

Verité

Open Trade Data

Pilot Web App

Visualize the Risk of Unfair Labor in International Trade

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Abstract

This essay introduces an original web app that can be found at the URL: <https://arshsinghphd-forcedlaborrisk-github-io-app-5pqff6.streamlit.app/>. I present two walk-through demonstrations on how to use it, and a brief discussion on its limitations and potential.

Organization of this Document

[1. What This App Can Do for You](#) describes the exact problem that the app supplies a solution to. In the next section [2. User Interface](#), I describe the layout of the app's web interface.

As examples of how the app can be used, I present two sample use cases - [3. Cotton Exports from Burkina Faso in 2021](#) and [4. Cotton Imports to USA in 2021](#).

I end with a discussion on the limitations of the current version of the app, its potential, and ways to realize this potential in the section [5. Limitations and Further Possibilities](#).

Although it is not possible to do away with all jargon, I have tried to use colloquial as much as possible. I have also tried to explain everything using examples and images.

Contents

Abstract.....	i
Organization of this Document.....	i
Acknowledgement	ii
Inception	ii
1. What This App Can Do for You.....	1
2. User Interface.....	2
3. Cotton Exports from Burkina Faso in 2021	7
4. Cotton Imports to USA in 2021	10
5. Limitations and Further Possibilities.....	12

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I would also like to thank Yamila Irizzary-Gerould and Marah Brubaker at Verité for their support.

I would like to acknowledge the support of UN Comtrade in the form of a trial premium subscription which allowed me to download the data for Cotton Trade between all countries in 2021. This data is used in the current version of the app.

In the production and running of this app I have used the following packages. These are generously made open source and free to use and enable novices and people with few resources to create and display their talents. I am grateful to:

- Python (python.org)
- Pyvis (<https://pyvis.readthedocs.io/en/latest/>)
- Streamlit (<https://streamlit.io/>)

In its current version, the app is housed at the Streamlit Community Cloud at no expense (<https://streamlit.io/cloud>).

Inception

In a presentation to her colleagues at Verité, **Allison Arbib** presented the case of international trade of cotton arising from Burkina Faso. Burkina Faso is a country which appears on the list of countries known by the U. S. Dept. of Labor to have considerable risk of unfair labor involvement in the production of cotton. Burkina Faso exports this cotton to many countries. The biggest trade partner for Burkina Faso in 2021 was Switzerland. Allison asked a very clever and insightful question:

What happens after Switzerland?

In other words, what can the open international trade data tell us about the trans-national transformation and transfer of goods involving unfair labor. This is public information hiding in plain sight that can easily become public knowledge if we can shine light on it – make the international trade data easy to access and understand.

I was presented with this problem by Allison and as a possible solution I created this app. It can be used repeatedly with different parameters to request, process, and visualize information about international trade with an emphasis on the involvement of unfair labor.

1. What This App Can Do for You

What does this app do? I find it easy to think in terms of problems and solutions. So, following is a problem statement that one can think the app is a solution to.

For a user interested in visualizing the risk of unfair labor involvement in the international trade of a commodity, create an application that will do the following:

1. Retrieve any relevant international trade data from UN Comtrade based on:
(1) country/area, (2) commodity, (3) trade flow (export or import), (3) year, (4) the number of largest partners-in-trade to be included.
2. Allow the users to get information for partners, partners-of-the-partners, etc. many times over (call it depth).
3. Visualize this data in a compact and easy to understand form.
4. What part of total imports are provided by each partner, or what proportion of total exports go to each partner?

Use the list provided by U. S. Dept of Labor as the source of information about unfair labor practices in countries and specific goods from these countries. In the visualization, highlight the risk of unfair labor in the following way:

5. Flag the countries that are known to have unfair labor practices for the commodity under consideration.
 6. Show what part of total imports of each country/area comes from countries/areas that may have unfair labor practices, even if these are not among the largest trading partners.
-

If the problem statement presented above does not make sense right away, please bear with me and read on. The utility of the app and its functions will become clear in the following sections where I describe the use cases. Let's begin with a visual tour of what you see as soon as you open the app, the User Interface.

2. User Interface

The web app is publicly and freely available, with limited data for now, at the URL: <https://arshsinghphd-forcedlaborrisk-github-io-app-5pqff6.streamlit.app/>.

When a user opens the app, they see a Logo and five labels with down arrows, which shows these can be expanded (upon mouse or space bar click). The containers are described briefly in the following pages.

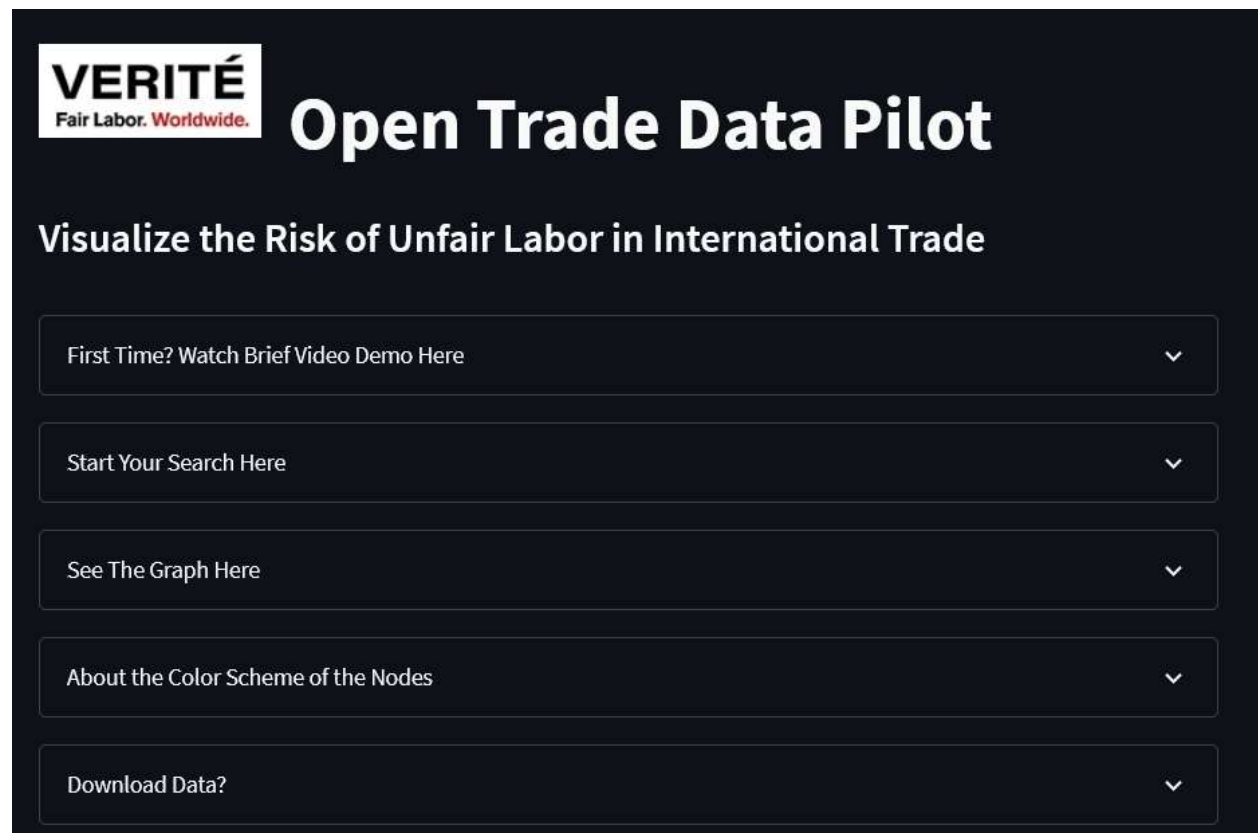
[First Time? Watch Brief Video Here](#)

[Start Your Search Here](#)

[See The Graph Here](#)

[About the Color Scheme of the Nodes](#)

[Download Data](#)



First Time? Watch Brief Video Demo Here

For a new user, a brief video on how to use the app.

Start Your Search Here

The form first asks for commodity, trade flow, and year, based on which data is requested from UN Comtrade. Then the app asks you to choose a country (see image below).

Please note:

- The UN Comtrade allows looking up data using a few different classification systems. In the current version of the app, we are the Harmonized System (HS) Commodity Code e. g. *52 - Cotton*. This category includes a wide range of raw and partially and fully processed cotton products.
- A complete list of HS Codes can be found at the following URL:
<https://www.wcoomd.org/en/topics/nomenclature/overview/what-is-the-harmonized-system.aspx>.
- The number in front of the country is the code linked to the country as they appear in the UN Comtrade data, e.g., 854-Burkina Faso.
- The list of countries is not comprehensive and is limited to the data available from UN Comtrade. For example, for *52 - Cotton*, and the year *2021*, there is no data for Cote d'Ivoire.

Start Your Search Here

HS Commodity Code Trade Year

52 - Cotton Export 2021

Submit

Country

Bur

108-Burundi

854-Burkina Faso

100-Bulgaria

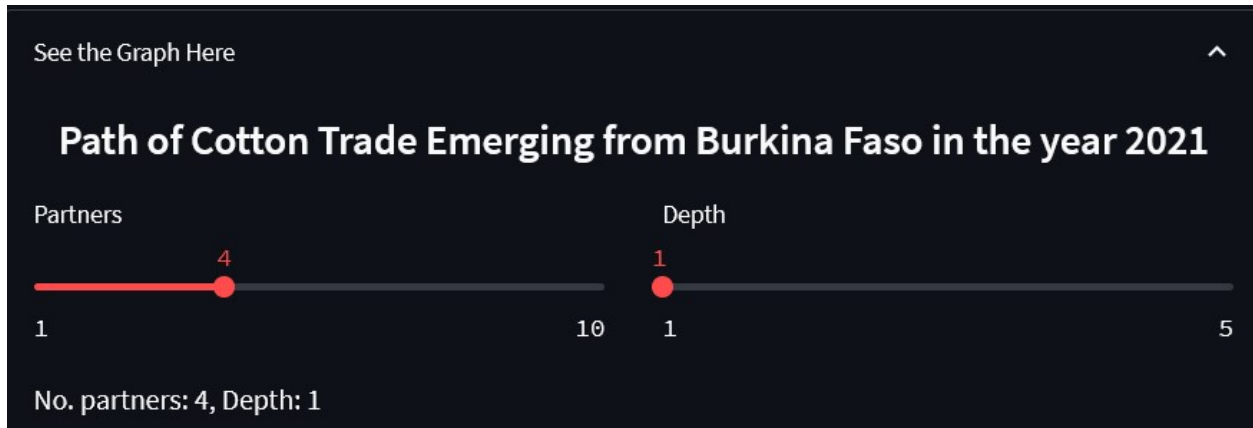
442-Luxembourg

96-Brunei Darussalam

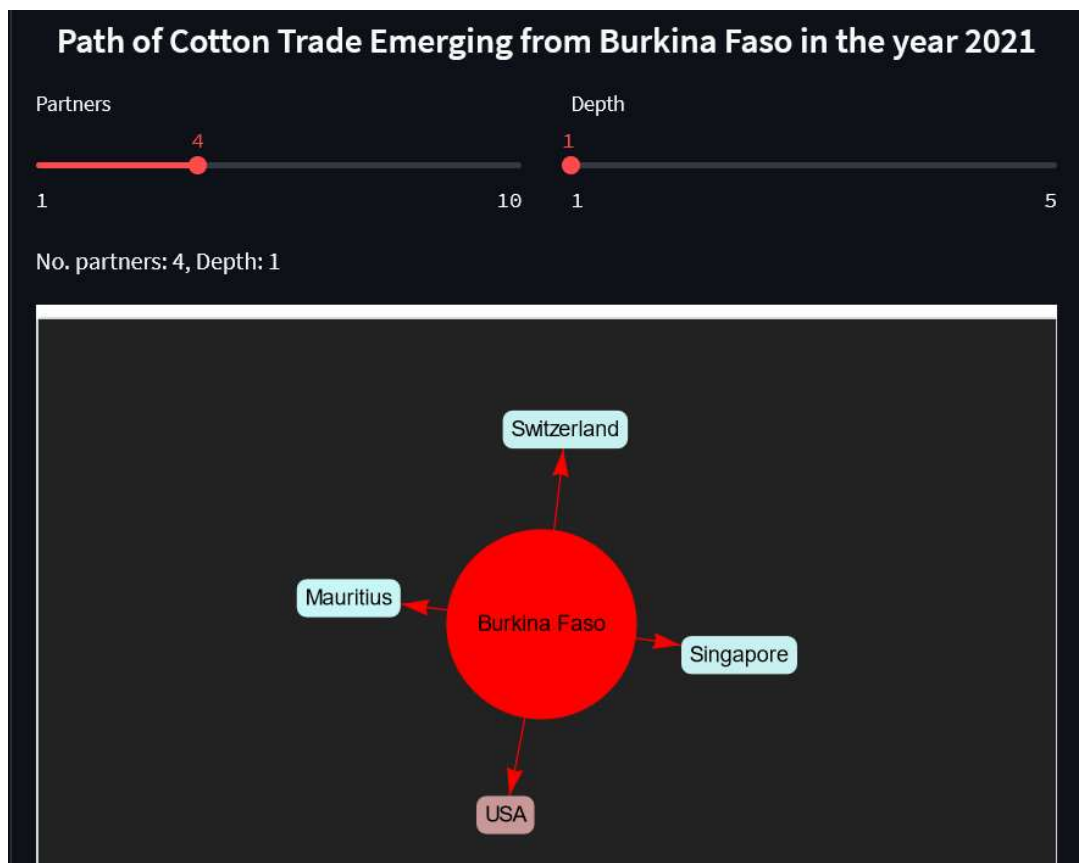
See the Graph Here

Adjusting Partners and Depth.

You can adjust the partners and depth of the search using these sliders. 



Result Graph

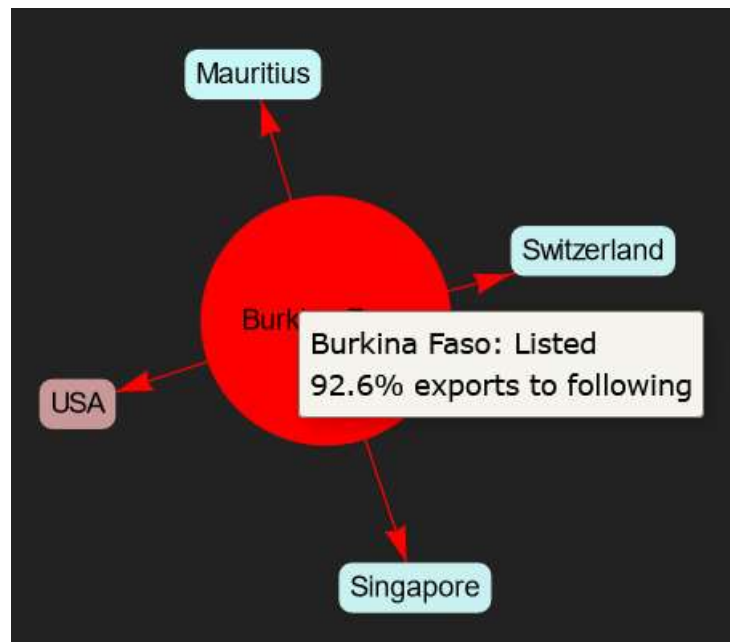


Two important metrics are visible on mouse hover.

For example, if you put the mouse on the central node, you see a rectangular label pop up which, in this case, says:

Burkina Faso: Listed

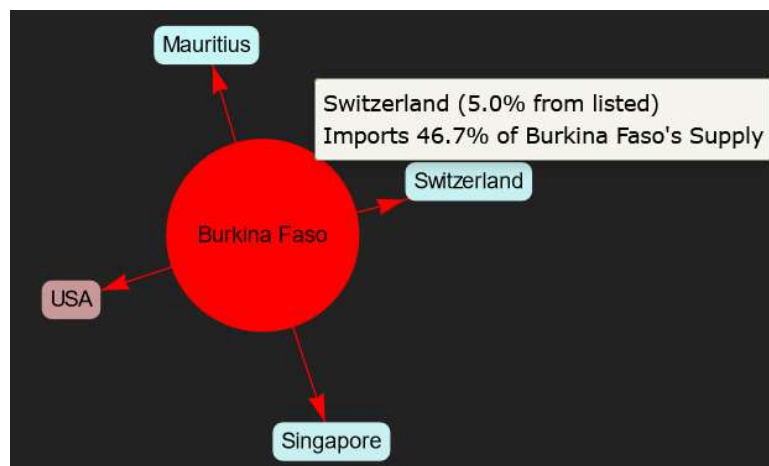
92.6% exports to the following



or if you hover the mouse over the node for Switzerland, the label says:

Switzerland (5% from listed)

Imports 46.7% of Burkina Faso's Supply



About the Color Scheme of the Nodes

This section holds information about the color scheme of the nodes. This information is static and does not change with search.

About the Color Scheme of the Nodes

RED

U. S. Dept. of Labor reports a list of countries that have a high risk of involving forced and/or child labor. Such countries are colored red and labelled 'Listed'. Any countries downstream a red node will also suffer a risk, which is color coded in shades from pink to white.

PINK

The color of the node for a country not in the (U. S. Dept. of Labor) list depends on the proportion of its imports that come from the listed countries - even the ones that do not appear on the graph.

WHITE

Darker the color, higher the risk of involvement of forced or child labor in its imports.

Download Data?

Finally, the app lets you download the data table that was used to make the graph in two formats: excel (tab separated) or csv (comma separated) text files.

Download Data?

.xls

.CSV

3. Cotton Exports from Burkina Faso in 2021

In this section, I want to walk you through an example of how to use the app to visualize the risk of unfair labor in the exports of cotton from Burkina Faso in 2021. I will do this in two steps: first, I will show using images, how to do this on the app. Then, I will very briefly describe what the app does in the background to get to the resulting visuals.

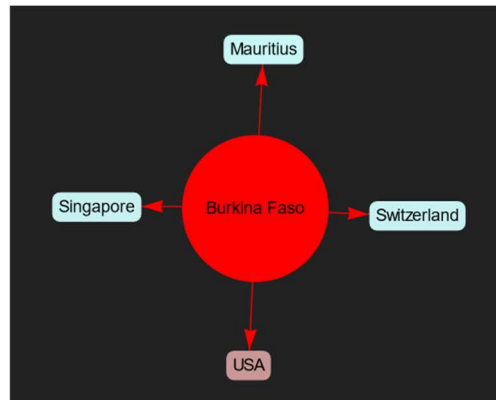
A Walk-Through

For the first few steps the images are the same as in the section [2. User Interface](#).

- 1) Open the app using your web browser by pointing it to the URL: <https://arshsinghphd-forcedlaborrisk-github-io-app-5pqff6.streamlit.app/>
- 2) Open the container labelled **Start Your Search Here**.
- 3) Select the **Commodity** (in the current version it is limited to 52 - *Cotton*). The number in front of the commodity name is the HS (harmonized system) code linked to the commodity.
- 4) Select the **Trade** to *Export*.
- 5) Select the **Year** (in the current version it is limited to 2021).
- 6) Press the **Submit** button.
- 7) The app will now ask you to select a **Country** from a drop-down menu or you can start typing the name and the menu will suggest the best matches. In this case we are interested in *854-Burkina Faso*.
- 8) If it is not open, please click the label 'See Graph Here' to open this container to view the graph.
- 9) You will see an image with a red circle labelled 'Burkina Faso' and an arrow from it pointing to a rounded rectangle labelled 'Switzerland', the largest trading partner of Burkina Faso in the trade of Cotton.
- 10) You can move these nodes around using a mouse.
- 11) You can also zoom in and out of the graph using the mouse (scroll function) or page-up page-down buttons.
- 12) Since Burkina Faso appears on the list of US Dept of Labor, it is colored red.
- 13) Switzerland on the other hand is almost white, since only about 5% of its total imports are from listed countries.
- 14) Above the graph, you will also see two sliders labelled 'Partners' and 'Depth'.
 - a) Moving the slider under 'Partners' will allow you to increase or decrease the number of partners.
 - b) Moving the slider under 'Depth' will allow you to increase or decrease the depth of your search.The following illustration should make this clear.

The image below set at Partners = 4 and Depth = 1, shows the four most important trade partners of Burkina Faso. (Which is Switzerland (46.7%), Singapore (27.8%), USA (11.5%), and Mauritius (6.7%). This information is seen when you hover the country nodes.

Depth = 1



If you change the Depth to 2 using the slider, you will see many more nodes, 4 partners for every partner to be precise. These countries may repeat. For example, Viet Nam is among the four most important partner for both Singapore and USA.

Depth = 2



The Works

The python code that runs in the background of this app does the following (in a few seconds!):

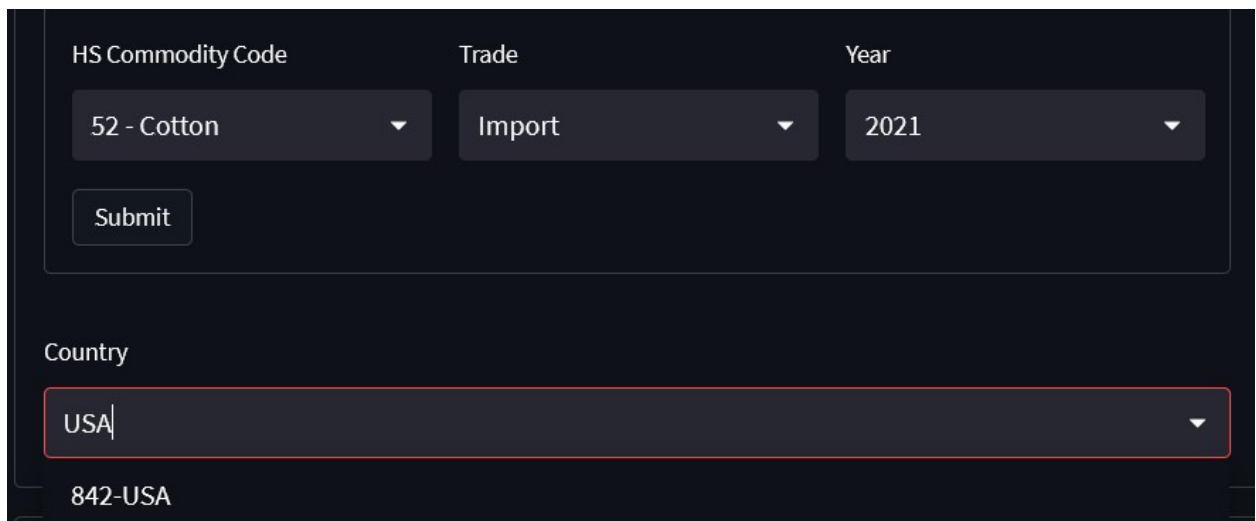
1. Processes the list from U. S. Dept of Labor which has information about countries, and goods from the countries, which are known to have unfair labor practices.
 - a. The app has the list from US DoL stored.
 - b. Searches the list for the countries listed for the commodity you are searching for.
 - c. Matches countries in the list to their names in the UN Comtrade list and gets the *id* - a number which is linked to each country and is used for data lookups.
2. UN Comtrade data request (look-up) and processing:
 - a. Requests data from UN Comtrade (the current version uses data from UN Comtrade stored in the app)
 - b. Processes the data - the code performs many data search operations for making each graph. The format of data files from UN Comtrade are not the best suited for this purpose. The python code processes the files to keep only the useful information and in a form most amenable for fast data search.
 - c. Searches for the most important partners for the country provided by the user.
 - d. If depth is more than one, searches for the most important partners of partners, etc.
 - e. Calculates the proportion of total trade of the preceding country accounted for by each partner and stores it in association with each country to be reported on the graph nodes.
3. For each country on the graph, calculates the proportion of imports from the listed countries. This is used to decide the color of the node for countries not in the list.
4. Makes a graph:
 - a. Generates graph nodes that hold information about the country and the calculated metrics, and of the node colors based on the total trade with listed countries.
 - b. Makes edges that connect the partnering countries.
 - c. Plots nodes and edges and saves the visual display in html format for display.
5. Reformats the data used for making graph (edges) into downloadable tables.

4. Cotton Imports to USA in 2021

In this section, I want to walk you through another example of imports of cotton to the USA in 2021.

A Walk-Through

- 1) Open the app using your web browser by pointing it to the URL: <https://arshsinghphd-forcedlaborrisk-github-io-app-5pqff6.streamlit.app/>
- 2) Open the container labelled **Start Your Search Here**.
- 3) Select the **Commodity** (in the current version it is limited to 52 - Cotton).
- 4) Select the **Trade** to *Import*.
- 5) Select the **Year** (in the current version it is limited to 2021).
- 6) Press the **Submit** button.
- 7) The app will now ask you to select a **Country**. We are interested in 842-USA.



The screenshot shows a web application interface with a dark theme. At the top, there are three dropdown menus labeled 'HS Commodity Code', 'Trade', and 'Year'. The 'HS Commodity Code' dropdown is set to '52 - Cotton', the 'Trade' dropdown is set to 'Import', and the 'Year' dropdown is set to '2021'. Below these dropdowns is a 'Submit' button. Further down, there is a 'Country' label above a dropdown menu. The dropdown menu is open, showing 'USA' as the selected option. Below the dropdown menu, the text '842-USA' is visible.

- 8) If it is not open, please open the container labelled 'See the Graph Here' (images on the next page).
- 9) By default, you will see an image with a circle labelled 'USA' and an arrow pointing to it from a rounded rectangle labelled 'Pakistan', the largest trading exporter of Cotton to USA 2021.
- 10) Above the graph, you will also see two sliders labelled 'Partners' and 'Depth'.
 - a) Moving the slider under 'Partners' will allow you to increase or decrease the partners (see next page for an image of 10 partners and depth of 1).
 - b) Moving the slider under 'Depth' will allow you to increase or decrease the depth of your search (see next page for 4 partners and depth of 2).
- 11) You can move the nodes of the graph around using a mouse.
- 12) If country names are not legible, you can zoom in and out of the graph using the mouse (scroll function) or page-up page-down keys.

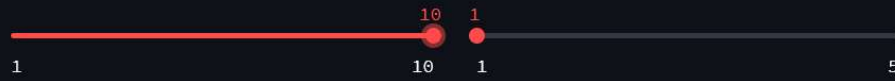
See the Graph Here



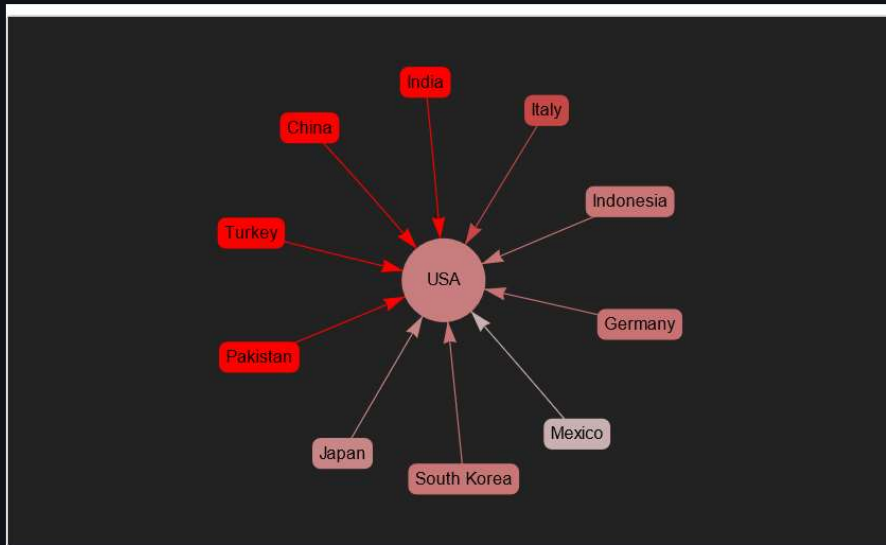
Path of Cotton Trade Reaching USA in the year 2021

Partners

Depth

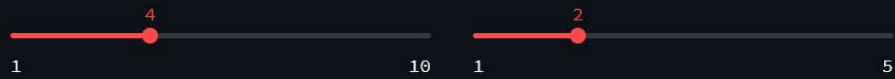


No. partners: 10, Depth: 1

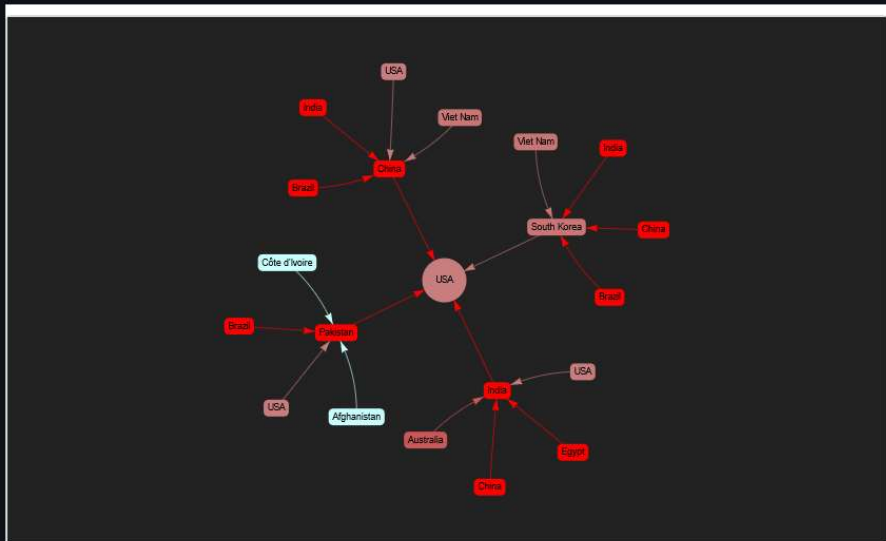


Partners

Depth



No. partners: 4, Depth: 2



5. Limitations and Further Possibilities

I am listing some limitations and possible improvements here in order of the difficulty of achievement, from easy to more difficult (time consuming or difficult to obtain data).

A. Allow Users to Download Nodes Data

Currently the app only allows users to download the edge data as a table. We can let the user to down the metrics stored in the nodes as well: whether the country is listed or the imports from listed countries.

B. Allow User to Select the Form of Unfair Labor

Currently, the app does not differentiate between the two kinds of unfair labor practices reported by the US DoL - child labor and forced labor. The app can be easily changed to allow the user to decide which kind of unfair labor they want to investigate - child labor, forced labor, or both.

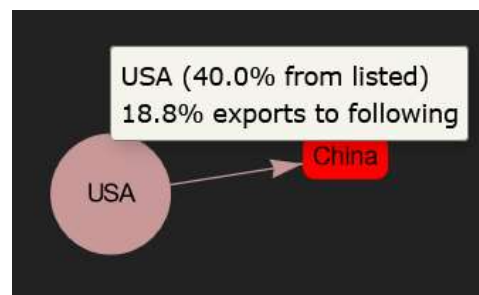
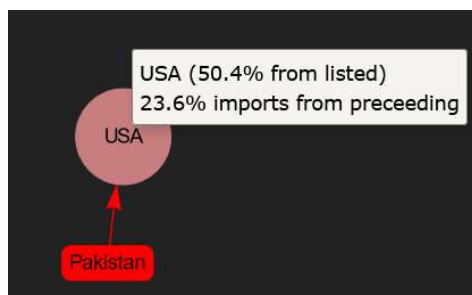
C. UN Comtrade Subscription

In its present form the app does is unable to request data from UN Comtrade in real time and is thus limited to trade of 52 - *Cotton* in 2021 which is stored. It can easily be changed to be able to request any data the UN Comtrade holds. This requires a premium subscription and API.

D. Infer Missing Data

Our only source of international trade data is UN Comtrade, which in turn relies on countries to supply their data voluntarily. Countries which are more likely to have unfair labor practices, say Afghanistan, are also unlikely to share data with UN Comtrade. Resultantly, we have two kinds of inconsistencies:

1. We are likely misrepresenting countries which do not provide the data to UN Comtrade as white nodes (rather than shades of red/pink).
2. To illustrate the second inconsistency, say if we query imports of cotton to USA in 2021, the central node shows that 50.4% of USA's 52 - *Cotton Import* in 2021 was from listed countries, but if we query *Export*, the same number falls to 40%.



One possible solution to this problem is to infer information, say imports into Afghanistan based on the reported exports of other countries to Afghanistan. It will not be complete, or perfect, but will remove the current inconsistencies.

E. Expanding the Source of Data for Unfair Labor

Verite houses a wealth of data which can likely be incorporated with the current app to better estimate the risk of involvement of unfair labor in International Trade. I would like to seek avenues of collaboration with other projects at Verite such as Cumulus.

F. Sets of Products

We can make this app much more relevant and useful if we can infer a 'supply chain'. I use the words in quotes because I do not mean it in the strictest sense of the word, more like a set of all the product codes that can be grouped together.

For example, there are more than 100 categories outside of 52XXXX which consist of mostly cotton (85% of the content). If we can make such a group, then rather than depend on the classification made by HS (52XXXX) we can do a more intuitive grouping – say, of the products that are more than 85% cotton. Moreover, reporting without this kind of re-grouping will be meaningless in most categories. For example, if one was interested in palm oil and palm oil related products, the HS codes are not very simply linked: Palm seeds are HS-120710, Palm Oil and fractions are HS-1511XX, and Palm Oil Cake and Other Residues are HS-230660. We can group them all together under one category that can be easily searched for using the app and reported on.

Verité has generated many product and country reports which likely contain this knowledge and can be used for the purpose of making these sets. Such information can also be gleaned from the definitions of HS categories which are readily available.

G. Adding Domestic Production Data

Putting data into context really helps us understand its real implication. For example, we could easily find that Burkina Faso was exporting about 50% of its cotton to Switzerland, but finding out that this tainted cotton makes only 5% of Switzerland's imports (which needs much more data and data processing) has changed the way we view this information, or color the node of Switzerland.

If we also knew how much cotton was produced in Switzerland in 2021, we may be able to draw conclusion about the expected amounts of tainted goods in Switzerland's exports of cotton and related products, allowing for a better estimation of the 'risk'.

I am not certain about the availability of data of domestic production for every country, but most large economies make such data readily accessible in their countries' annual GDP reports.