 11 between Niger and Benin, and at survey point 5 between Senegal and Mali. At the borders of Burkina Faso, the freight volume of individual roads is not much though many roads have been built.



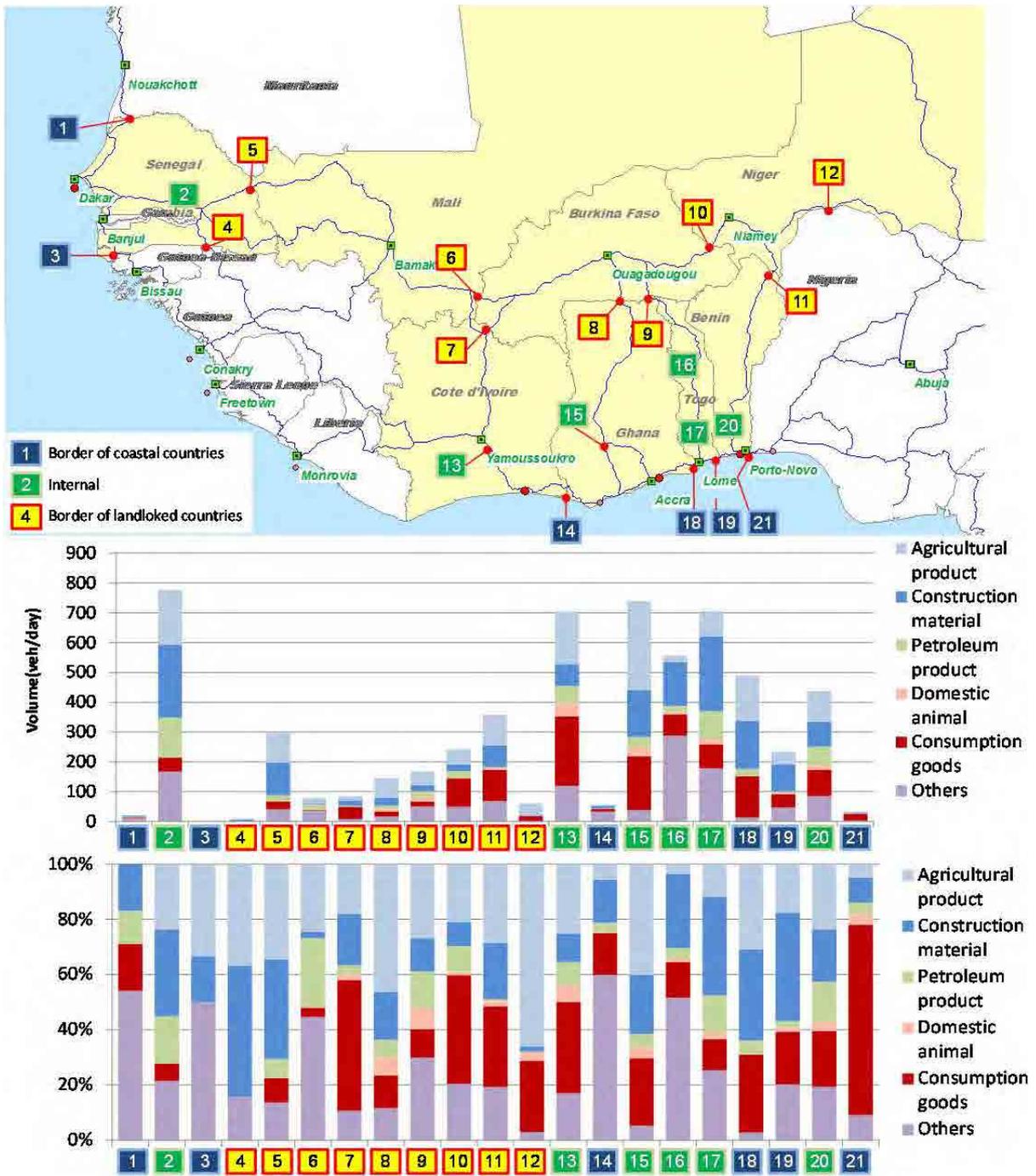
Source : JICA Study team

Figure 8-16 Numbers of passengers and volume of goods

(4) Types of freight

1) Number of vehicles basis

By numbers of vehicles, relatively large numbers of vehicles carrying agricultural products were recorded at point 15, and relatively large numbers of vehicles carrying consumer goods at points 15, 13, and 18; construction materials accounted for large numbers of vehicles at points 17, and 2.

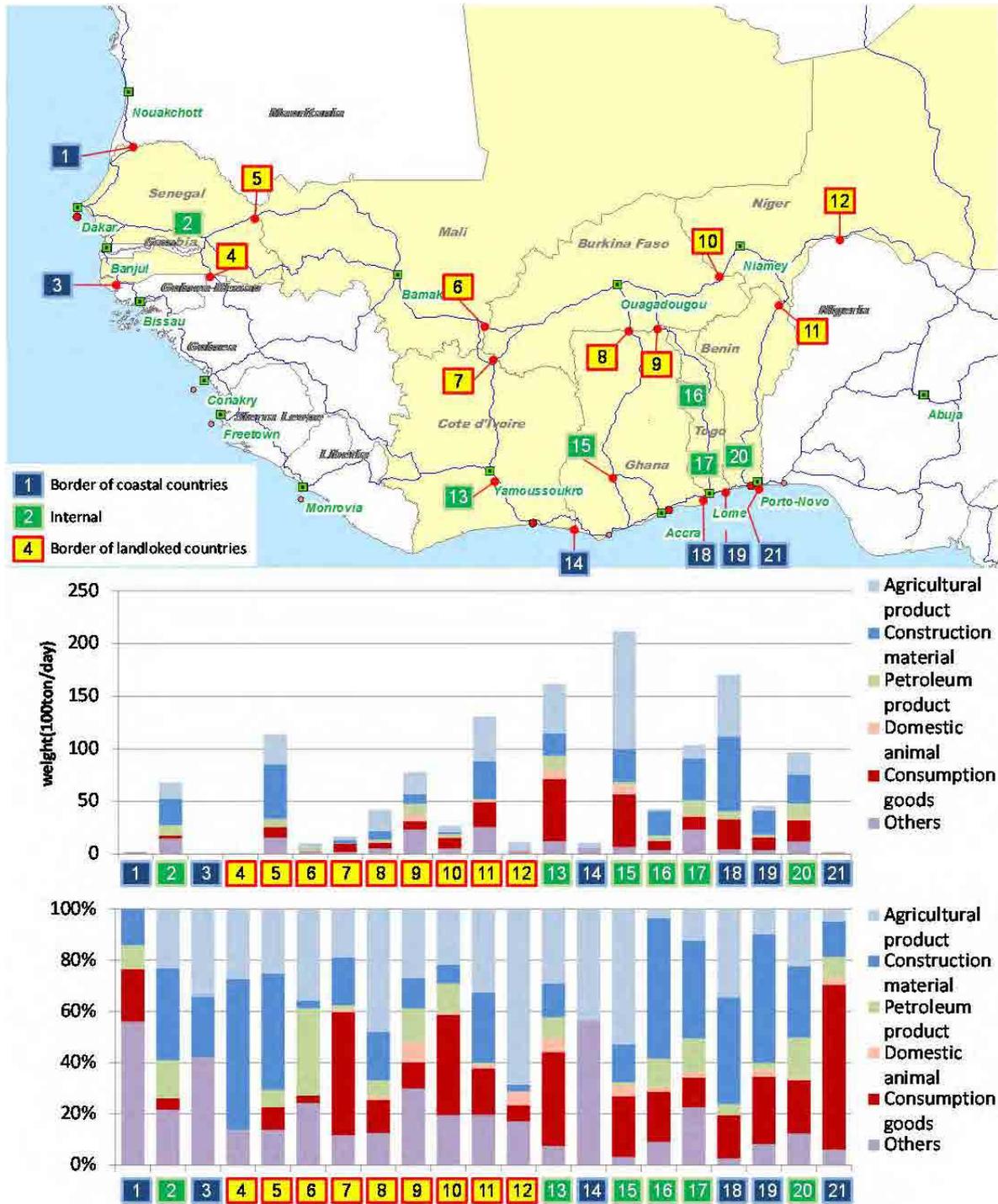


Source : JICA Study team

Figure 8-17 Composition of goods (Vehicles basis)

2) Weight volume basis

By weight, agricultural products accounted for a high share of the freight transported at points 15 and 18; as did construction materials at points 18 and 5, and consumer goods at points 13 and 15.

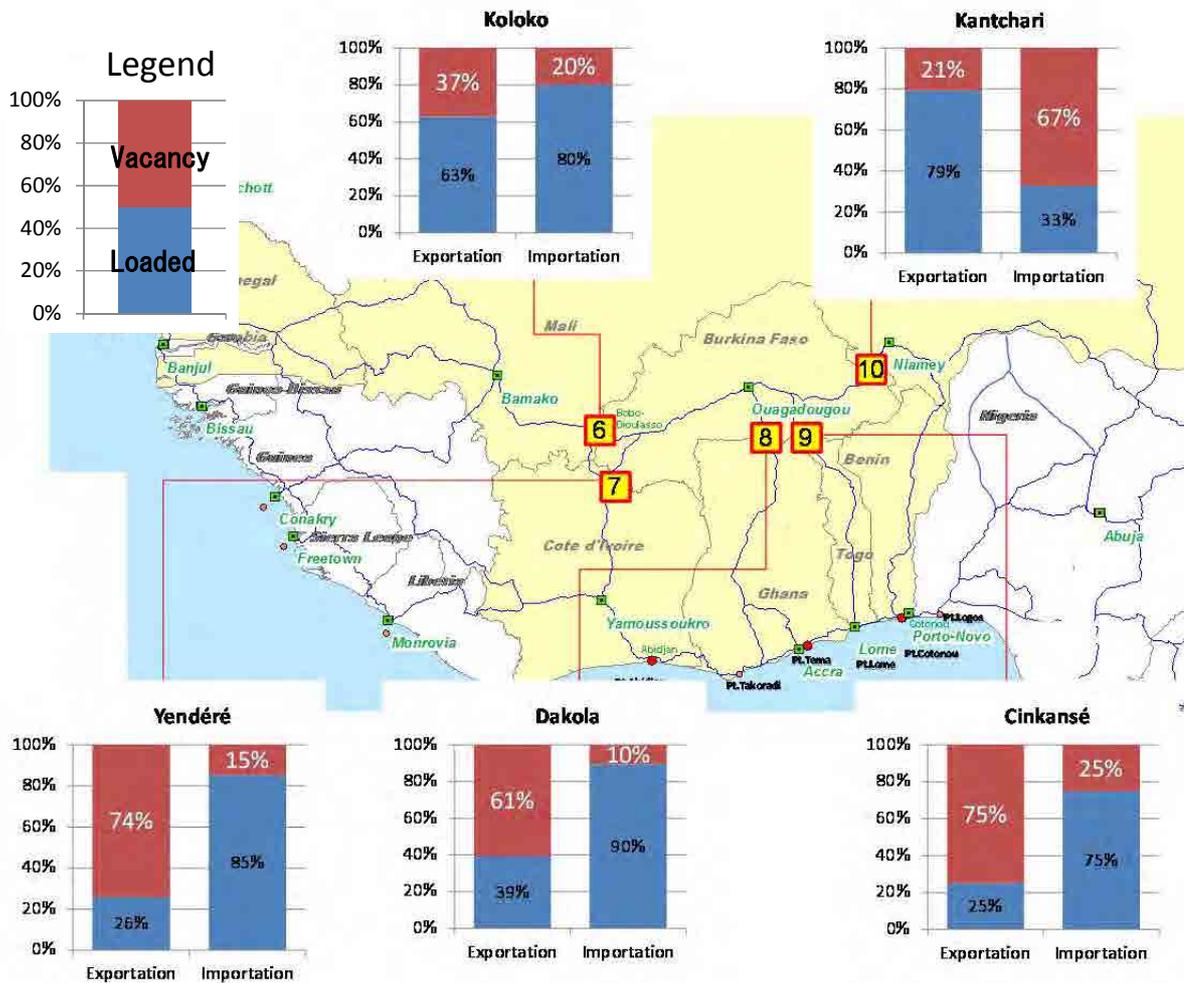


Source : JICA Study team

Figure 8-18 Composition of goods (Weight basis)

3) Vacancy ratio

In the case of exportation, the vacancy ration of heavy truck was high at border between landlocked countries and coastal countries (Cinkansé, Yendéré, and Dakola), amounting to 75 % at maximum.



Note: Light truck is excluded
Source : JICA Study team

Figure 8-19 Vacancy ratio of heavy truck

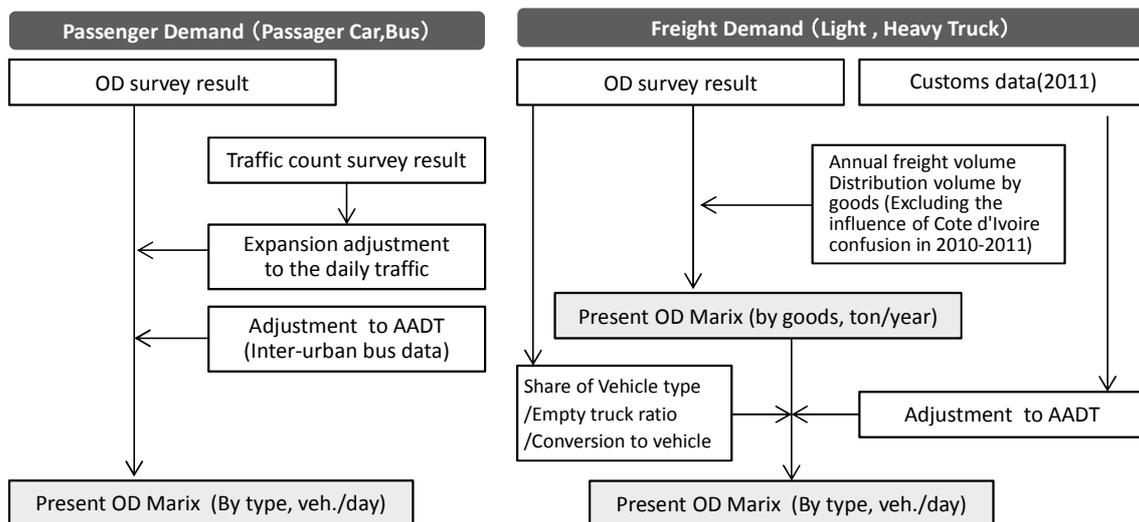
8.4 Analysis of Present Traffic Flow

8.4.1 Preparation of Present OD tables

In analyzing traffic flows, data obtained from OD surveys were analyzed to prepare OD tables to indicate the present situation (2011). These OD tables were created by separately preparing those for passengers and passenger vehicles and others for freight and freight vehicles.

OD tables for passengers and passenger vehicles were prepared by expanding data obtained from OD surveys and transforming them to data that can be obtained from spot traffic volume surveys. In addition, annual average daily traffic (AADT) was established using data of actual cross-border traffic via intercity bus operation.

OD tables for freight and freight vehicles were prepared based on data obtained from OD surveys and each country's customs clearance data. Customs clearance data can indicate details of how and how much freight flows throughout the year. By using the customs clearance data, several adjustments were made on annual average daily traffic (AADT) and freight volume data by item of goods as well as impact of the Cote d'Ivoire crisis (2010-2011) was eliminated. In addition, empty vehicle rate of freight vehicles was obtained using results of roadside OD surveys to incorporate the rate in OD tables for freight vehicles.



Source : JICA Study team

Figure 8-20 Steps in preparing of present OD tables

(1) Zoning

These targets eight except Senegal are each divided into 2 zones while Senegal is not divided and has 1 zone. In addition, each of major ports was counted as one zone. Neighboring countries were incorporated as appropriate. As the result, the survey area was divided into 27 zones in total.

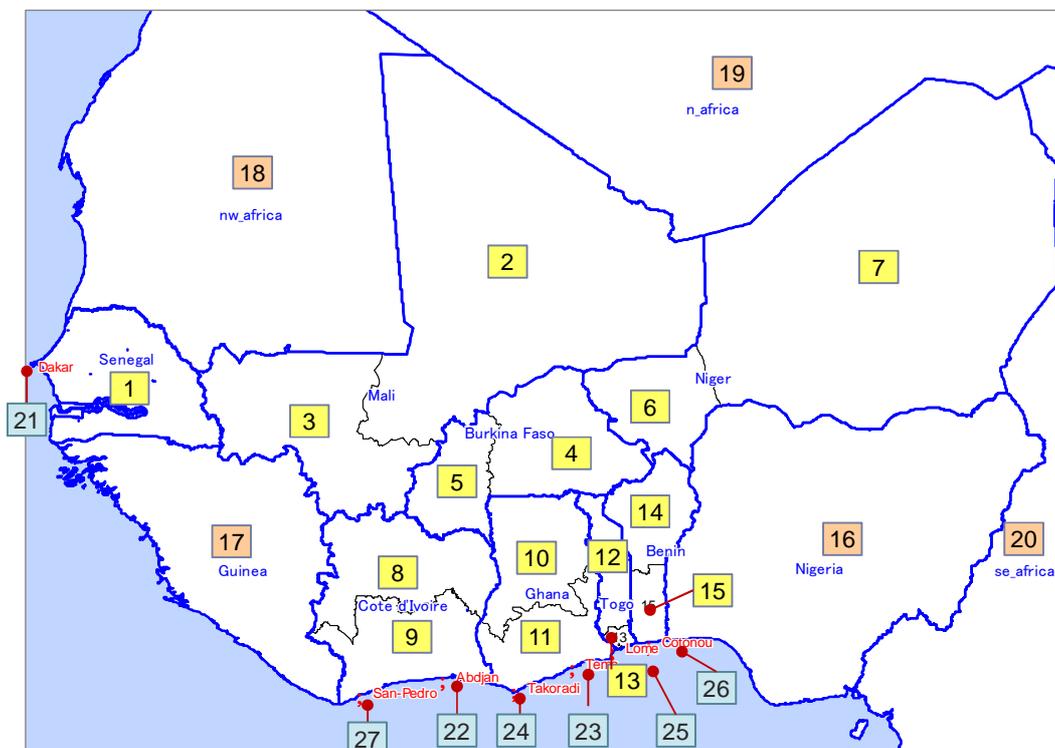


Figure 8-21 Zone of OD table

Table 8-7 Zone code

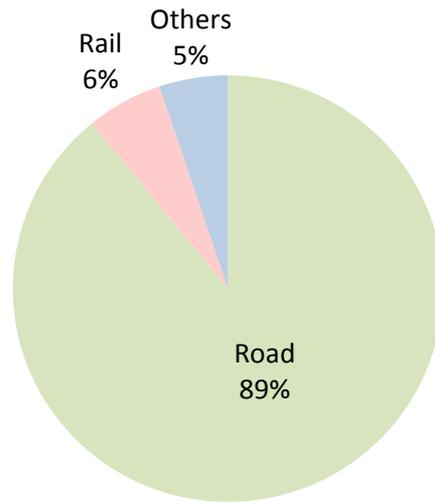
1	Senegal	16	Nigeria
2	Mali(North)	17	Guinea coast
3	Mali(South)	18	North west africa
4	Burkina Faso(East)	19	North african
5	Burkina Faso(West)	20	East,Central,South Africa
6	Niger(Niamey region)	21	Port Dakar
7	Niger(other)	22	Port Abidjan
8	Cote d'Ivoire(North)	23	Port Tema
9	Cote d'Ivoire(South)	24	Port Takoradi
10	Ghana(North)	25	Port Lome
11	Ghana(Sourth)	26	Port Cotonou
12	Togo(North)	27	Port San-Pedro
13	Togo(Sourth)	99	Overseas
14	Benin(North)		
15	Benin(Sourth)		

Source : JICA Study team

(2) Shares of transportation means

According to customs data of the eight countries, we examined the transportation means (at the time of import and export) for imports and exports within the African continent by weight.

The share of transportation means is approximately 90 % for roads, and only about 10 % for railways and others.



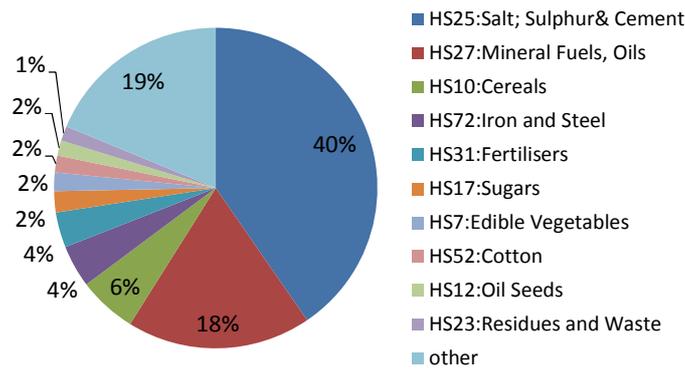
*Others: air, pipeline, unknown, etc.

Source: 2011 Customs data of each country

**Figure 8-22 Shares of transportation mode for imports and exports
(Weight basis, excluding traffic to overseas)**

(3) Top-ranked goods

According to the concept of section 8.4.1, the table for present OD only of vehicle traffic was prepared on the basis of the OD survey results, long-distance bus data, and customs data. The table was prepared according to numbers of vehicles, numbers of passengers, and freight weights. As a freight-weight based OD table, the OD table by ten top-ranked goods (based on HS2 digit code) in the total import/export weights restricted to vehicle transport in the eight countries concerned was prepared as shown below.

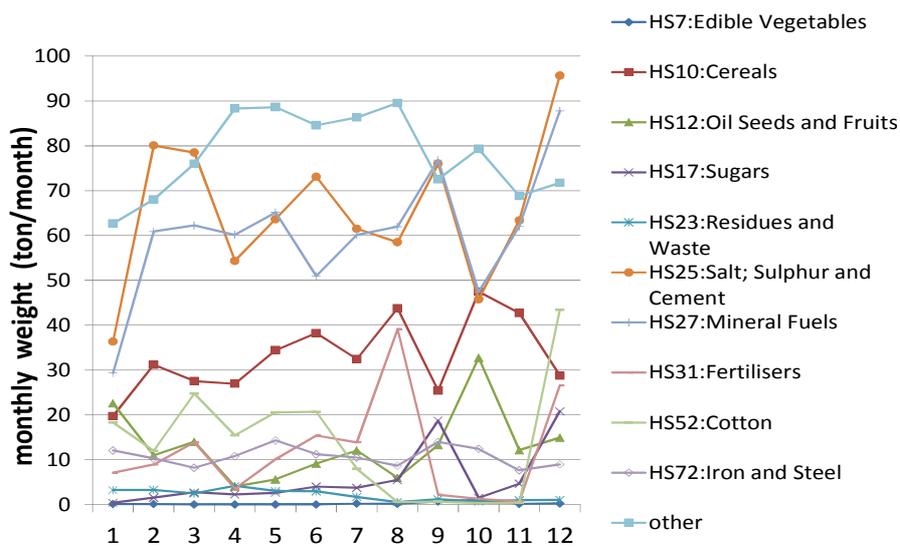


Note: To highlight transport of landlocked countries, road transport of coastal countries handling large amount of freights via their own ports was excluded.

Source: JICA Study team based on customs data

Figure 8-23 Ranking by good

The monthly change of the export/import weights of top-ranked goods in Burkina Faso was shown as follows. Freight vehicle OD table of annual average day was made in consideration of these changes.



Source: JICA Study team based on customs data

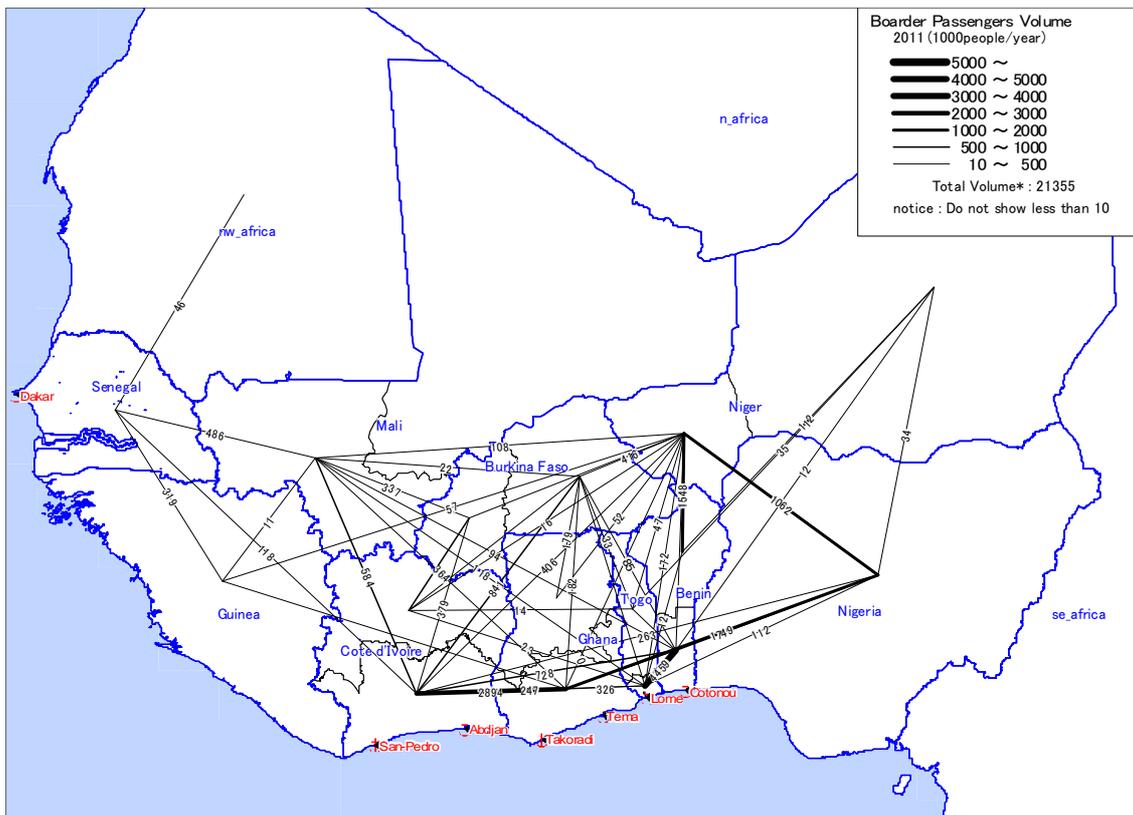
Figure 8-24 Monthly variation of export/import weight in Burkina Faso

8.4.2 Analysis of Present Traffic Flow

(1) Present passenger flow

Overall, the passenger distribution showed a similar trend to that of the total amount by vehicle type, but the amount between the southern and northern zones of Ghana is extremely large. For Senegal, also a coastal country, the flow is not indicated because the distribution ratio of passenger cars and taxis as well as buses is low.

An examination of the flow related to landlocked countries, shows Mali with the largest flow to Cote d'Ivoire, followed by flows to Senegal and Ghana. Burkina Faso shows a dispersed flow to Cote d'Ivoire, Ghana, and Togo, with the flow with Cote d'Ivoire being the largest. Niger has the large flow with Benin and Nigeria, followed by Burkina Faso, which corresponds to the fact that the number of passenger cars and taxis is large there.



Source : JICA Study team

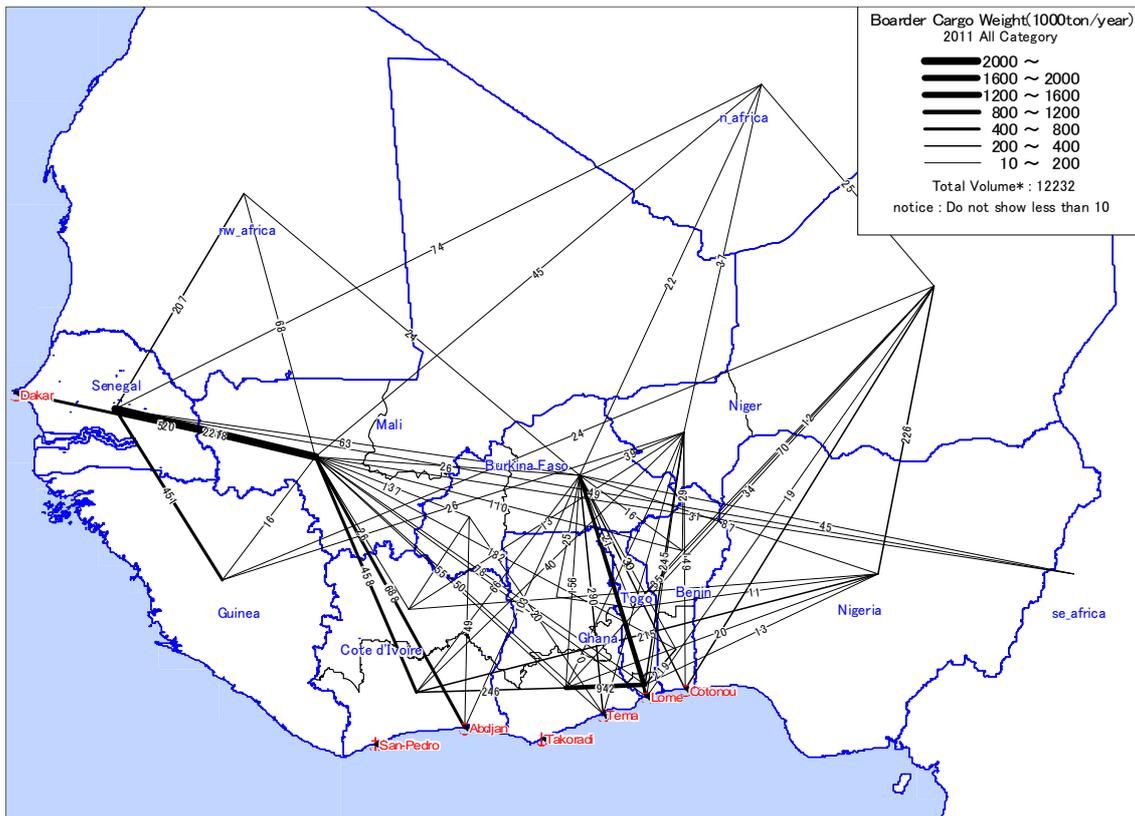
Figure 8-25 Present passengers flow ('000 people /year)

(2) Present freight flow

1) Present freight flow (Total of all goods)

Overall, the flow between zones of coastal countries and ports is large, particularly, in Cote d'Ivoire and Ghana. Large flow in Mali and Senegal is also noteworthy.

An examination of the flow related to landlocked countries indicates that Mali has the largest flow with Senegal. Regarding ports, its flow to Abidjan Port is the largest, followed by Dakar Port. Flow to Lomé Port and others is limited. In the case of Burkina Faso, the flow to Lomé Port is clearly greatest, followed by the ports of Tema and Cotonou. The flow in Burkina Faso is concentrated to the eastern zone, and the number of concentrated occurrences in western zones is limited. Niger shows the largest flow between its eastern zones and Cotonou Port. The flow between the eastern zones and Nigeria is also large. The western zone of Niger shows the large flow with the southern zone of Togo, followed by the flow to Cotonou Port.

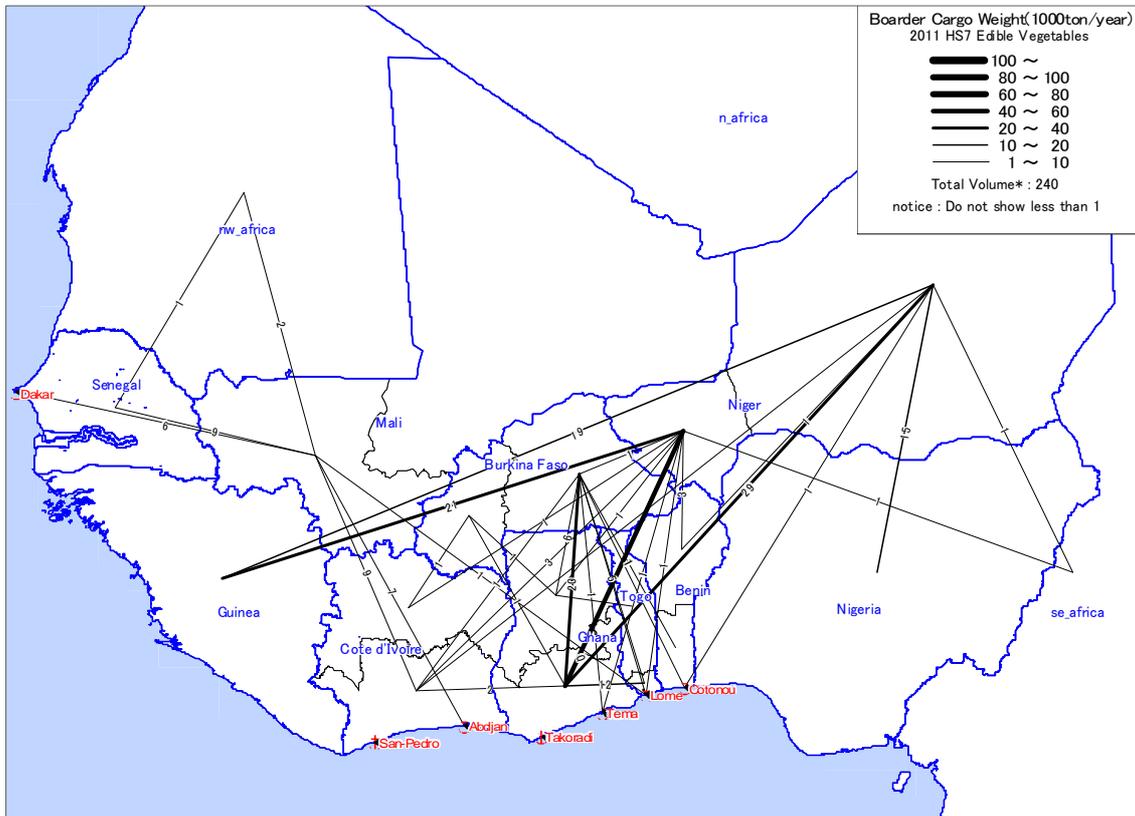


Source : JICA Study team

Figure 8-26 Present freight flow (All goods: '000t/year)

2) Present freight flow (HS7: Edible Vegetables)

Overall, the flow between Senegal and Dakar Port is the largest. For the landlocked countries, the flows between Niger and Ghana's southern zones, and Guinea are large.

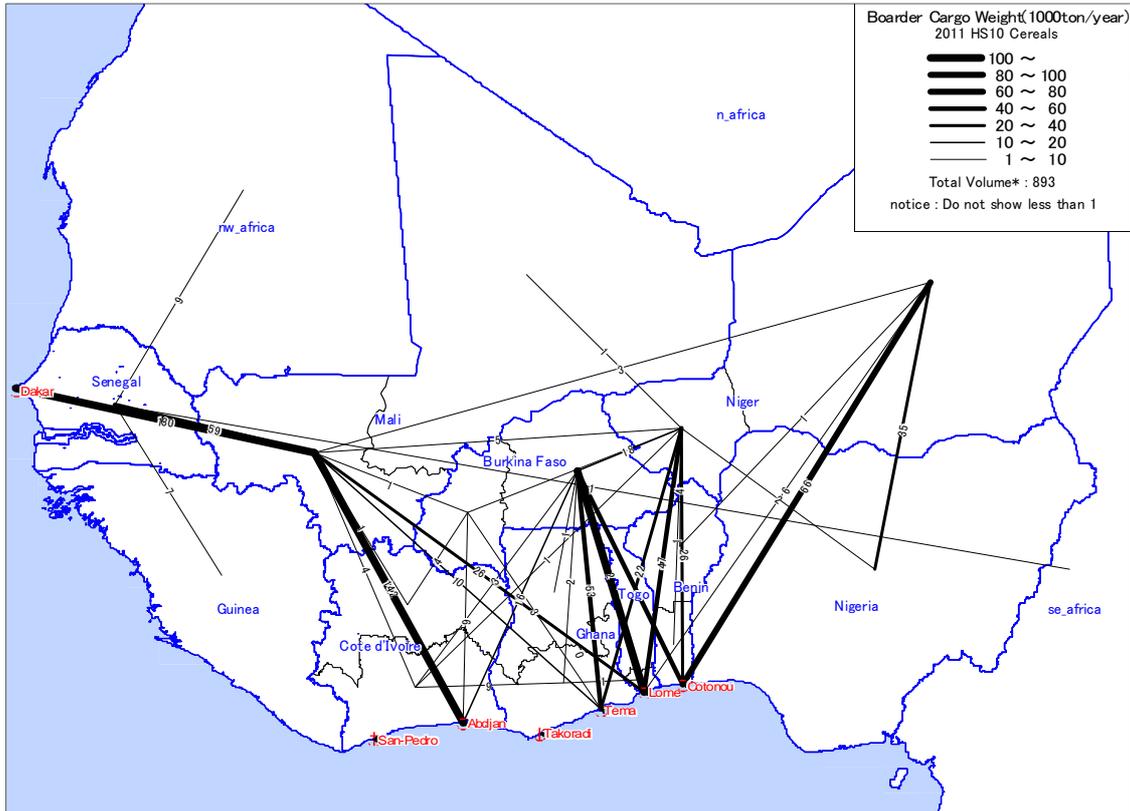


Source: JICA Study team

Figure 8-27 Present freight flow (HS7: Edible Vegetables: '000t/year)

3) Present freight flow (HS10: Cereals)

Overall, the flows between Ghana and Senegal ports and the domestic zones are large. As for the landlocked countries, the flows between Mali and the ports of Abidjan and Dakar are largest, followed by the flow between Burkina Faso and Lomé Port.

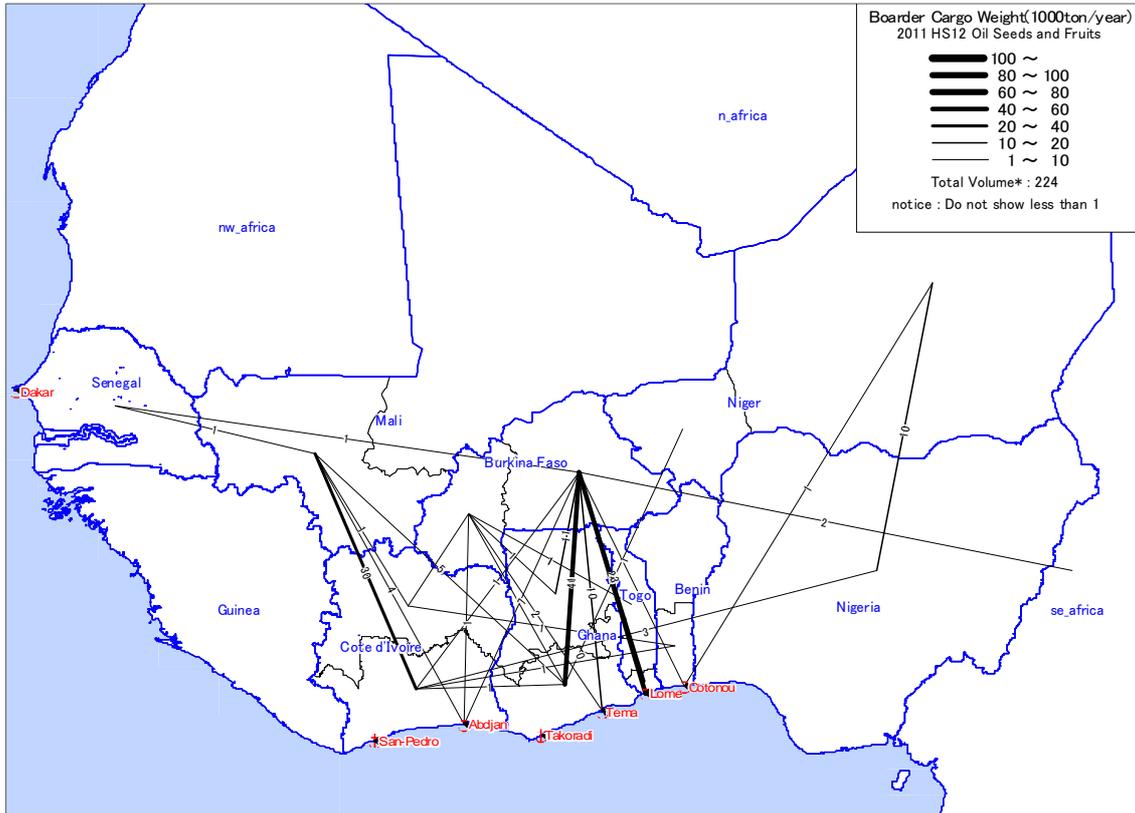


Source : JICA Study team

Figure 8-28 Present freight flow (HS10: Cereals: '000t/year)

4) Present freight flow (HS12: Oil Seeds and Oleaginous Fruits)

The largest flows are between the Burkina Faso eastern zones and Lomé Port. Most of the flows are concentrated in the eastern zone of Burkina Faso, to which the flow comes from the domestic zones and ports of Ghana and Togo.

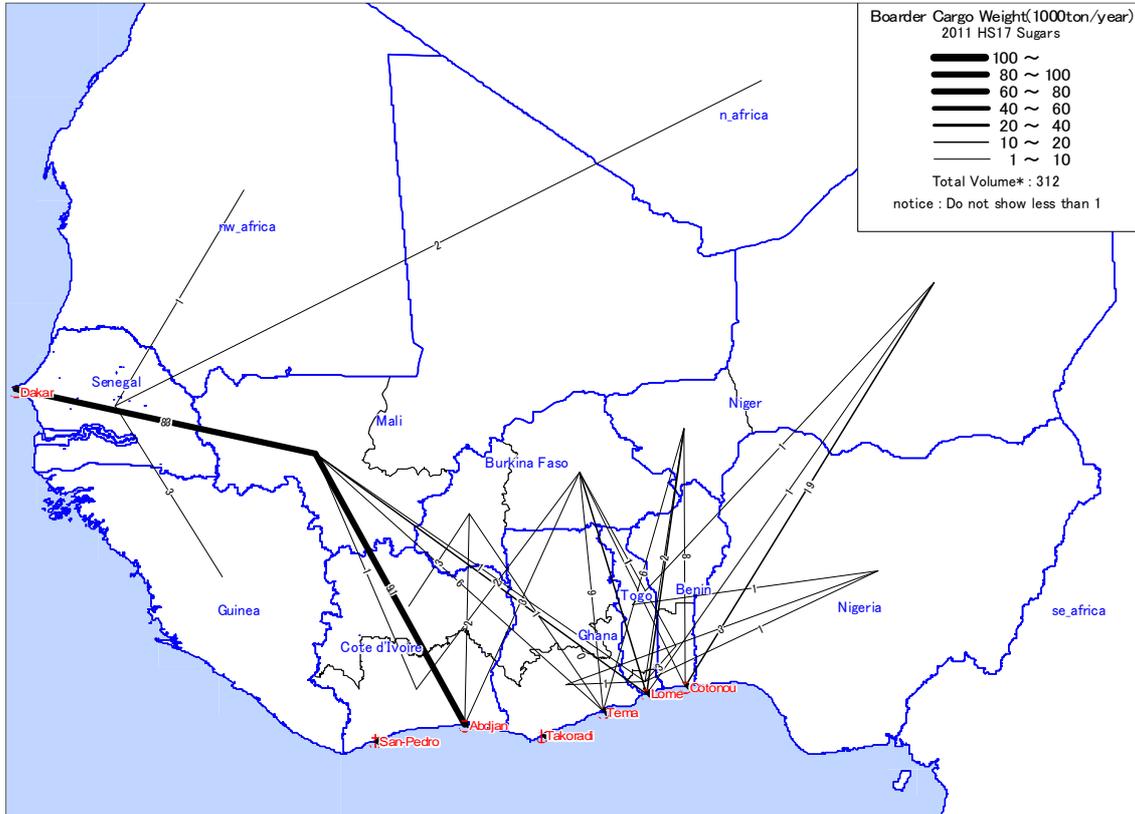


Source : JICA Study team

Figure 8-29 Present freight flow (HS12: Oil Seeds and Oleaginous Fruits: '000t/year)

5) Present freight flow (HS17: Sugars and Sugar Confectionery)

The flows between Mali and the ports of Abidjan and Dakar are the largest.

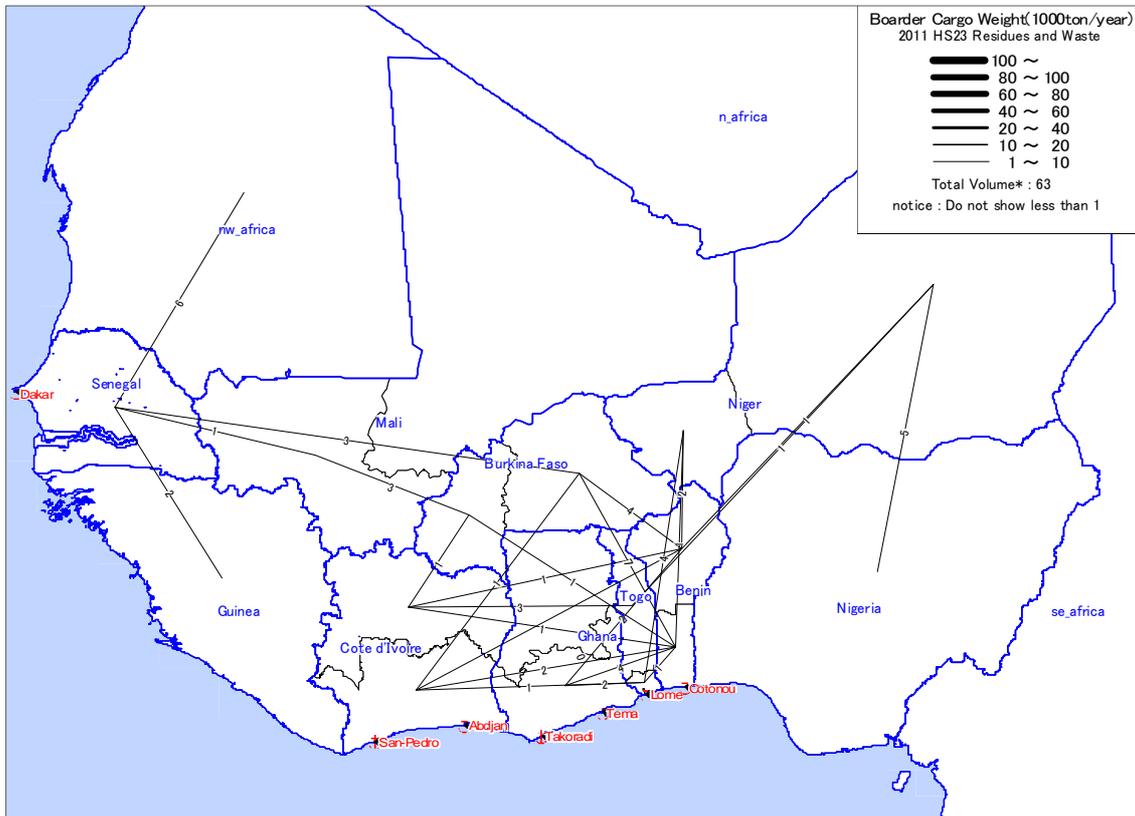


Source : JICA Study team

Figure 8-30 Present freight flow (HS17: Sugars and Sugar Confectionery: '000t/year)

6) Present freight flow (HS23: Residues and Waste)

Most of the flow is between Senegal and North Africa, with partial flows observed between the southern zone of coastal countries to the south of the survey area and the ports.

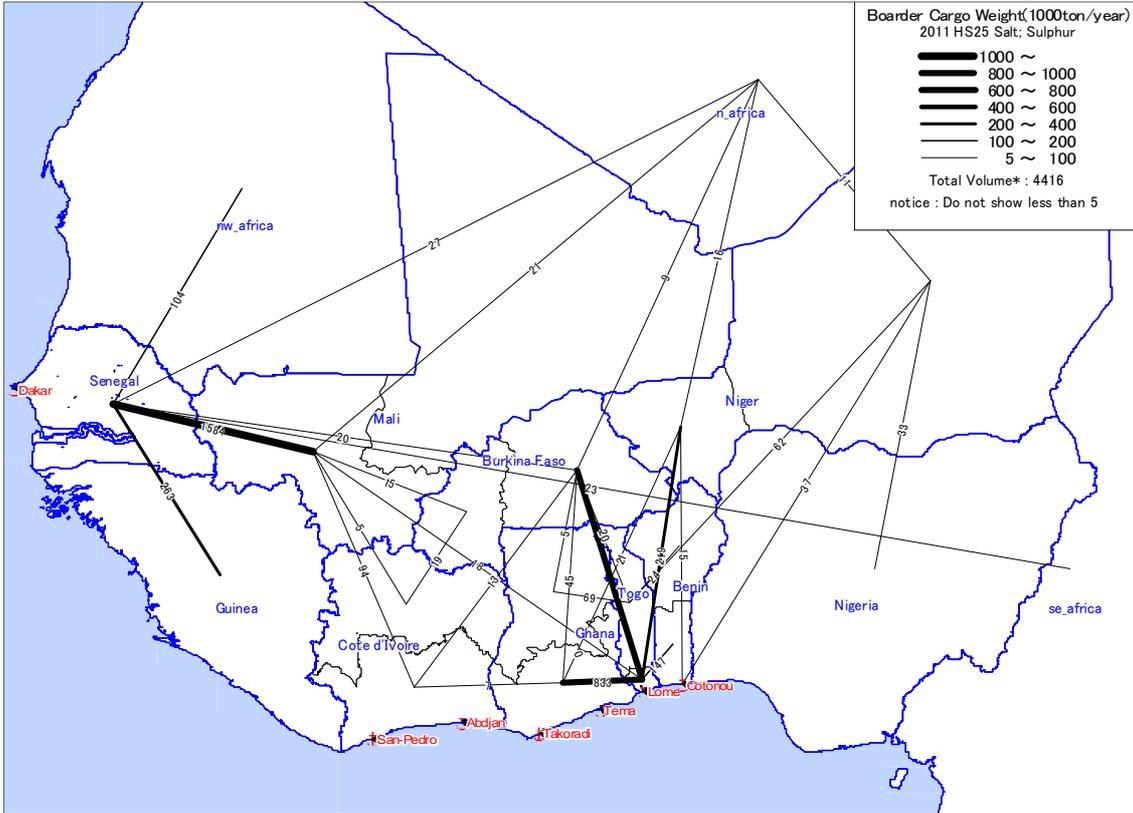


Source : JICA Study team

Figure 8-31 Present freight flow (HS23: Residues and Waste: '000t/year)

7) Present freight flow (HS25: Salt & Sulphur)

Most of flows are between Ghana's southern zones and Tema Port. As for the landlocked countries, the flow between Mali and Senegal is large.

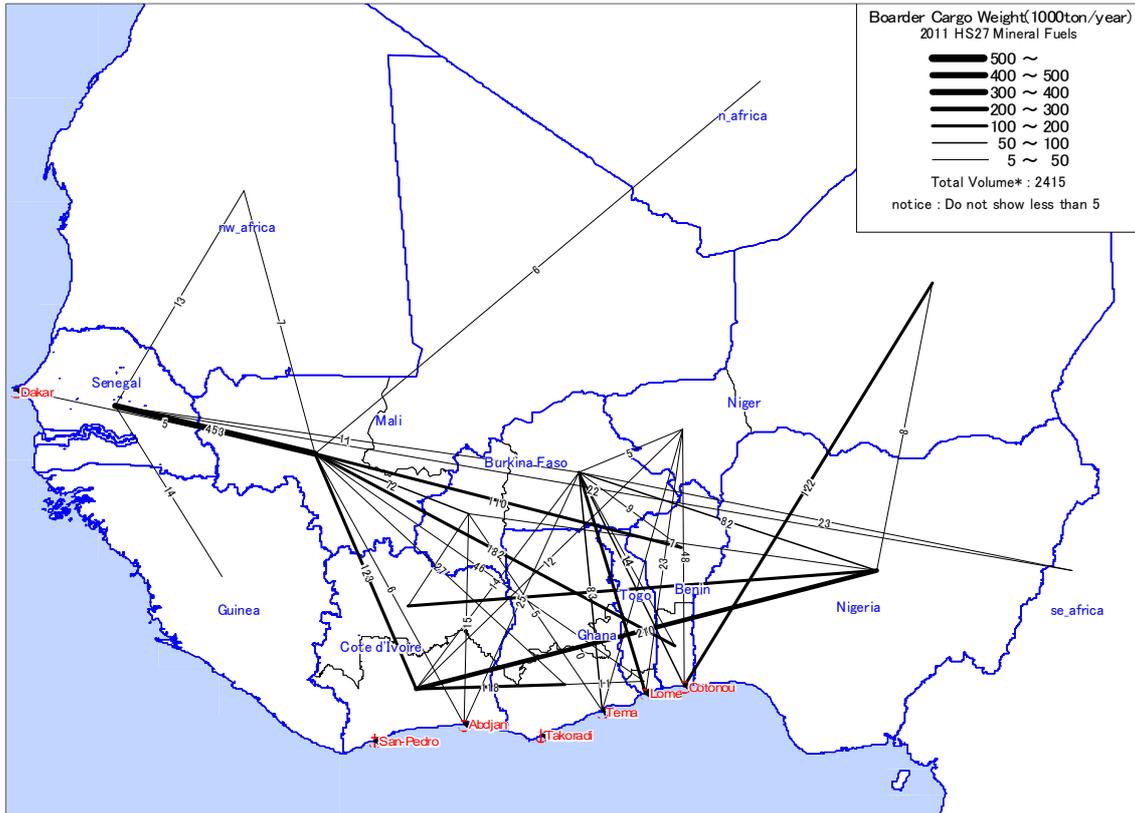


Source : JICA Study team

Figure 8-32 Present freight flow (HS25: Salt & Sulphur: '000t/year)

8) Present freight flow (HS27: Mineral Fuels)

The flows between domestic zones and ports in Cote d'Ivoire and Ghana are the largest. As regards Senegal, the flows with Mali and Nigeria are large. (For Senegal and Nigeria, around one half of the amount is separately imported by sea.)

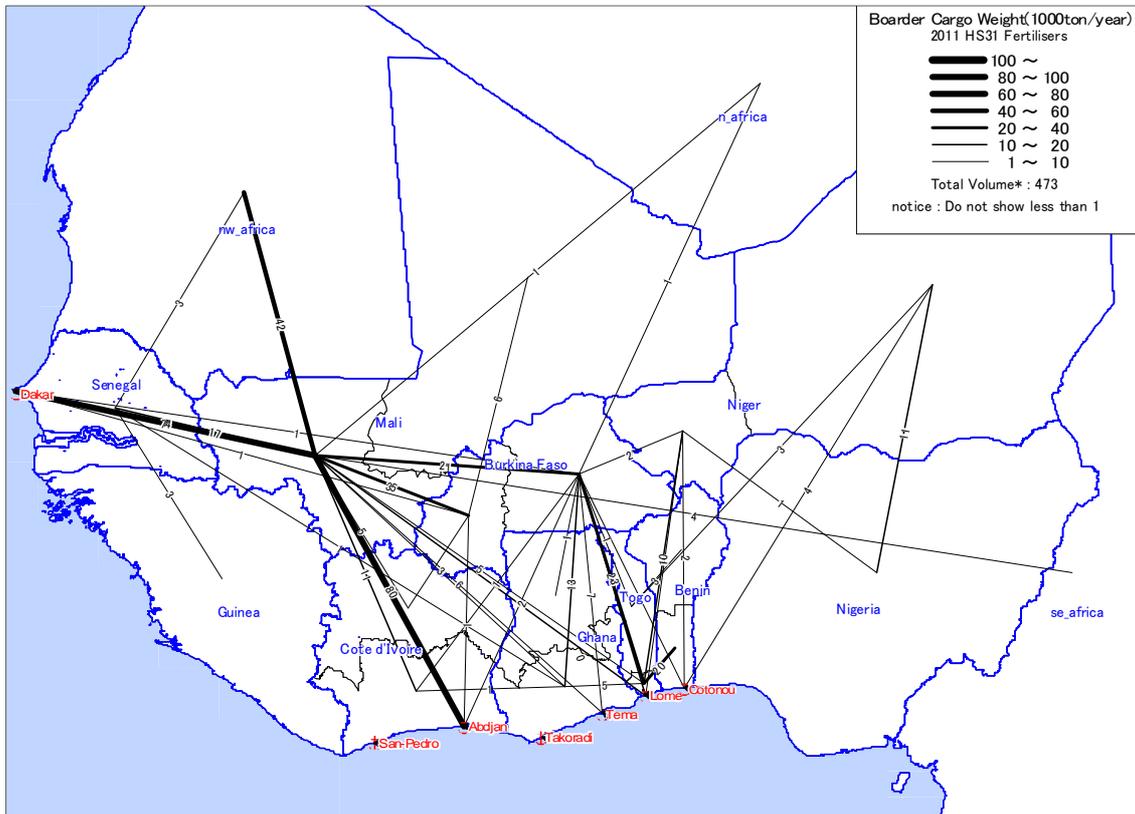


Source : JICA Study team

Figure 8-33 Present freight flow (HS27: Mineral Fuels: '000t/year)

9) Present freight flow (HS31: Fertilisers)

The flow between Ghana's southern zone and Tema Port is the largest. As regards the landlocked countries, the flows between Mali and the ports of Abidjan and Dakar are large.

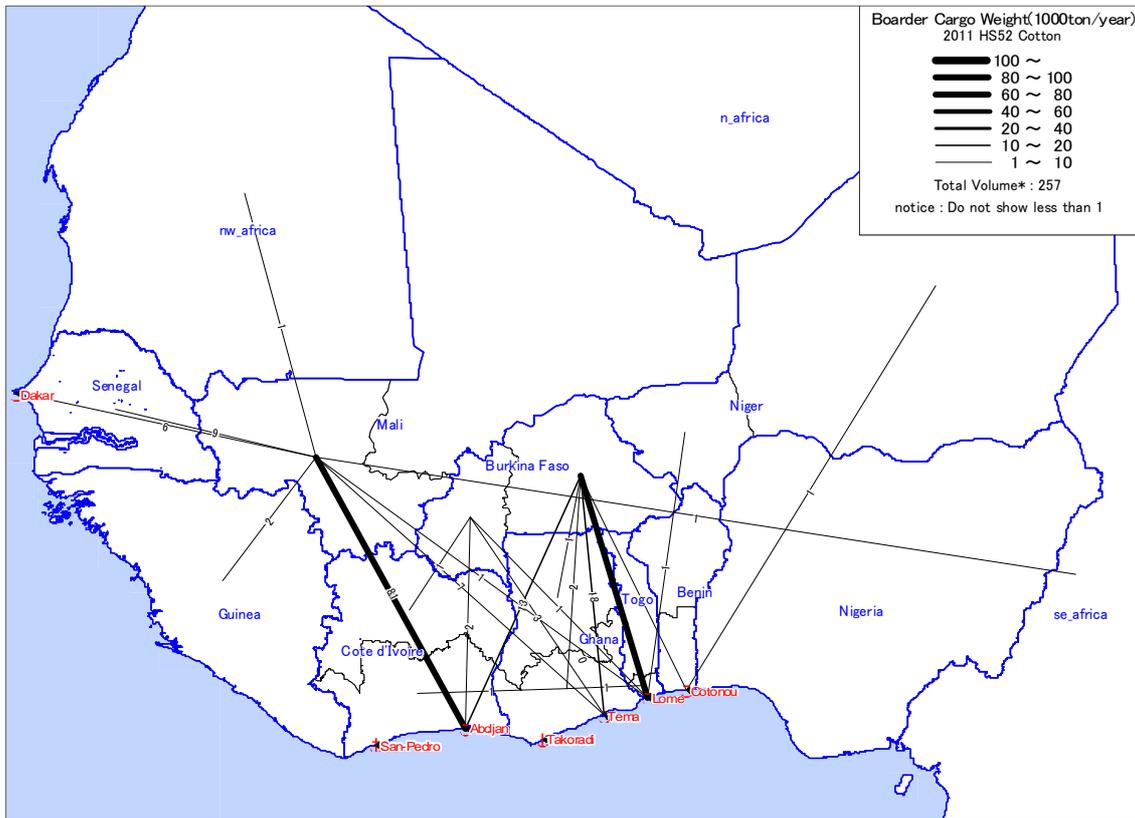


Source: JICA Study team

Figure 8-34 Present freight flow (HS31: Fertilisers: '000t/year)

10) Present freight flow (HS52: Cotton)

The flows between Burkina Faso and Lomé Port and between Mali and Abidjan Port are the largest.

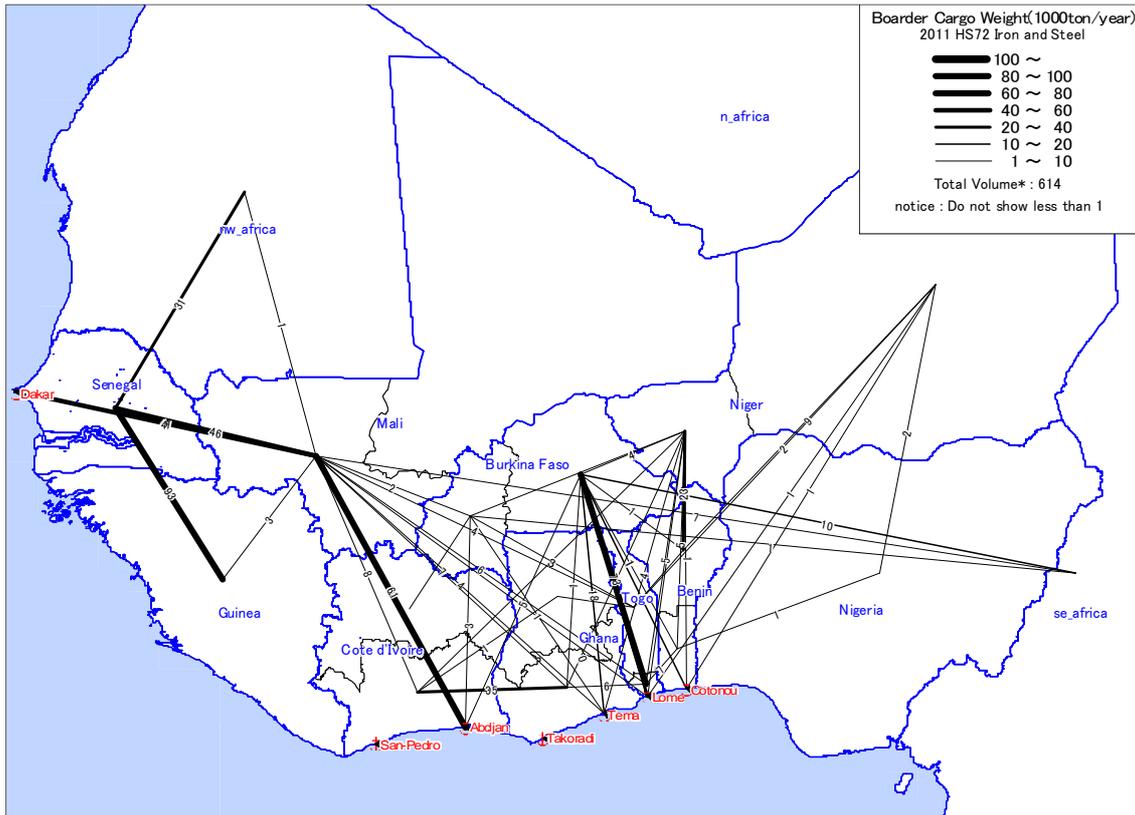


Source : JICA Study team

Figure 8-35 Present freight flow (HS52: Cotton: '000t/year)

11) Present freight flow (HS72: Iron and Steel)

The flow between Senegal and Dakar Port is the largest, followed by the flows between Ghana's southern zone and Tema Port, between the Benin southern zone and Cotonou Port. Among the landlocked countries, the flows between Burkina Faso and Lomé Port and between Mali and Abidjan Port are large.



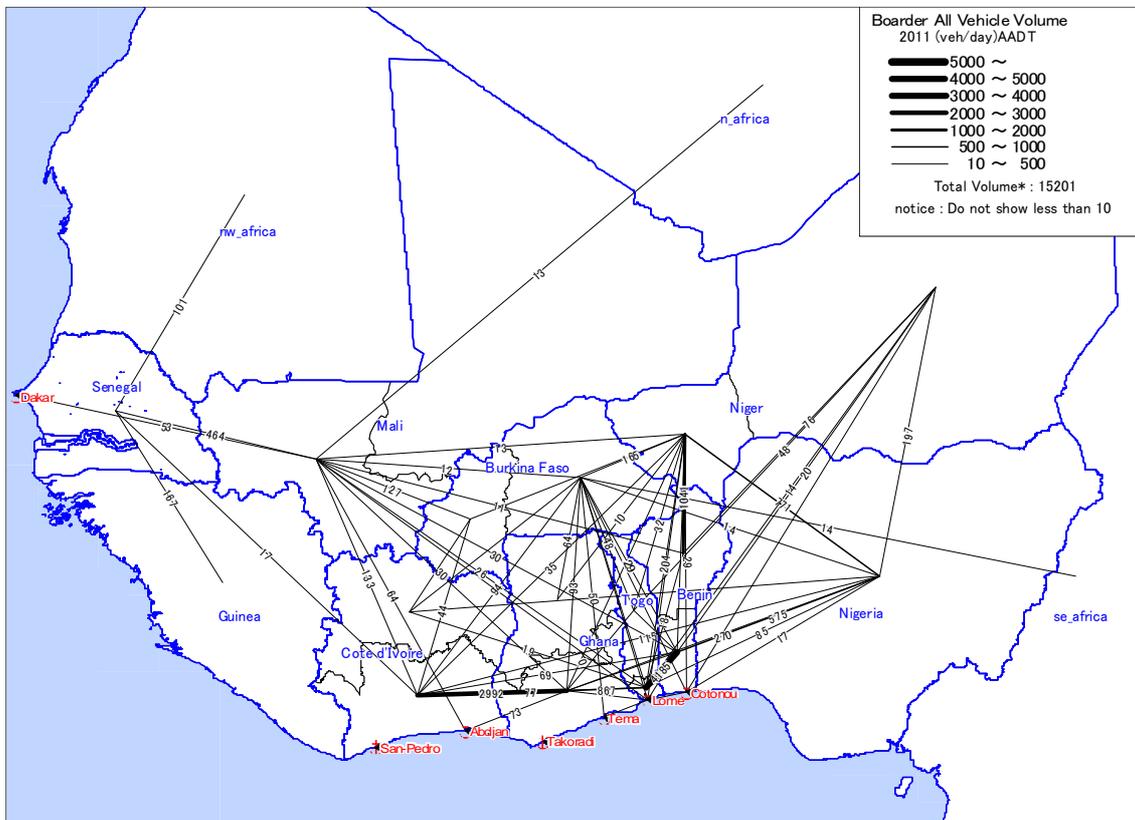
Source : JICA Study team

Figure 8-36 Present freight flow (HS72: Iron and Steel: '000t/year)

(3) Present vehicle flow

As a whole, the flow is large in zones in the coastal countries in the southern part of the survey area, between ports and southern zones of coastal countries, and between southern zones of coastal countries. Among coastal countries, Senegal shows the smallest flow.

An examination of the flow related to landlocked countries indicates that Mali has the largest flow to Senegal, with the flow to ports divided into two: one to Dakar Port and the other to Abidjan Port. In Burkina Faso, the dispersed flow to the coastal countries of Cote d'Ivoire, Ghana, and Togo is noted. The largest flow is to Togo. Niger has large flows to Benin and Nigeria, followed by the flow to Togo. Eighty percent of the flows to Benin and Nigeria are accounted for by passenger cars and taxis.



Source : JICA Study team

Figure 8-37 Present vehicle flow (Total of all type, veh. /day)

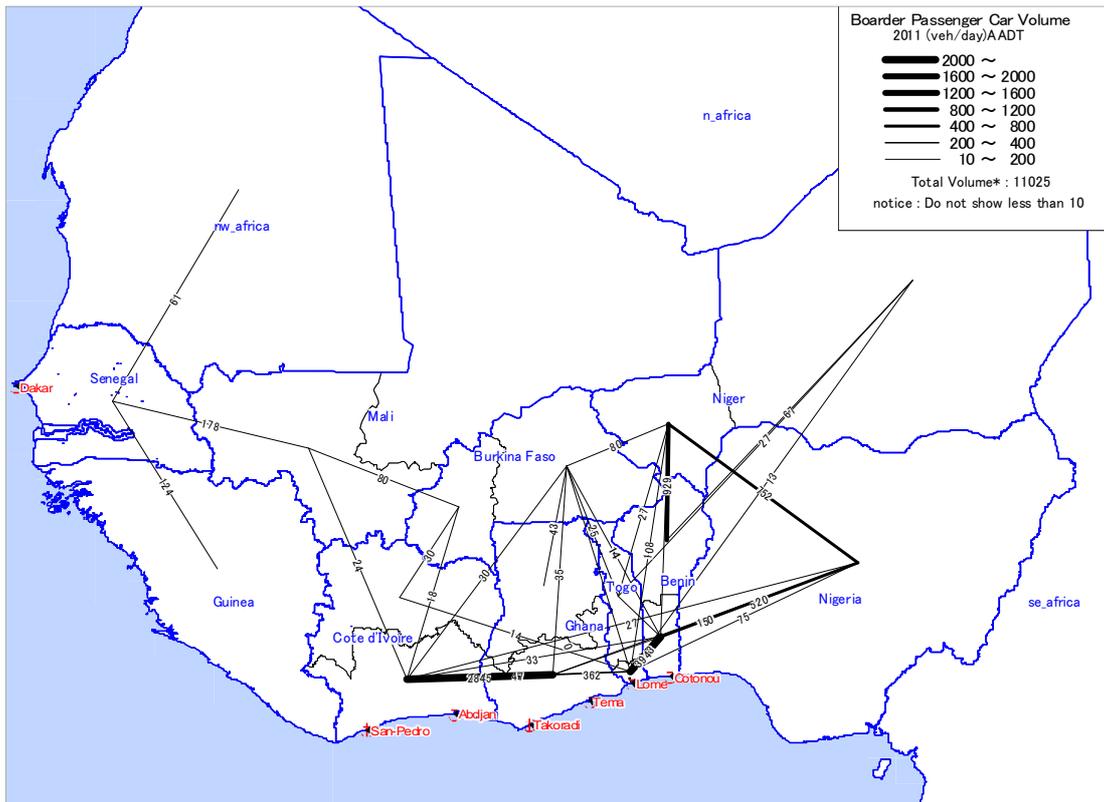


Figure 8-38 Present vehicle flow (Passenger car, veh. /day)

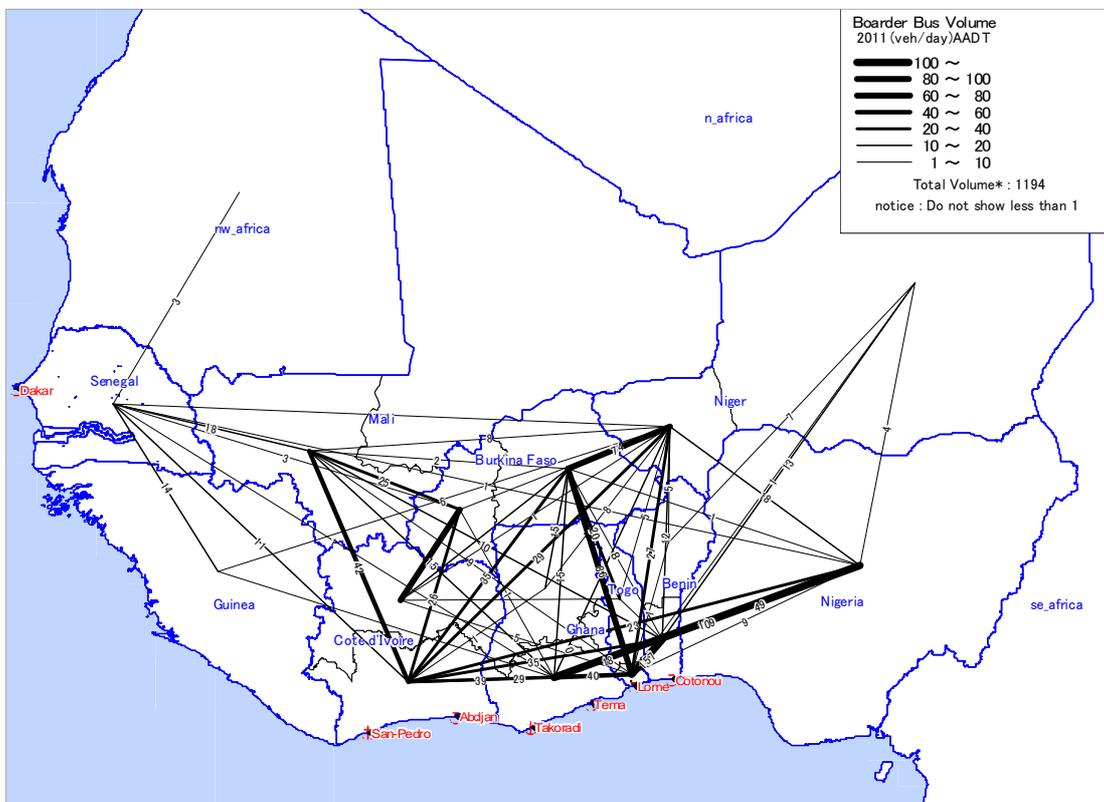


Figure 8-39 Present vehicle flow (Bus, veh. /day)

Source: JICA Study team

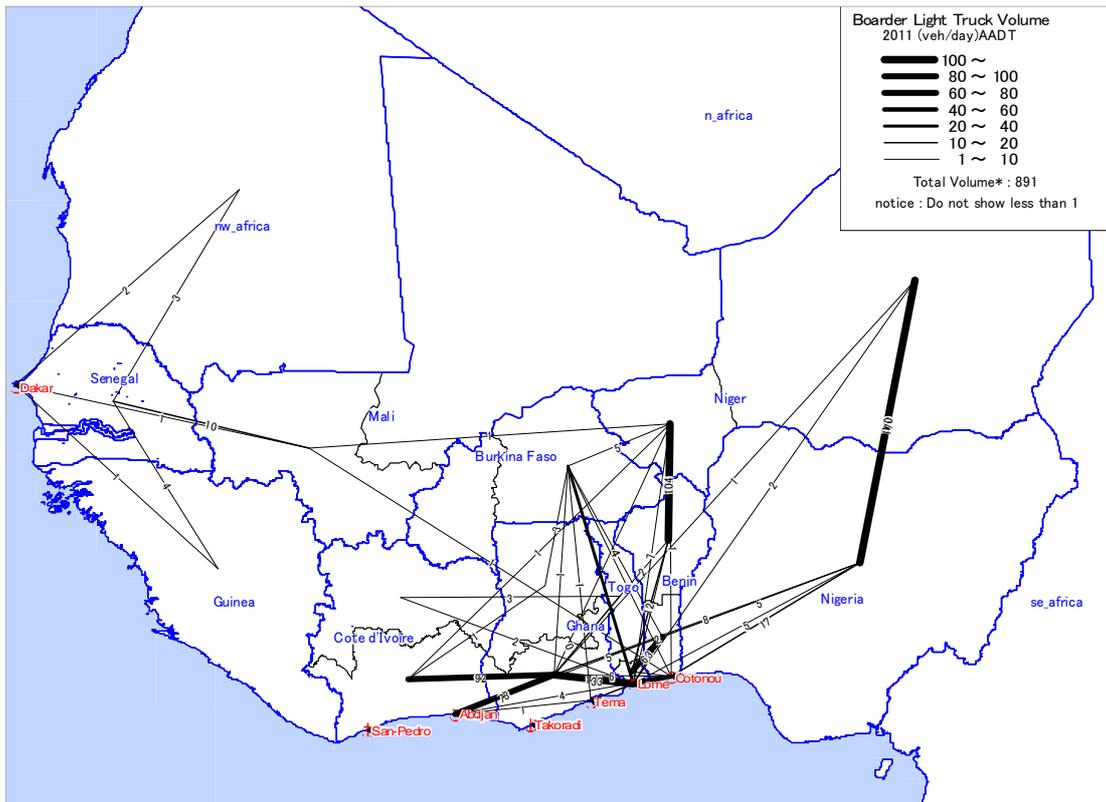


Figure 8-40 Present vehicle flow (Light truck, veh. /day)

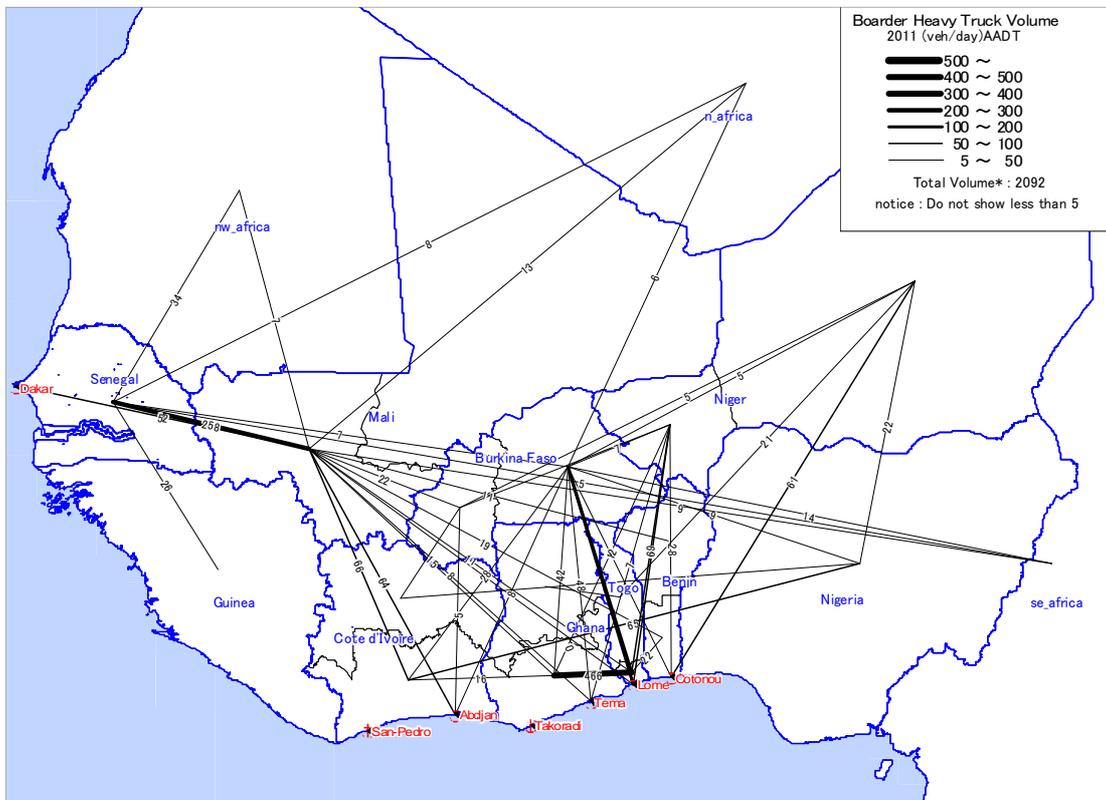
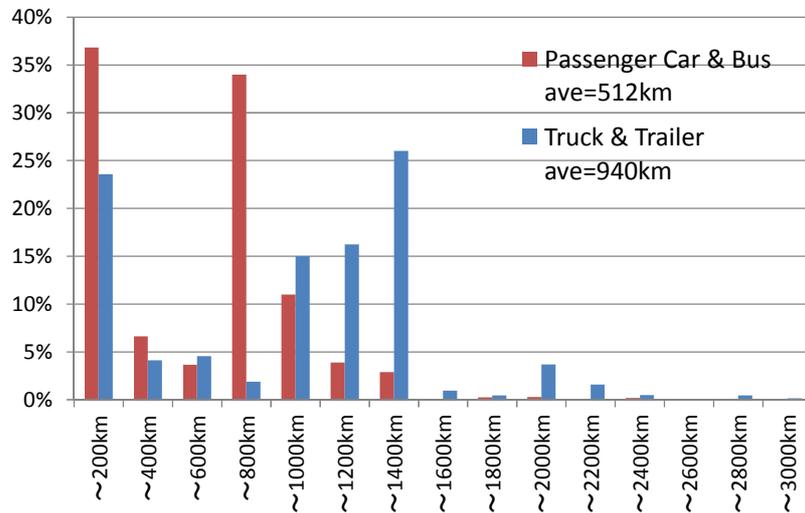


Figure 8-41 Present vehicle flow (Hevy truck, veh. /day)

Source: JICA Study team

When comparing the average trip length, it is 512km for passenger vehicles and 940km for large-sized freight vehicles, which indicates that the latter is about twice of the former.



Source: JICA Study team

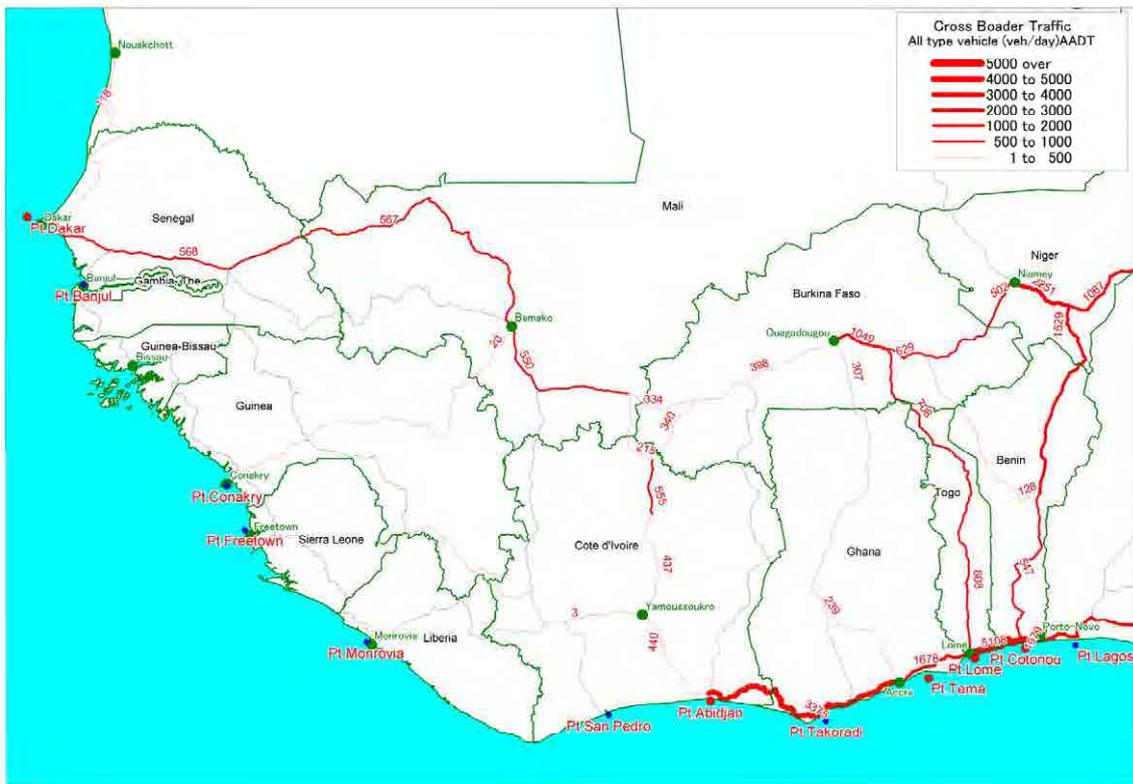
Figure 8-42 Average Trip Length

8.5 Present Traffic Assignment

Based on OD tables for vehicles already created, traffic volume was allocated along the present international corridors to calculate present cross-border traffic volume. Traffic volume shown here is cross-border traffic volume and presented in the form of annual average daily traffic.

(1) Cross-border traffic volume

When looking at the entire target area, traffic volume along roads running from east to west in coastal areas is as large as from 1,700 veh./day to 5,000 veh./day, which indicates traffic is busy between coastal countries. Meanwhile, of corridors connecting landlocked countries and coastal countries, traffic is the largest along the Ouagadougou-Lomé corridor (608 veh./day), followed by the Dakar-Bamako corridor (568 veh./day).



Source: JICA Study team

Figure 8-43 Result of the present road traffic volume (Total of all vehicles, veh./day)

(2) Share of goods type

By the share of goods weight, the largest goods on the Ouagadougou-Lomé corridor is cements as a construction material. On the other hand, the Ouagadougou-Cotonou corridor is used mainly to transport fuels like gasoline. Apart from these corridors, the corridors of Tema and Abidjan are used to transport a wide range of good.

(3) Share of transit freight

The Dakar-Bamako corridor is used mainly as important route for trade between Senegal and Mali. On the other hand, the transit traffic and country-to-country traffic are almost equal on the Ouagadougou-Lomé and the Ouagadougou-Tema corridors. Based on this, it is considered that UEMOA corridors are important not only for trade overseas such as Europe or Asian countries but also for the transport country to country in UEMOA zone and Ghana.

Data Collection Survey on Traffic for International Port and International Corridor in Western Africa

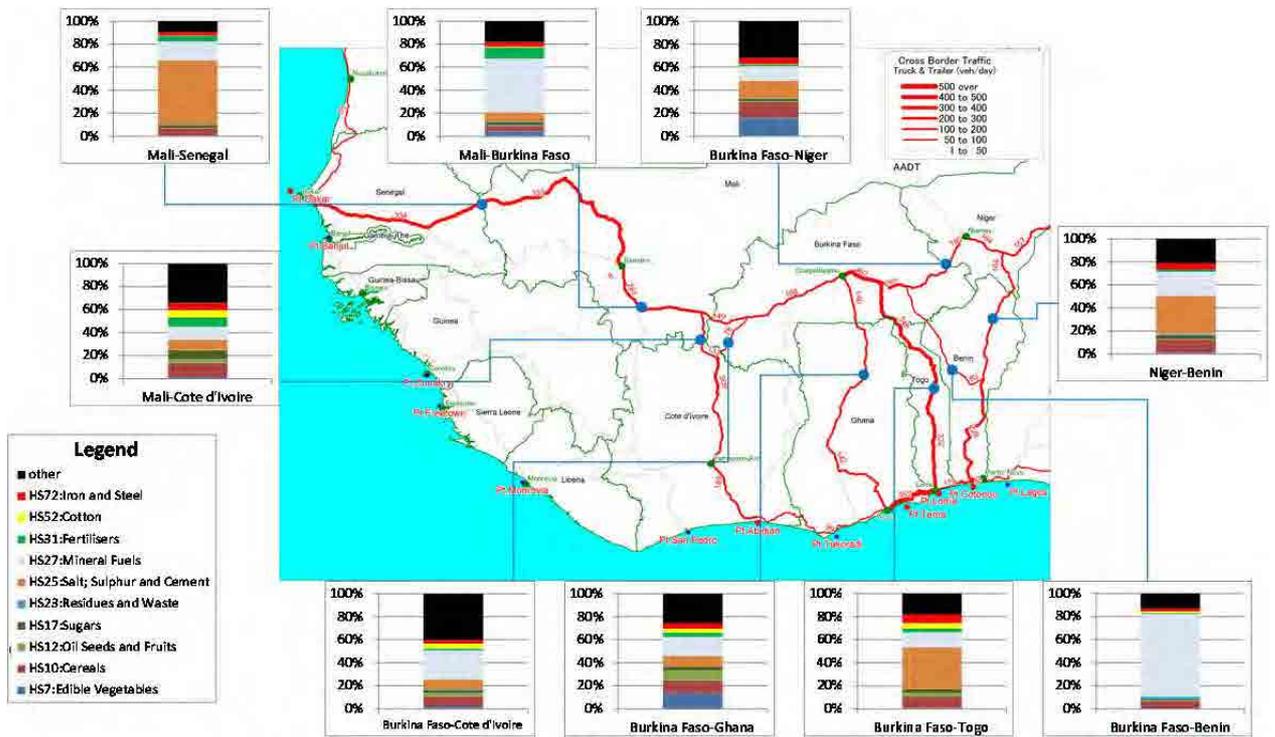
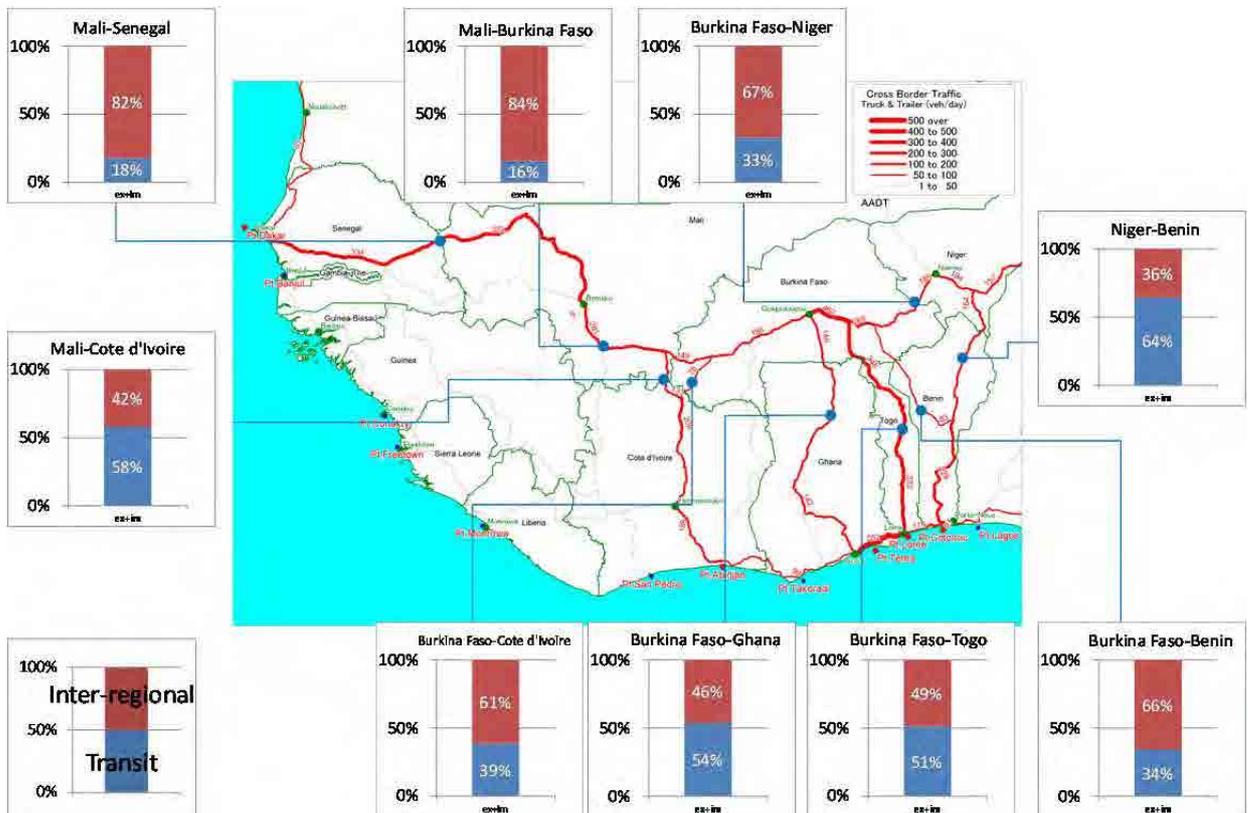


Figure 8-44 Share of goods type



*Regional: Traffic country to country in this area,Transit::Traffic between landlocked country-Coastal country

Figure 8-45 Share of transit freight

Source : JICA Study team

8.6 Traffic Volume Origin/Destination from 3 Landlocked Countries

Among the OD tables for 2011 mentioned above, we totalized and arranged OD only relating to the three landlocked countries of Mali, Burkina Faso and Niger, by the corridors to be utilized.

(1) Total

Figure 8-46 shows the total traffic volume related to 3 landlocked countries. The Ouagadougou-Lomé corridor is found to have the largest freight truck traffic volume (572veh./day), followed by the Dakar-Bamako corridor (543veh./day) and the Niamey-Cotonou corridor(526veh./day).

(2) Passenger car

Figure 8-47 shows the passenger car traffic related to 3 landlocked countries. The Niamey-Cotonou corridor is found to have the largest traffic volume. As a reason for the large volume of traffic, this corridor is used by cars that have a short trip length and cross daily the border. Two regions that border the boundary have a strong connection as a daily living area.

(3) Bus

Figure 8-48 shows the bus traffic related to 3 landlocked countries. The bus traffic is relatively large between landlocked countries and Cote d'Ivoire.

(4) Light truck

Figure 8-49 shows the light truck traffic related to 3 landlocked countries. The volume of light truck is relatively small. Almost of trip is limited in a short length trip.

(5) Heavy truck

Figure 8-50 shows the passenger car traffic related to 3 landlocked countries. The Dakar-Bamako corridor is found to have the largest freight truck traffic volume, followed by the Ouagadougou-Lomé corridor and the Niamey-Cotonou corridor. Each of these corridors functions as a main logistics route for Mali, Burkina Faso and Niger, respectively.

Traffic of freight trucks leaving and arriving at Burkina Faso is dispersed along a number of corridors such as the Abidjan route, Tema route, Lomé route and Cotonou route. Among these, the Ouagadougou-Lomé corridor has the largest share in freight truck traffic. It can be said that serving here as background is the fact that the Ouagadougou-Lomé corridor is competitive in terms of transport costs and time distance. In addition, it is partly because freight trains have a larger share in freight traffic to the port of Abidjan than freight vehicle traffic along roadways. It is also partly because at the port of Tema, transit freight has a limited share as the port handles a larger volume of domestic freight.

Data Collection Survey on Traffic for International Port and International Corridor in Western Africa

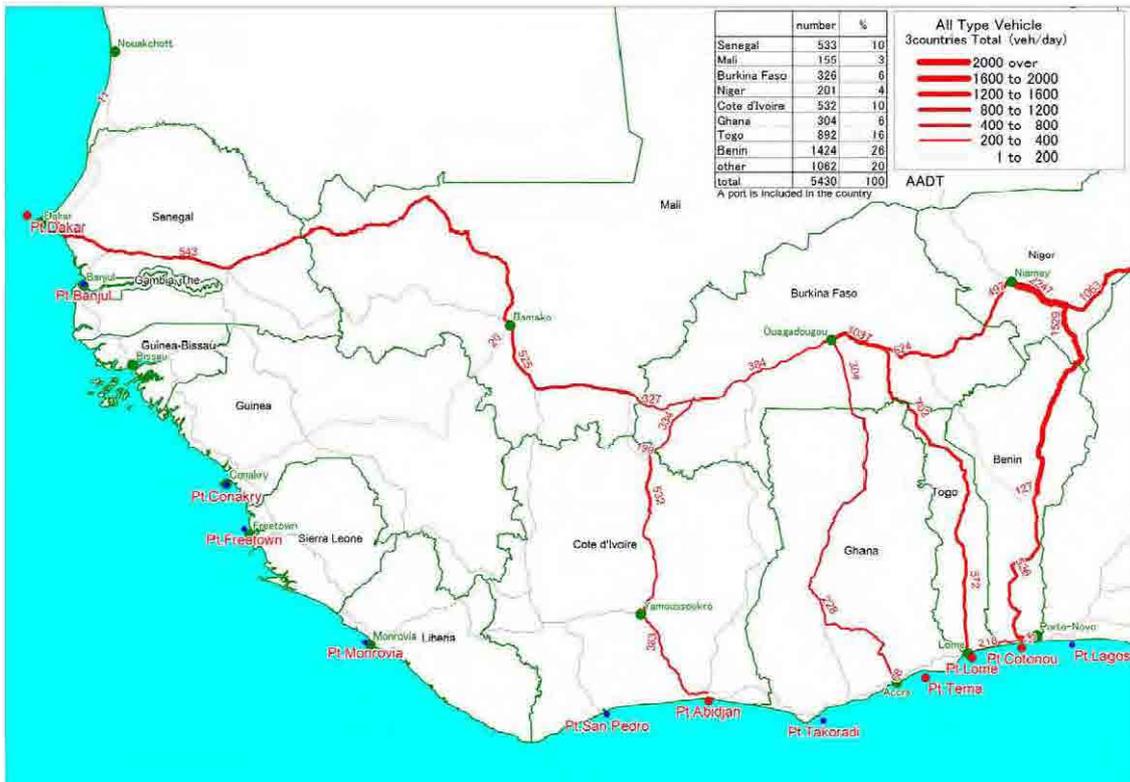


Figure 8-46 Present traffic volume related to 3 landlocked countries (Total of all vehicles, veh./day)

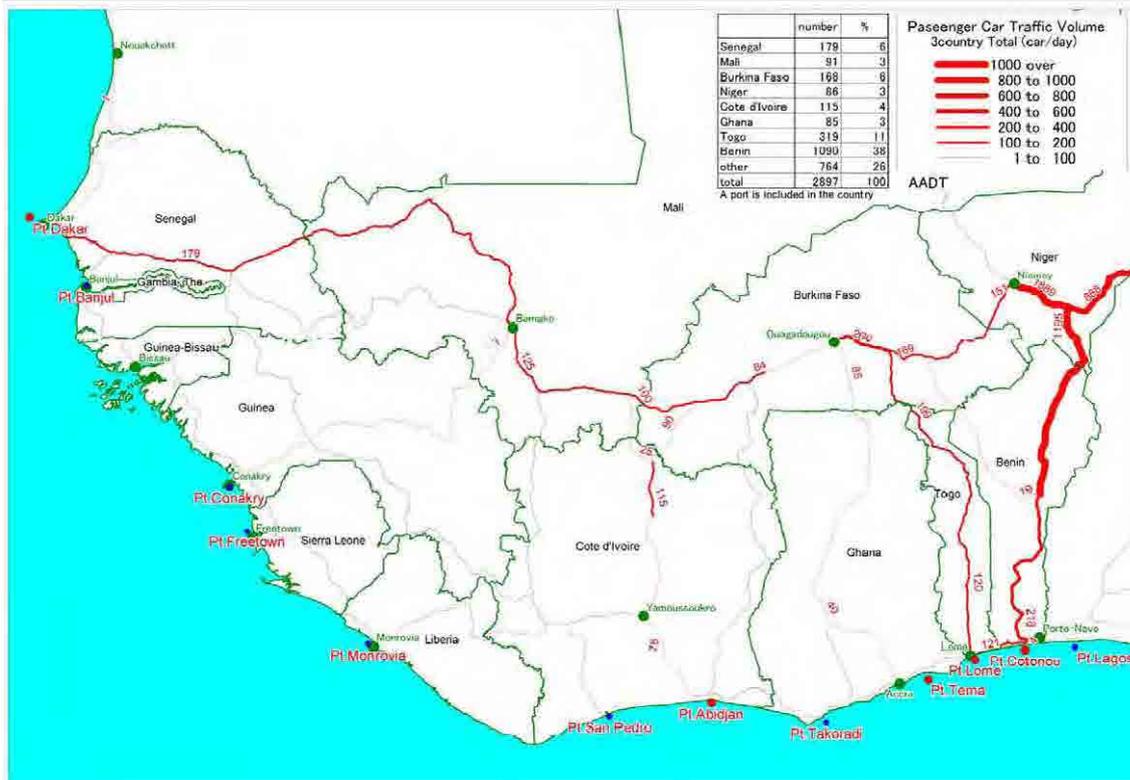


Figure 8-47 Present traffic volume related to 3 landlocked countries (Passenger cars, veh./day)

Data Collection Survey on Traffic for International Port and International Corridor in Western Africa

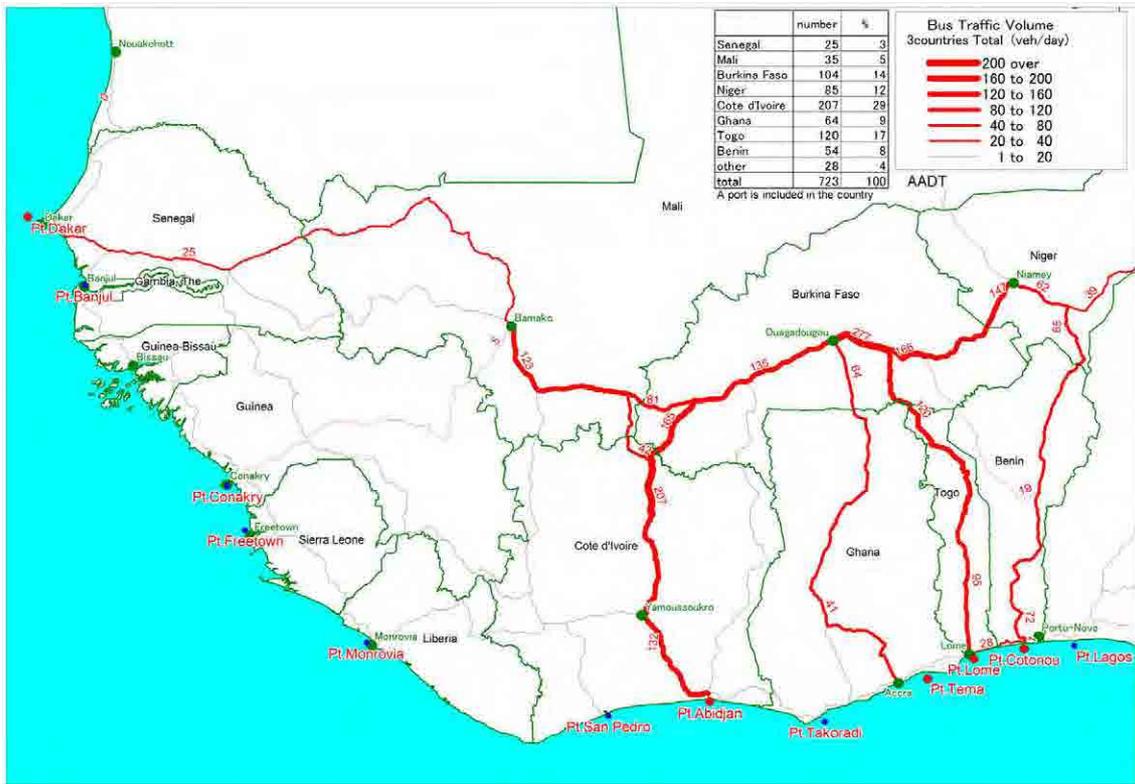


Figure 8-48 Present traffic volume related to 3 landlocked countries (Bus, veh./day)

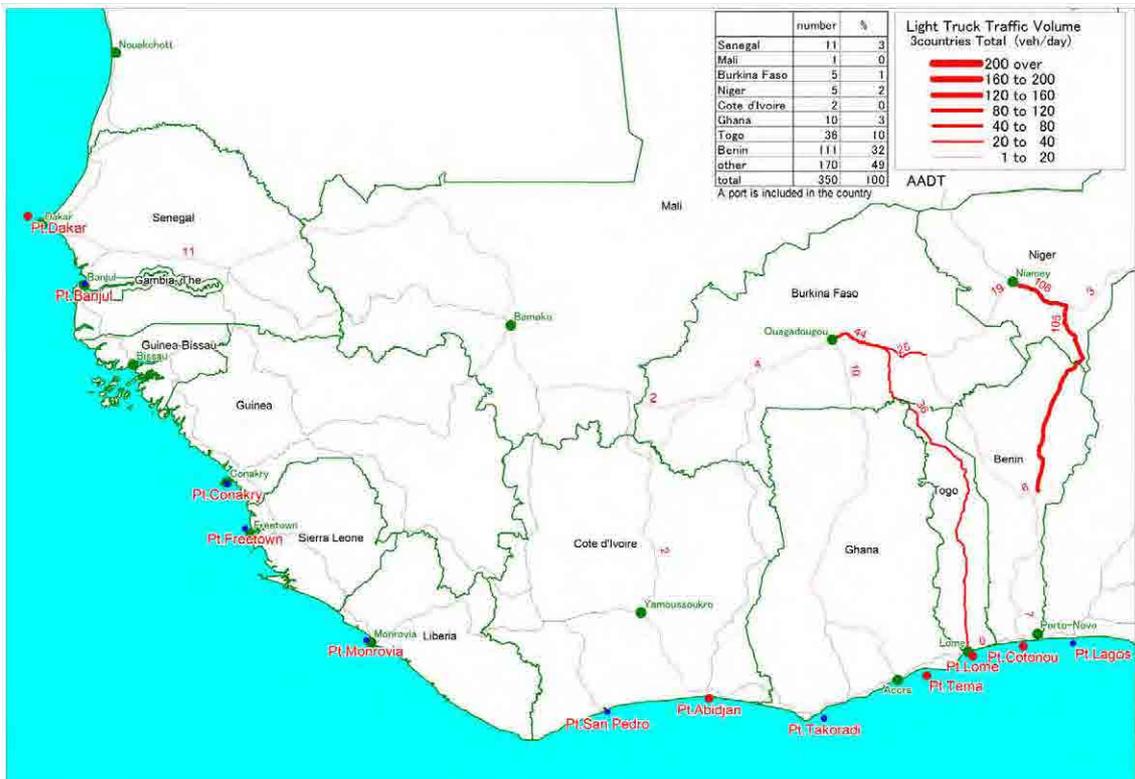


Figure 8-49 Present traffic volume related to 3 landlocked countries (Light truck, veh./day)

Source: JICA Study team



Figure 8-50 Present traffic volume related to 3 landlocked countries (Heavy truck, veh./day)

Source: JICA Study team