
BUAN 5260: Midterm Project

IFRC Aiding Africa: Disaster/disease relief plan

To: Gareth Green

From: Afsar Ali

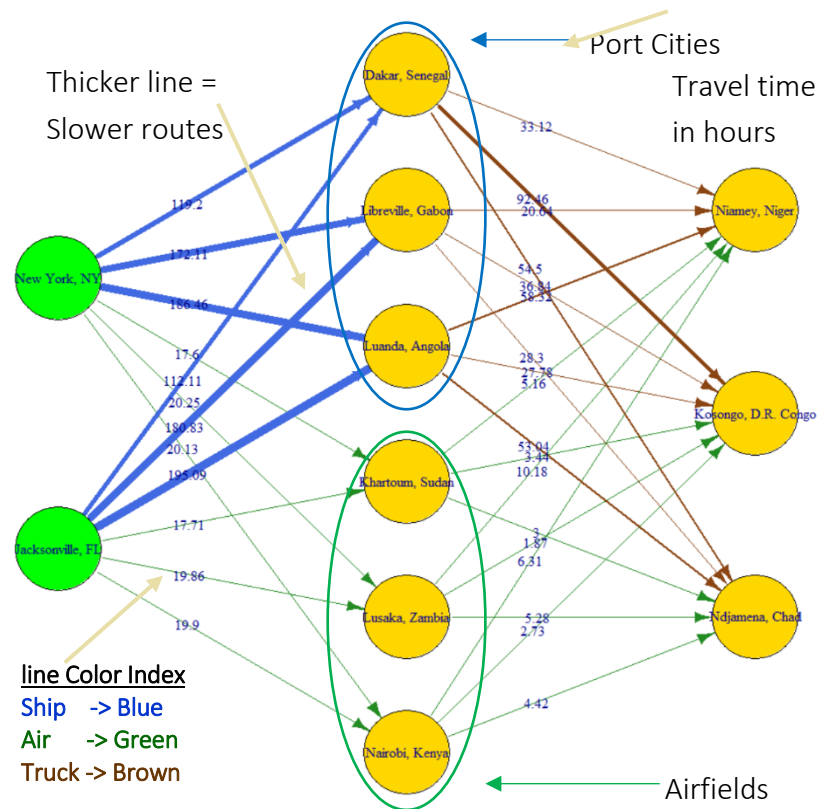
Climate change is impacting our world harder than ever, places explicitly with limited resources, harsh terrain, political and social instability such as in Africa. In the midst of it all, the victims are the innocent people that are trying to make ends meet. We must be ready to respond and come to their Aid. Due to Initiatives from Gail McGovern, CEO of the American Red Cross, and the International Federation of Red Cross (IFRC), this memo illustrates aid disbursement plans for Africa. The attached aid disbursement strategy consists of three comprehensive action plans given three different scenarios. Each scenario has different limitations due to resource and political environments in that region. The analysis illustrates that restrictions make a significant impact on IFRC ability to move and deliver aids, specifically air transportation. These action plans are for potential donors and IFRC to raise funds, to help prevent these restrictions, to prepare and ultimately save countless lives.

Network Map

President of the Board of Governors for the IFRC, Tadateru Konoe, specified that all of the necessary labor and materials for disaster relief would be assembled and sent from two American cities New York, NY and Jacksonville, FL (light green discs) routing aid through nine African cities (gold discs). Figure 1: Network Map on the right shows different routes to the nine cities.

There are three types of transportation methods Aircraft (Green line), ships (Blue line), and trucks (Brown line) that make up the routes. All aircraft, ships, and vehicles can carry both workers and cargo but subject to different cargo capacity, speed, and cost. As expected, air crafts can move shipment much faster than ships and trucks. Figure 1 shows the routes going through Airfields (Green ovals) are thinner and faster. On the other hand, going through Port Cities (Blue ovals) takes longer time, which can be subject to bottlenecks when it comes to speed of delivery. IFRC should work to reduce any bottlenecks to get to the three strategic cities Niamey, Niger, Kosongo, D.R. of the Congo; and Ndjamen, Chad by working with the local governments to lift restrictions. These strategic cities can ultimately be used both to support the cities and to disperse supplies across Africa. The table above shows the quickest routes in hours. In a scenario, with no resource or cost constraints, IFRC would take about 20 to 23 hours to get to the three strategic cities.

Figure 1: NETWORK MAP WITH FASTEST ROUTE



Dakar, Senegal	55.88	55.99
Libreville, Gabon	43.40	43.51
Luanda, Angola	48.82	48.93
Khartoum, Sudan	17.60	17.71
Lusaka, Zambia	20.25	19.86
Nairobi, Kenya	20.13	19.90
Niamey, Niger	22.76	22.87
Kosongo, D.R. Congo	21.04	21.15
Ndjamen, Chad	20.60	20.71
(Fastest Route)		

Minimum Cost

Thicker line =
Larger Cost

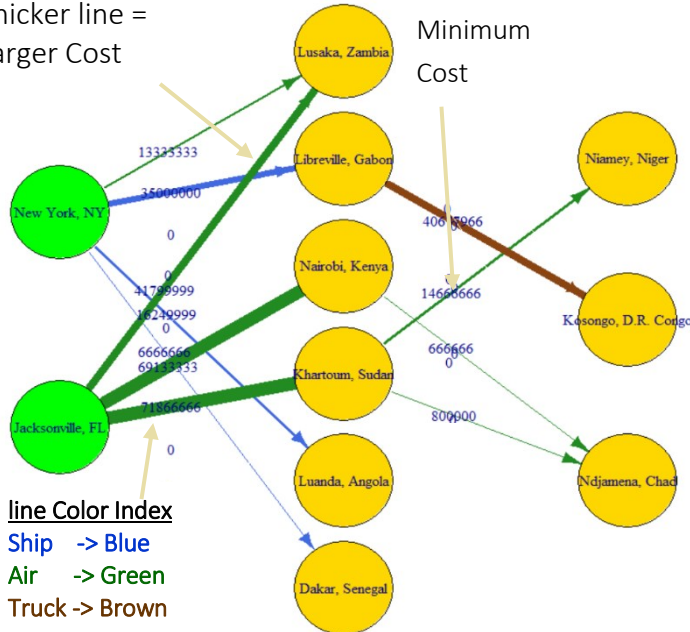


Figure 2: Minimum Cost Routes

	Solution #of Trips	duals/coef	Min Cost	Total Aid
Ship	1,917	92,000	57,916,668	460,000
Air	4,800	245,000	212,266,667	720,000
Truck	10,169	4,000	40,677,966	180,000
Total	16,886	341,000	310,861,300	1,360,000

Although utilizing the available airfields IFRC can arrive at the strategic cities with Aid in less than 24 hours. Cost impact can be substantial.

In the second scenario, the analysis takes cost into account and finds optimal routes which include all three transportation methods and the fuel, labor, and maintenance costs, appropriate port or airfield taxes and tariffs. It also includes other costs such as bribery that vary by region and some transportation restrictions. Accordingly, the minimum cost is \$310,861,300, shown in the table on the left, aggregated by different transportation methods.

The map above illustrates the optimal Aid routes and the line width proportion to its minimum cost. For example, the green lines going from Jacksonville, FL to the three airfields are air transportation cost which accounts for a substantial fragment of the total cost thus the lines are broader. Majority of the aid coming out of New York, NY are through ships with minimal costs. Therefore, the lines are thinner. There are some restrictions, 200 Max flights from Lusaka, Zambia to Ndjamen, Chad and from Khartoum, Sudan to Ndjamen, Chad. Additionally, supplies to Niamey, Niger can only arrive via air. These restrictions can be a bottleneck to get the Aid supplies to the three strategic cities. In Figure 3: Minimum Cost Summary, the analysis output shows that one additional trip from Khartoum, Sudan to Ndjamen, Chad can decrease the minimum cost by 10K. IFRC Should focus their efforts to increase the Max flights thus lowering the overall Minimum cost.

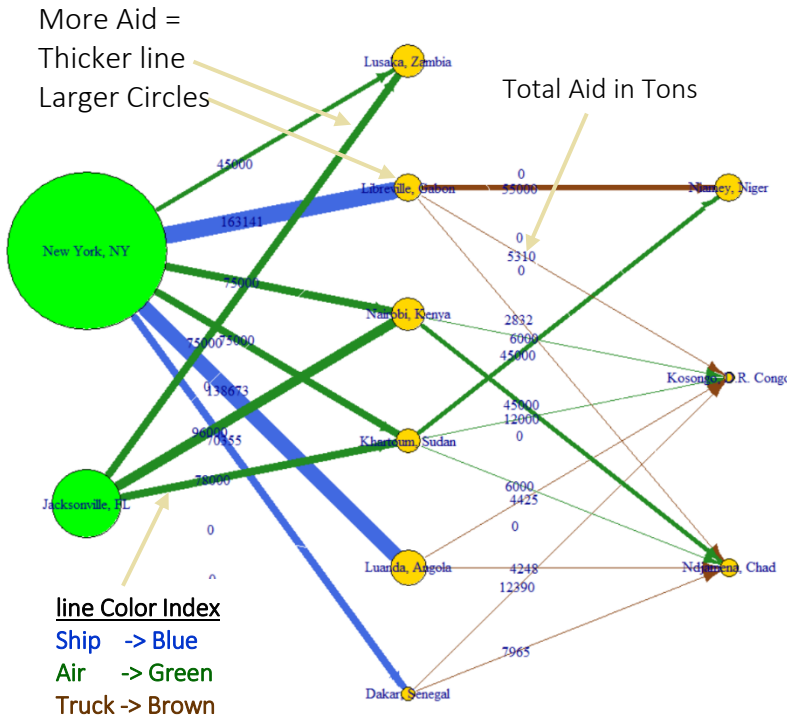
Reasonably the number of trips made by trucks is much larger than all the other transportation method since one truck can only transport 17.7 tons of aid. However, the truck route accounted for only one city from Libreville, Gabon to Kosongo, D.R. Congo. Having the restriction of 840 trucks to Ndjamen, Chad from each port and having Niamey, Niger only available by air transportation creates a bottleneck to these strategic cities.

Figure 3: Minimum Cost Summary

Objective Value = 310,861,299.435	Solution #of Trips	duals/coef	Min Cost	Total Aid	Sens From	Sens Till
New York	500,000	373			500,000	500,000
Jacksonville	500,000	420			500,000	500,000
Lusaka	(150,000)	40			(150,000)	(150,000)
Libreville	(100,000)	248			(100,000)	(100,000)
Nairobi	(120,000)	13			(120,000)	(120,000)
Khartoum	(90,000)	93			(90,000)	(90,000)
Luanda	(130,000)	248			(130,000)	(130,000)
Dakar	(50,000)	240			(50,000)	(50,000)
Niamey	(100,000)	(53)			(100,000)	(100,000)
Kosongo	(180,000)	22			(180,000)	(180,000)
Ndjamen	(80,000)	-				
Khartoum->Ndjamena Flight Lin	200	(10,000)			-	533
New York->Lusaka (Air)	267	50,000	13,333,335	40,000	48,250	51,000
New York->Libreville (Ship)	1,167	30,000	35,000,001	280,000	(5,315)	36,800
New York->Luanda (Ship)	542	30,000	16,250,001	130,000	16,441	32,800
New York->Dakar (Ship)	208	32,000	6,666,666	50,000	16,441	44,800
Jacksonville->Lusaka (Air)	733	57,000	41,799,998	110,000	56,000	58,750
Jacksonville->Nairobi (Air)	1,133	61,000	69,133,331	170,000	51,000	62,000
Jacksonville->Khartoum (Air)	1,467	49,000	71,866,668	220,000	40,648	52,000
Khartoum->Niamey (Air)	667	22,000	14,666,667	100,000		32,000
Libreville->Kosongo (Truck)	10,169	4,000	40,677,966	180,000		4,986
Nairobi->Ndjamena (Air)	333	2,000	666,667	50,000	(8,000)	19,000
Khartoum->Ndjamena (Air)	200	4,000	800,000	30,000		14,000
Total:	16,886		310,861,300	1,360,000		

Maximum Flow

Figure 4: Maximum Flow Routes



In the third scenario, with the help of Tadateru Konoe, the model accounted for the number of planes to expect at the airfields, the number of ships to expect at the docks, the number of trucks to expect to travel across the roads and other socio-economic restrictions that are limiting trucks and air transportation. Fortunately, all shipping lanes have no capacity limits, and IRFC decided to disregard cost and maximize the flow of total amount of cargo to the nine cities.

Figure 4: Maximum flow route illustrates the Aid distribution across all nine cities, and the type of

Figure 5: Total Supply received Table

	Received	Required	Delta
I-NY	567,170	500,000	67,170
I-JAX	249,000	500,000	(251,000)
LusakaR	120,000	150,000	(30,000)
LibrevilleR	100,000	100,000	-
NairobiR	120,000	120,000	-
KhartoumR	90,000	90,000	-
LuandaR	130,000	130,000	-
DakarR	50,000	50,000	-
NiameyR	100,000	100,000	-
KosongoR	40,125	180,000	(139,875)
NdjamenaR	66,045	80,000	(13,955)
	816,170	1,000,000	(183,830)

	# of Trips	Total Aid
Ship	1,551	372,170
Air	3,200	480,000
Truck	5,727	101,374
	10,478	953,544

transportation used to deliver the aid. The disc size of the cities is proportional to the total support. Due to all the restrictions, the analysis shows that as the cargo filled with aid goes from the USA and distributes across port and airfields to the strategic sites, the Total aid distributed gets smaller. The total aid given the restriction is 816,170 Tons with New York shipping the bulk of the aid through ships.

The most significant impact in this scenario is on Kosongo, D.R. Congo which only received 40,125 Tons of Aid out of 180,000 required aid. Lusaka, Zambia and

Ndjamena, Chad would not receive all the aid necessary as shown in Figure 5. Air transportation was able to deliver about 48% of the aid, followed by Ship and Truck with the least amount of aid, as shown in the table on the left.

	# of Trips	Total Aid
New York, NY > Lusaka, Zambia	300	45,000
New York, NY > Libreville, Gabon	680	163,142
New York, NY > Nairobi, Kenya	500	75,000
New York, NY > Khartoum, Sudan	500	75,000
New York, NY > Luanda, Angola	578	138,673
New York, NY > Dakar, Senegal	293	70,355
Jacksonville, FL > Lusaka, Zambia	500	75,000
Jacksonville, FL > Nairobi, Kenya	640	96,000
Jacksonville, FL > Khartoum, Sudan	520	9,204
Libreville, Gabon > Niamey, Niger	3,107	55,000
Khartoum, Sudan > Niamey, Niger	300	45,000
Libreville, Gabon > Kosongo, D.R. Congo	300	5,310
Nairobi, Kenya > Kosongo, D.R. Congo	40	6,000
Khartoum, Sudan > Kosongo, D.R. Congo	80	12,000
Luanda, Angola > Kosongo, D.R. Congo	250	4,425
Dakar, Senegal > Kosongo, D.R. Congo	700	12,390
Libreville, Gabon > Ndjamena, Chad	160	2,832
Nairobi, Kenya > Ndjamena, Chad	300	45,000
Khartoum, Sudan > Ndjamena, Chad	40	6,000
Luanda, Angola > Ndjamena, Chad	240	4,248
Dakar, Senegal > Ndjamena, Chad	450	7,965
	10,478	953,544

With so many restrictions, there was no aid going from Lusaka, Zambia to any of the strategic cities. Khartoum, Sudan, and Nairobi, Kenya route to Kosongo, D.R. Congo has the trip restricted of 40 and 80 respectively opening up these restrictions would let more aid flow to Kosongo, D.R. Congo and saving more lives there. IFRC should focus on lifting restriction from Lusaka, Zambia, Khartoum, Sudan and Nairobi, Kenya as shown in the table on the left.