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Data4Good: Helping IOM Forecast Logistics for Refugees in Africa

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Outline:

IOM Challenge, “Towards enhanced needs mapping for improved capacity and resource planning”.

The International Organization for Migration of the United Nations challenged start-ups to come up with a solution for better supply chain management by utilizing data and analytics. Notilyze and Elva together came up with a suitable solution to make more use of already available data using SAS Viya.

Specifically, the project team helped to create an analytical tool that allows for a better translation of existing analytical outputs (e.g. the displacements tracking site assessments) for site planning and concrete supply chain management. It strives to realize this goal by achieving the following objectives:

1. Using both existing displacement tracking site assessment data and input from humanitarian field workers within IOM and other relevant stakeholders to identify a set of common indicators on humanitarian needs, related development needs and supply chain gaps for needs mapping and forecasting during this project.
2. Based on the these standardized indicators, develop a prototype algorithm that provides automated forecasting of humanitarian and development needs and supply chain requirements.
3. Visualize these on-the-ground needs and supply gaps in interactive dashboards, maps and automated forecasts.

The Challenge

In its day-to-day practice, the International Organization for Migration works towards strengthening the interconnection between emergency aid and development initiatives. This area of convergence will lead to positively impacting resource and capacity planning to provide adequate assistance to displaced populations and migrants. This project focuses on Ethiopia and Nigeria where in total 2.6 million persons are currently displaced. Globally over 40 million people are internally displaced (IDP).

In both emergency aid and development initiatives, information management systems are key to effective and efficient program and service delivery management. Aligning the methods and tools used for monitoring needs and services in both contexts would likely lead to a better understanding of the needs of those affected and the capacity and resource planning required to tackle them.

To track and monitor displacement, population mobility, and the needs of those that have been displaced, IOM uses the Displacement Tracking Matrix (DTM). It is designed to regularly and systematically capture, process and disseminate information to gain a better understanding of the movements and needs of displaced populations and migrants as they evolve. Its indicators are mostly related to individual needs and highly specific to geographic locations. Alternatively, development indicators are more often related to overall basic services at a much larger scale.

The Team

Elva has six years of experience providing data analysis and visualization tools to leading international organizations, including UNDP, the EU, the Dutch Ministry of Foreign Affairs and others, to map the development needs of communities in a range of conflict-affected contexts (Syria, Libya, Ukraine, Nigeria, etc.). Notilyze has more than 10 years experience in data analytics and is recognized by the SAS Institute as one of their leading partners in data analytics on the Viya platform. The organization employs econometricians and data scientists with experience in finance, logistics and marketing data analytics. All projects include data management and connecting open data, developing the algorithms and implementation in the customers business. Leiden University and IOM are renowned institutes with extensive experience in data-driven research for different purposes. In sum: The consortium combines experience in operations research, forecasting and machine learning and has a proven track record in delivering results in highly challenging and conflict-affected production environments.

Our Approach

In order to ensure a tight customer fit and interoperability with existing humanitarian operating standards and frameworks, the final solution is based on extensive input from stakeholders such as IOM. Since 2015, IOM has conducted 28 Site Assessments in areas in North-East Nigeria that have been most affected by displacement. In Ethiopia 16 similar site assessments were conducted from 2016. In total these 2 countries house over 2.6 million IDPs (Internally Displaced People) in 1250 camps. Although evolving somewhat in their design and sets of indicators, these regular assessments have been collecting significant amounts of data on a number of issues that can be used by our machine learning model to guide relevant operational responses, including: Water, sanitation and hygiene (WASH), health, shelter, food security, education and livelihood.

Innovation

The proposed project combines both innovative technological and methodological approaches to achieve its objectives:

- Technological innovation: We developed a way to import data from both IOM and other (open data) sources. The data is analyzed and visualized to provide IOM with more insight and improve comparability between different sites. The platform employs a state-of-the-art machine learning algorithm to forecast supply chain and (financial) resource needs for IDP sites, based on the collected DTM site assessment data.
- Methodological innovation: There are currently few common indicators and measurements that allow for tracking and addressing both humanitarian and related development needs simultaneously. The project build an innovative methodology that bridges this gap by establishing common indicators that can be used to track the needs of a displaced population, as these evolve from immediate emergency needs to recovery and development-related needs.

Sustainability

- Institutional interoperability: We ensured the closest possible integration of all project outputs (in particular the generated humanitarian inputs and their visualizations) into relevant, existing frameworks, including existing templates (e.g. IASC reporting standards and other templates, such as the HNO), relevant toolkits (e.g. the CCCM's Camp Management Toolkit) and other relevant industry standards.
- Extensive user validation: the team engaged relevant end users in the prototyping workshops, increasing their ownership of the tool and furthering the adoption of the prototype solution for piloting by relevant stakeholders.

Scalability

- Ensuring the highest potential adaptability of the software solution: the algorithms and functionalities designed within the proposed prototype can easily be adapted to process data from other sites, allowing for a relatively easy roll out to other contexts following a successful pilot phase.
- Using scalable technology: the platform will also largely be developed in SAS, Javascript and NodeJS, which allow for highly scalable data processing architectures.

Results

Elva and Notilyze have developed a basic but robust prototype of the described tool, preliminarily called Camp Forecast. This prototype was developed in close coordination with, and based on input provided by, field staff as well as supply chain management staff from different humanitarian organizations. The tool was developed within the space of three months only, and therefore we are currently testing the solution.

The first version of CampForecast is able to forecast 3 months ahead for an IDP camp in Ethiopia or Nigeria. Based on international standards we are able to define the needed amounts for required goods like water containers, toilets, toothbrushes, towels, soap, etc. It also shows the required budget to purchase these goods. This way camp management can focus on their challenges on the ground while our tool supports the supply forecasting.

Developments and Future Research

Currently we are working with IOM to test CampForecast in South Sudan, Nigeria and Ethiopia. It is a challenge to make the tool suitable for a broad selection of camp managers in different situations. The current version of the forecast is able to catch a trend, but forecasting a change in a trend is very hard. That is why we are currently looking into additional data sources to apply more advanced machine learning models.

Currently Camp Forecast is built on IOM's monthly "camp site assessments" and we apply a time series algorithm to forecast IDP population size for the next 3 months. To increase the quality of these forecasts we would need additional data sources to analyze. We are researching 3 sources that could support us with more accurate data; satellite or drone imaging, mobile device counting sensors and weather data (droughts and floods). Applying AI to these data sources would help to gather more detailed data more efficiently and provide more accurate forecasts.

Without analytics we would depend on local aid workers to gather the data and send it to IOM. While IOM's current datasets are impressive, they also show local differences in accuracy, recency and frequency. It would be a great step forward if we could embrace analytics and change the data cadence and develop more accurate and scalable applications.

Our Dream

In five years time, humanitarian supply chain management in crisis response no longer takes place on the back of a napkin. In stead, Camp Forecast will provide refugee camp managers with accurate demand forecasts based on a growing amount of data sources. Besides forecasting, Camp Forecast will also facilitate procurement through automated Bill of Quantity generation and integration with commonly used ERP systems. Lastly, Camp Forecast's ability to quickly forecast and visualize funding needs of any given refugee camp will provide humanitarian organizations with a powerful fundraising tool.

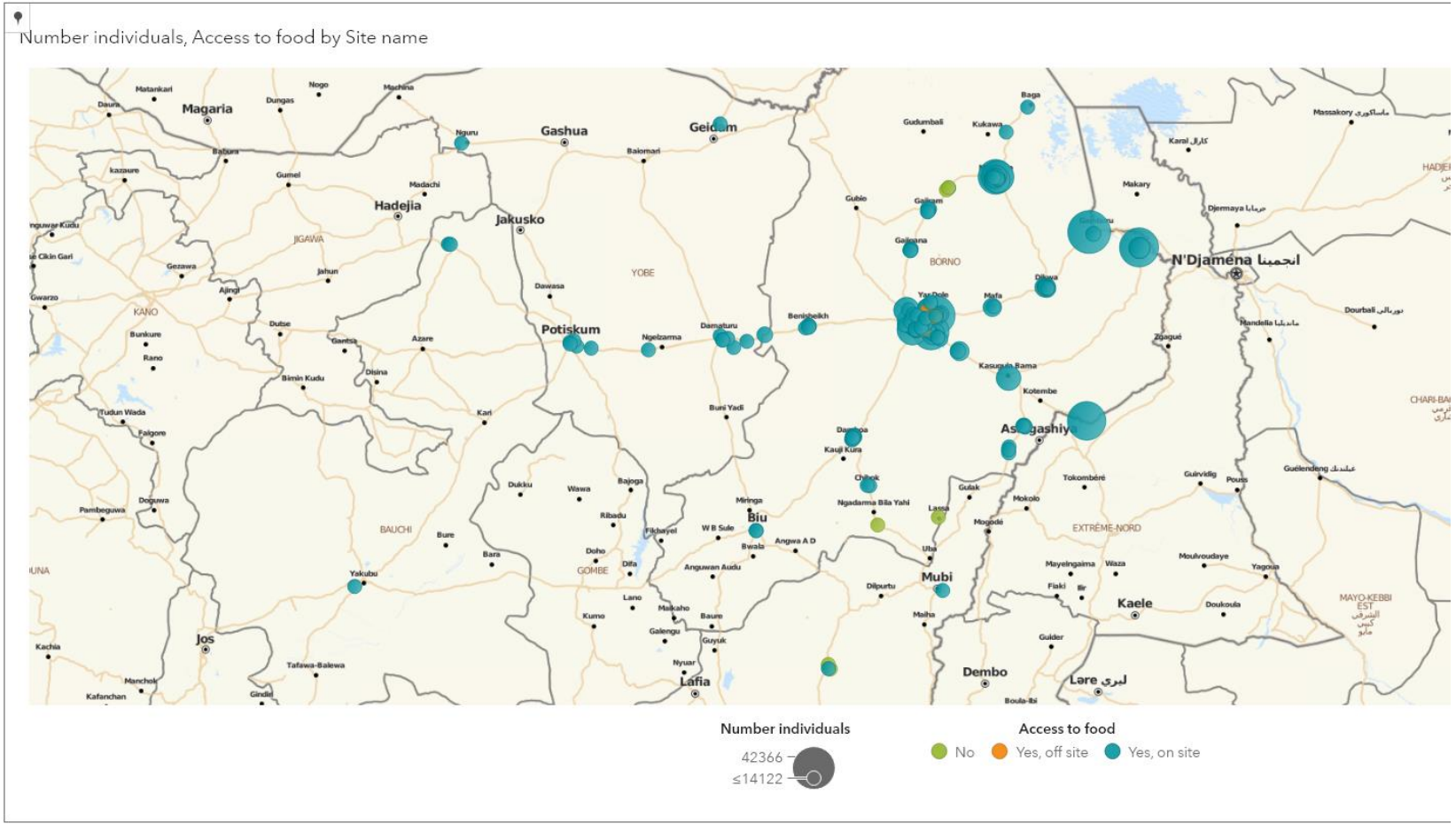
As a result, millions of refugees and IDPs will have better access to aid, as IDP camps will experience 15% fewer supply ruptures and 15% fewer overstocks, freeing up over 2 million USD for more effective aid. Given that yearly billions are spend on similar aid the implications of saving a few percent are enormous.

Presentation Outline:

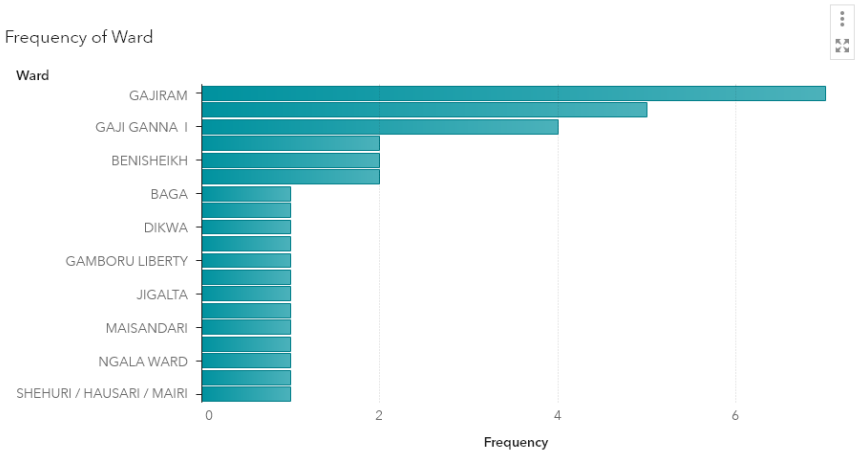
- The Challenge
  - IDP Camps in Ethiopia
  - The Data Visualized
- The Algorithms
  - Cluster Analysis
  - Forecasting & Machine Learning
  - Deployment
- Live Demo
- The Results
  - Supply chain improvements
  - Further Research
  - What we've learned

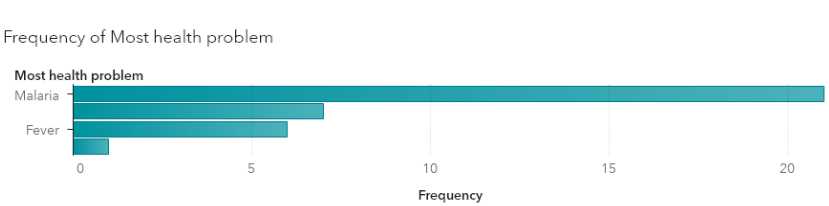
Presentation Visuals

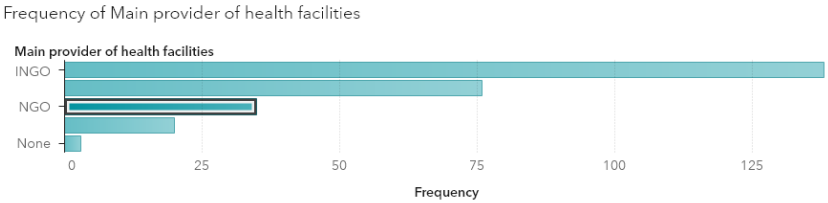
The number of individuals per refugee camp and their access to food in Nigeria.



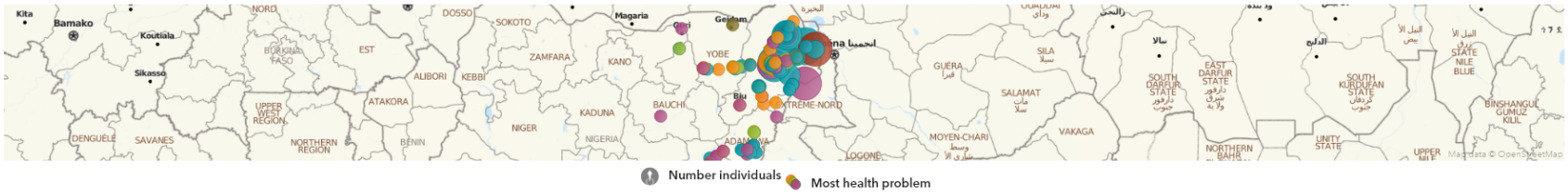
The most common health problems with their location per type of health facility.



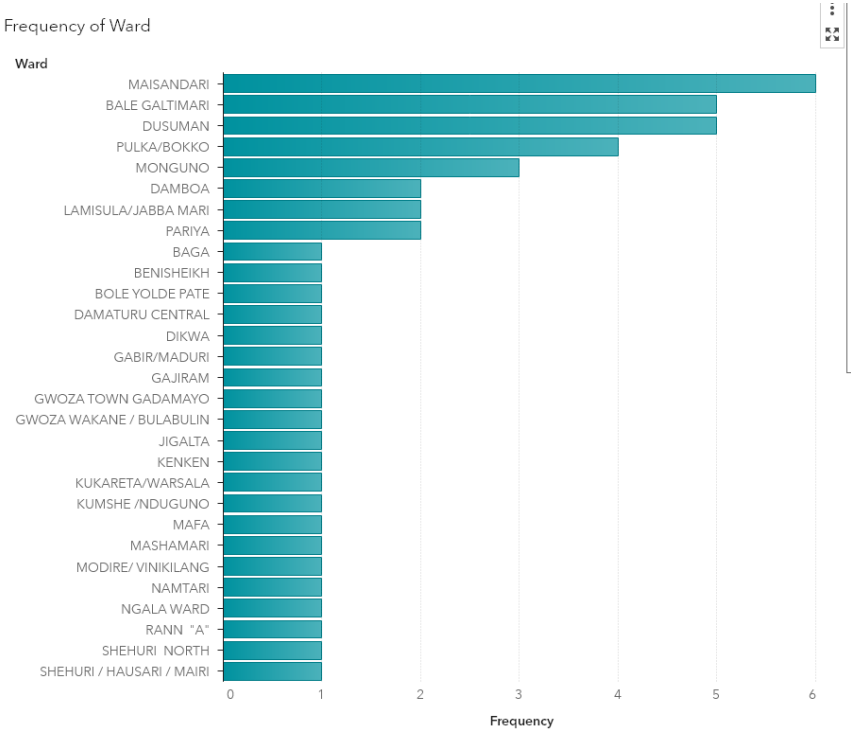


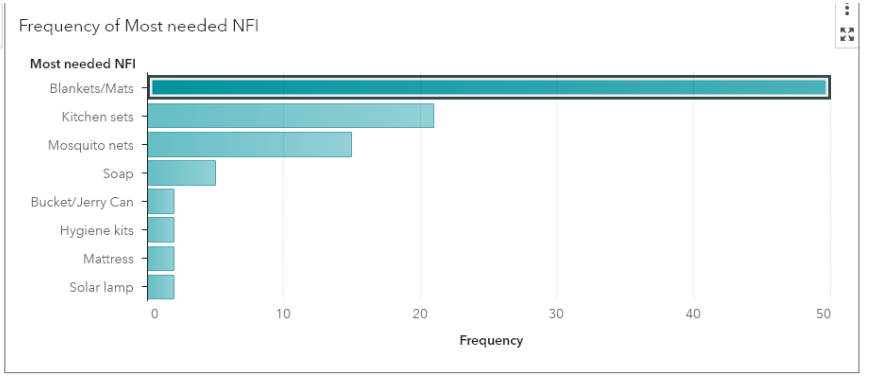


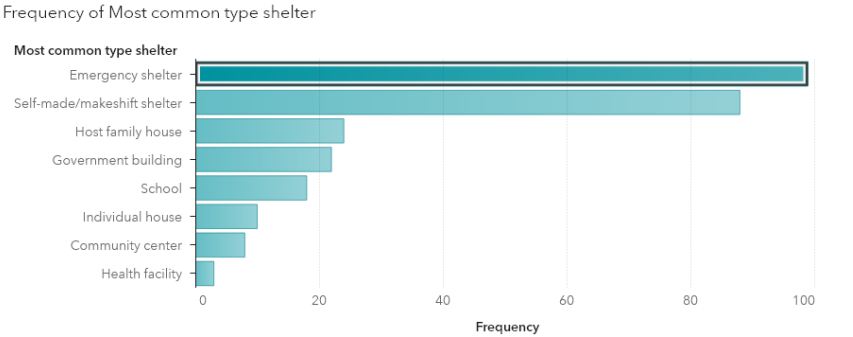
Number individuals, Most health problem by Site name



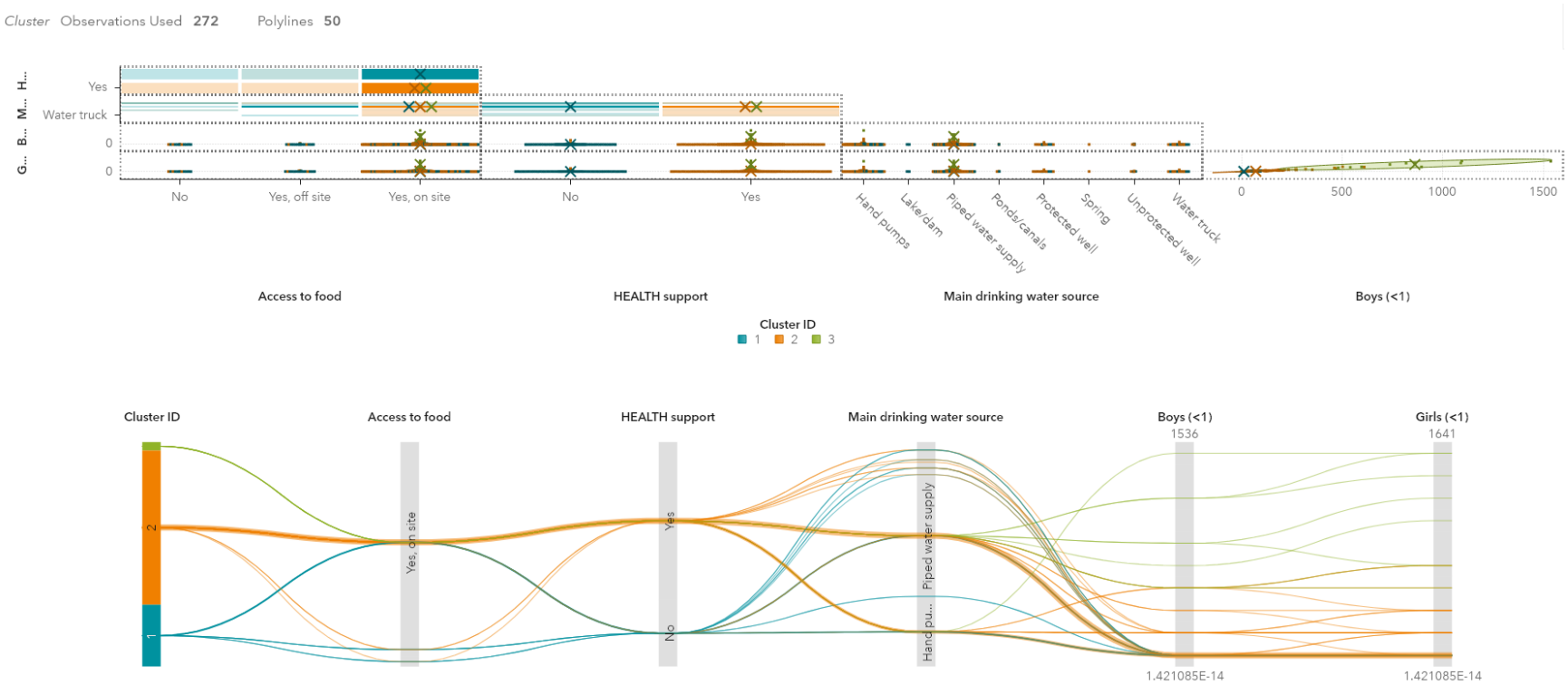
Most needed things in emergency shelter refugee camps.



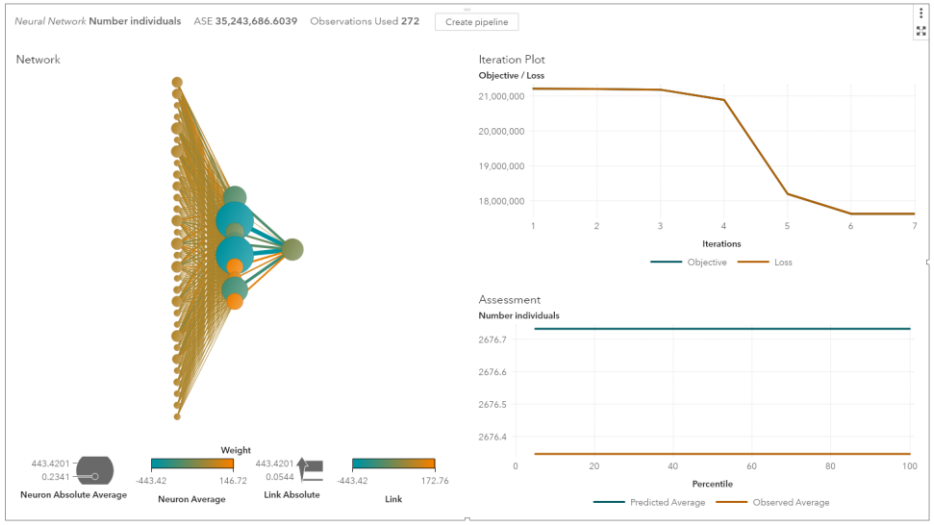


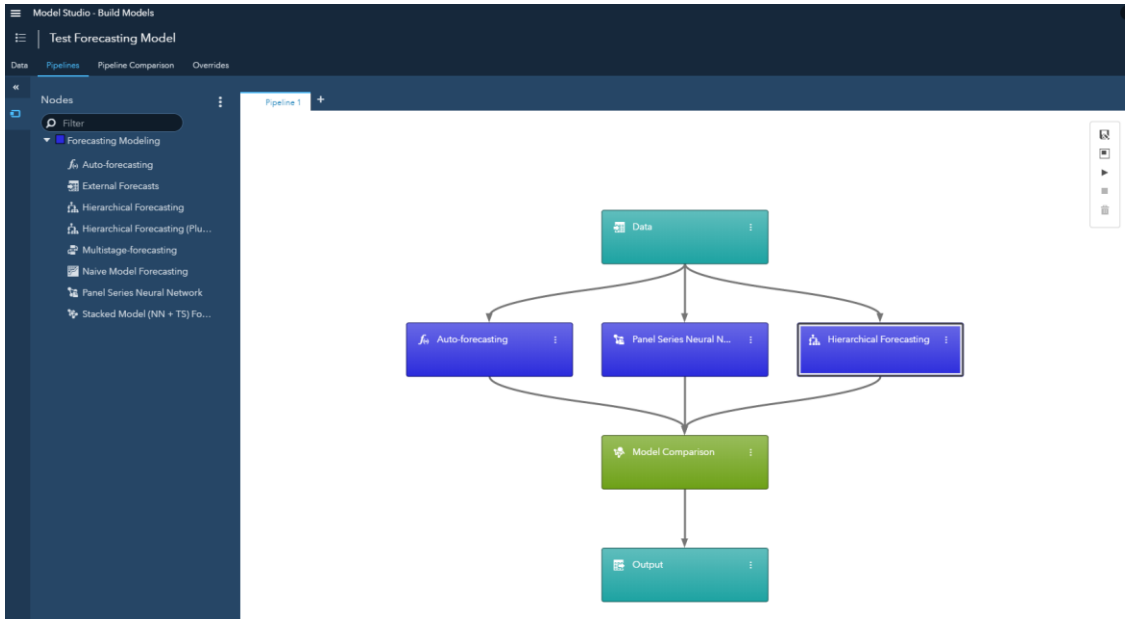


The first analysis is to find clusters of similar refugee camps in Nigeria. These clusters can be used to forecast different types of IDP camps.

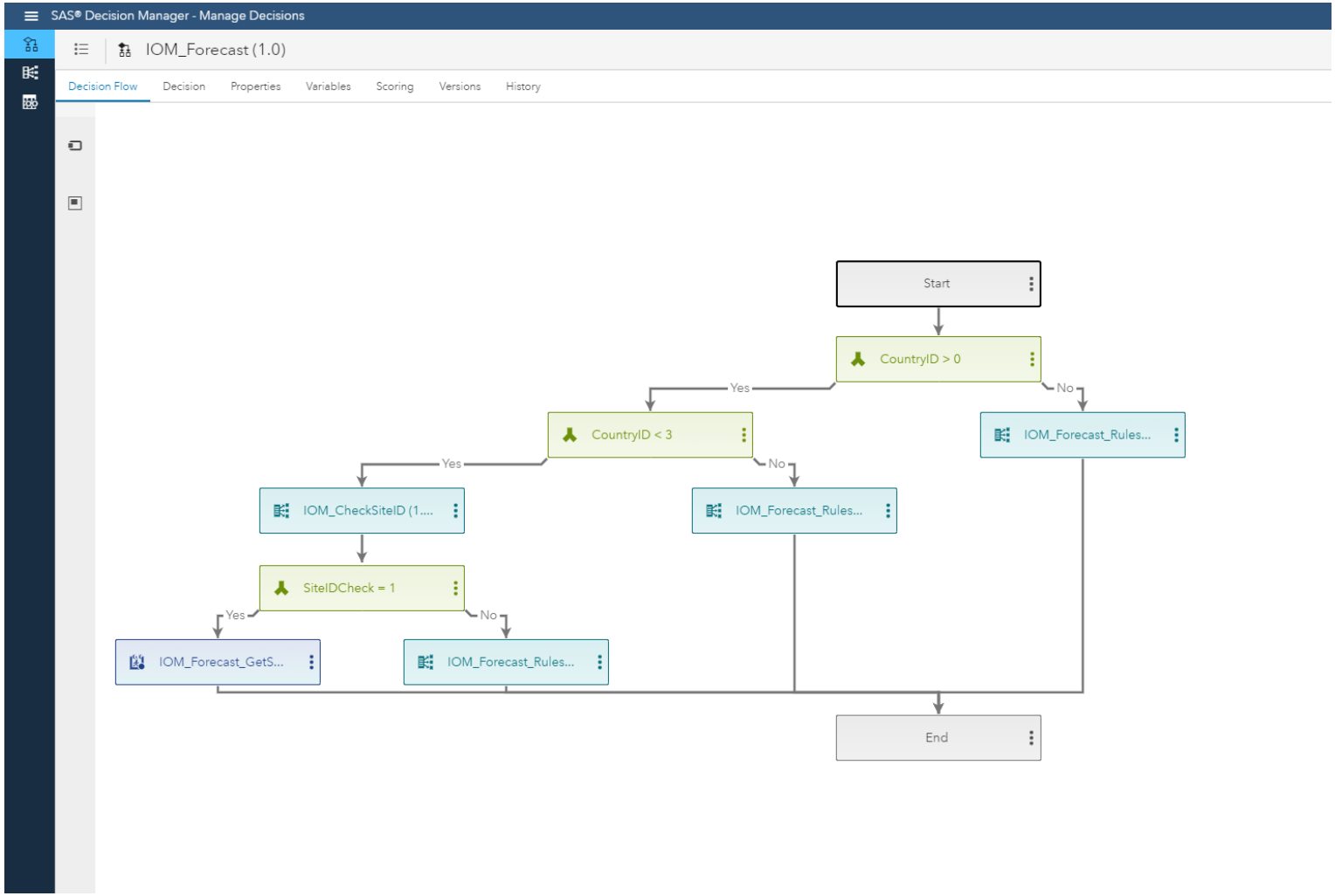


Finally we applied machine learning and timeseries analysis to find the best suitable model to forecast future numbers of individuals per IDP camp.

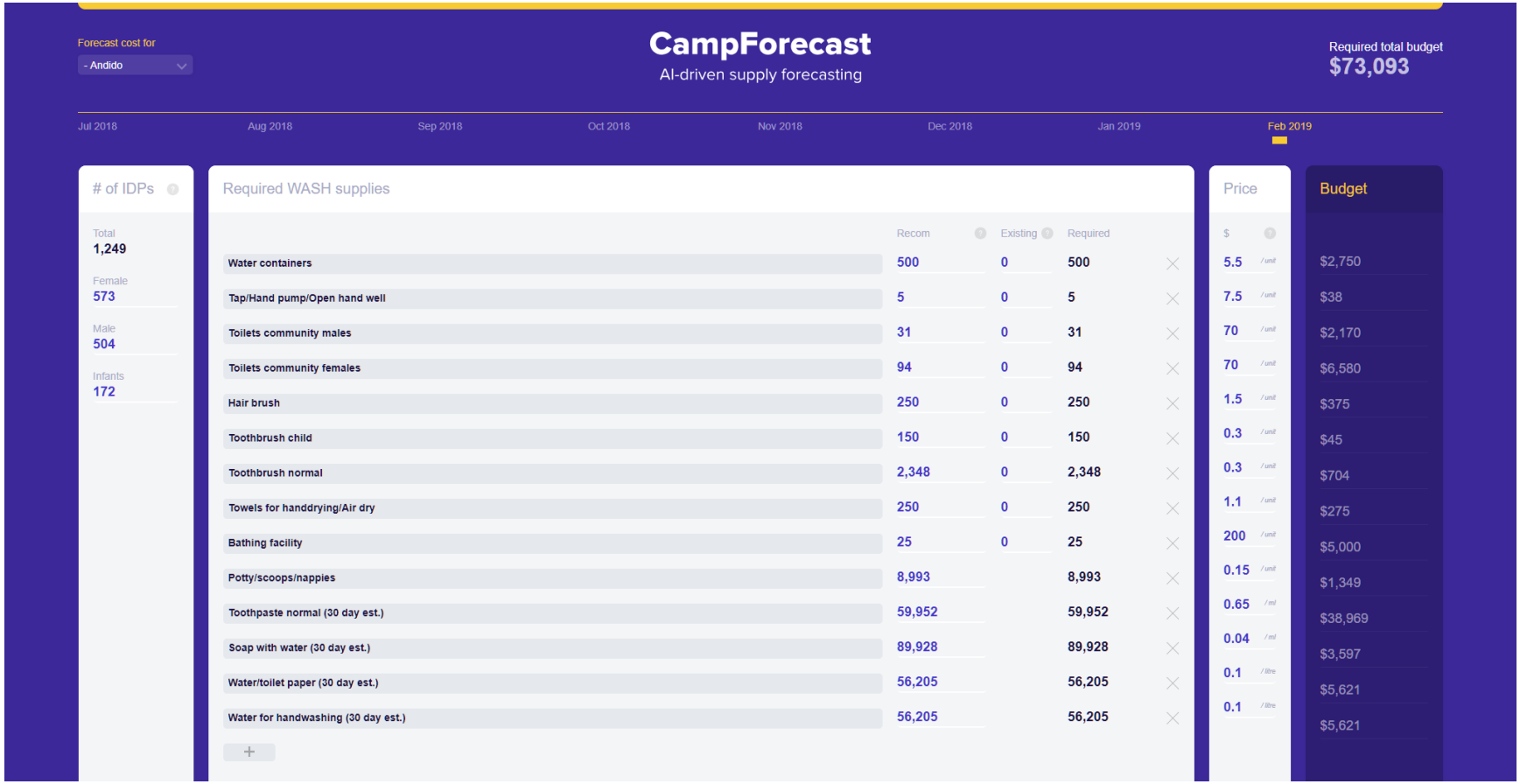




The forecast is operationalized using SAS Decision Manager. The underlying models and data can be updated separately while keeping the Decision the same. The model is shown in blue in the bottom left.



The final forecast is used in this first version of the camp forecast tool using an API.



Final Note:

Please note that we are still working on this project on a daily basis. As a result the screenshots and models are not yet final versions. If you want to help our project much of the data can be found online at https://migrationdataportal.org.

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