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Explorarea Gradului de Penetrare a Suportului în Domeniul Educației, Sănătății și Protecției Copilului

Exploring Education, Health, and Child Protection Support Penetration

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Abstract

A web application was developed allowing for the exploration of various scenarios in the field of education, health, and child protection. The application offers a platform for analysis of historical trends and patterns using a combination of open data and proprietary data shared by the Government of Moldova. Extrapolation of these trends and patterns could form a baseline scenario for the allocation of resources and improvement of child outcomes displayed through the web application. Through it, users can adjust these assumptions and respond to hypothetical shocks to consider how best to optimize outcomes for children under different scenarios.

Keywords

Protecția copilului, educație, sănătate, analiză cauzală, sisteme de informații geospațiale, planificarea scenariilor, știința datelor

Child protection, education, health, causal analysis, geospatial information systems, scenario planning, data science

Introduction

There is an ever-growing amount of data in circulation with potential to help guide more effective decision making in all areas of education, health, and social services. It is therefore essential that decision makers have access to the data necessary to both evaluate the current landscape of education, health, and child protection in Moldova and plan for the future. Further incorporating data analytics into the process of understanding and allocating child protection resources will help promote more efficient resource distribution, empowering relevant institutions to better serve the most vulnerable areas. To achieve this end, we integrated open-source data and proprietary data supplied by the Moldovan Government to build an interactive web application, available at https://palladiumgroup.shinyapps.io/Moldova/. The application allows the user to explore existing education, health, and child protection resource access; examine historical trends in supply and demand; and plan for theoretical future allocation needs. Through its use, relevant parties gain insight into the education, health, and child protection landscape at both the national and district (*rayon*) levels.

Data Sources

To create the web application, we relied on several streams of open-source data. We obtained modelled 2020 five-year age band population estimates at a 100-meter spatial resolution from WorldPop [1]. We then aggregated this data to a single raster layer reflecting the population under the age of 15. Using OpenStreetMap, we extracted point locations tagged as educational facilities inside of Moldova [2]. We obtained additional point locations for health facilities from healthsites.io [3]. These open sources were supplemented by government-supplied child protection and vulnerability data from the National Social Assistance Agency (NSAA), the Ministry of Labor and Social Protection (MOLSP), and the National Bureau of Statistics [4]. From an initial set of approximately three dozen indicators both on the resource supply and demand side, we downselected to four supply indicators (number of community social workers, number of personal assistants for children with disabilities, number of foster carers, and number of specialists in child protection) and three demand indicators (child population, number of separated children, and number of children at risk). All seven selected indicators were available at the rayon level, with values for each of the three demand indicators updated yearly since 2018.

Methods

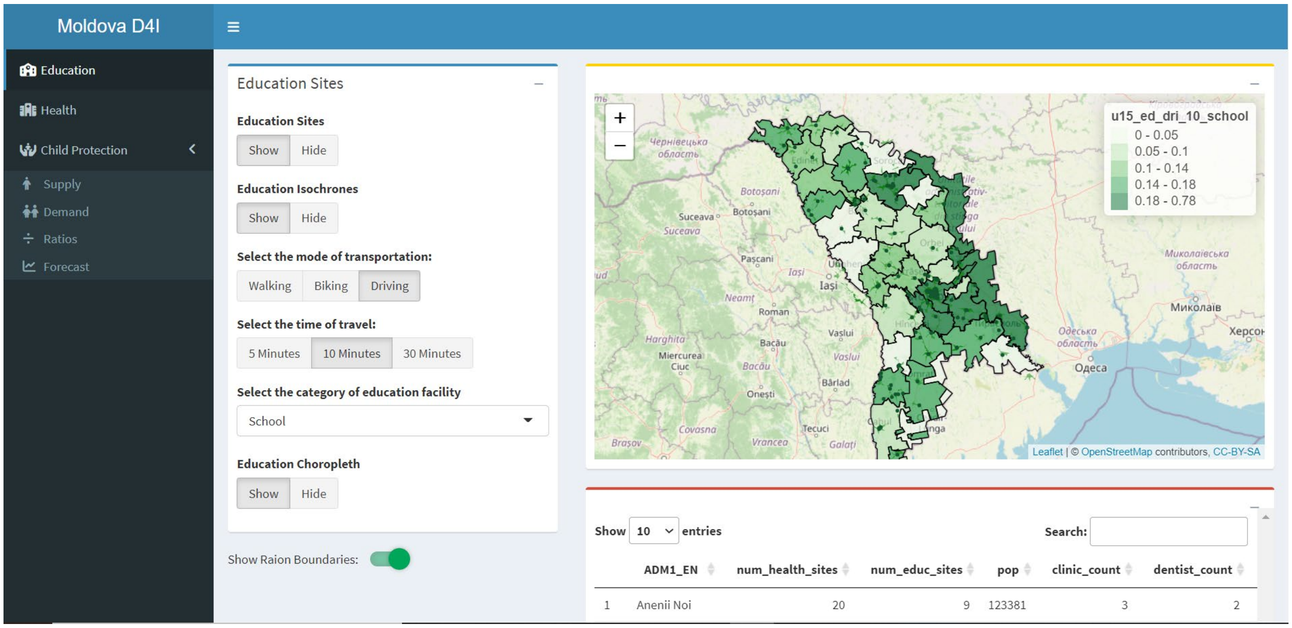
Data Processing

All data pre-processing was done using the R Programming Language, and the web application was created in R Shiny version 1.7.2. To capture the population served by the existing education and healthcare facilities, we generated nine layers of catchment zones surrounding their point locations using the Mapbox API [5]. These reflected areas accessible within 5, 10, and 30 minutes of travel by walking, biking, and driving. We then extracted and summed the 100-meter population estimates within each of these zones to determine the total number of individuals under the age of 15 living within each travel time of each location. We further combined the catchment zones to classify areas as either covered or not covered by each site type within a given travel time and mode of transportation. Using this, we were able to extract the proportion of the under-15 population within each rayon covered and not covered by each site type answering questions such as “what percentage of children under 15 in the Anenii Noi rayon are within a 30-minute walk of a school?”.

Facility Access

Using the processed data, we constructed the first two pages of the web application to highlight access to the existing education and health sites respectively. Both pages feature interactive maps that show the point locations of facility broken down by subtype. They also allow for the overlay of the isochrones reflecting access to each facility by selected mode of transport and time. Finally, the maps allow for the addition of a base choropleth layer capturing the percentage of the under-15 population within the selected mode of coverage of the site type of interest. All data represented on the map are also available to view in tabular form at the bottom of the page.

Figure 1: Education Site Access



Supply

To visualize spatial trends in the distribution of child protection resources, we opted to display a simple univariate choropleth map depicting rayon-level numbers for each category of employee (community social workers, personal assistants, foster carers, and child protection specialists).

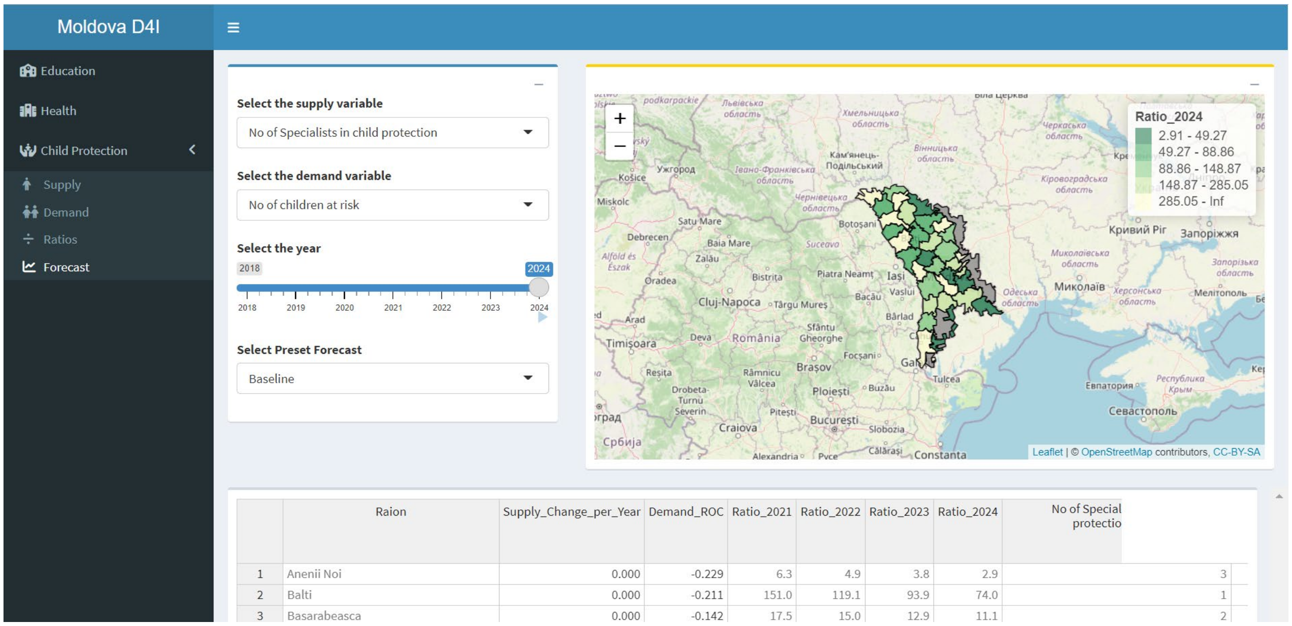
Demand

The “Demand” page of the web application leverages the rayon-level longitudinal data for these variables to show trends in them over the past four years (2018-2021). These are shown both aggregated by geographic region and broken out by individual rayon.

Forecast

The web application also allows for the exploration of hypothetical future trends in the data with the “Forecast” page. The page allows the user to select variables of interest on both the supply and demand side. Additionally, the user can pick the year whose data they would like to see visualized on a choropleth map. Years between 2018 and 2021 are populated with historical data while 2022 to 2024 are projected. The map itself depicts the ratio of the demand variable to the supply variable. In other words, it shows the number of individuals belonging to the selected demand group, such as children at risk, served by the available number of the selected supply group, such as community social workers. Areas highlighted in darker shades of green are those with the greatest availability of child protection resources relative to the existing demand in those rayons.

Figure 2: Web Application Forecast Page



Future projections for supply variables are calculated based on the editable supply change per year column in the table. If a user anticipates additional resources being hired in a rayon, then they can add those into the supply change column and see the changes reflected both in the choropleth map and in the projections present in the table. Similarly, future demand is calculated by applying the rate of change present in the namesake column to the most recent historical demand numbers for the selected variable.

In addition to manually changing rayon-level rates of change, users can also select one of three pre-programmed scenarios. The basic forecast assumes a constant supply variable where no additional social workers or foster care workers are hired over the period of interest. It applies a rate of change to the demand variables equal to the average rate of change for the rayon since 2018. The "Supply Shock in Regions with Highest Ratios" scenario assumes that an additional 10 child protection specialists of the selected type will be hired per year in the regions shown by the data to be most underserved at present. The "Demand Shock in Southern Region" scenario reflects a situation such as the Russian invasion of Ukraine wherein a large number of at-risk children are forced to flee to parts of Moldova.

Results

The web application demonstrated the potential for an interactive information platform to evaluate social services and aid in effective resource allocation in the event of future changes. The data visualizations show some general spatial patterns in current service coverage. Particularly notable is the slightly lower number of social service professionals in rayons in the northwest of the country, especially relative to the population of at-risk children. By contrast, the rayons around Chisinau municipality as well as those in the eastern half of the country appear to generally have higher numbers of employed professionals. These rayons also appear to have the greatest access to educational facilities, presumably due to the higher population density allowing sites to serve a greater number of people in closer proximity.

The MOLSP and NSAA data show a general slight decrease in the overall child population as well as the at-risk populations across all regions of the country with the exception of Chisinau. The baseline future forecasting generally reflects this as the negative rate of change leads to an improvement in the ratio of children served by each professional across 33 of 35 included rayons. The volatility of the rayon-level data for variables such as the number of children at risk complicates further analysis of this data at a granular level.

Discussion

The application offers a potential example for how data access and visualization can help improve the provision of social services in Moldova. With features such as future forecasting, decision makers can anticipate how well-equipped the current infrastructure is to handle shocks on both the supply and demand side. This is particularly relevant in light of the Russian invasion of Ukraine, which led to one such demand shock on the social services infrastructure in the country. With an influx of Ukrainian refugees, there came an influx of children causing added stress on the system at large. Additionally, an influx of at-risk children added further pressure on the already limited resource of specialized professionals. By interacting with the demand shock scenarios in the dashboard, decision makers can customize the changes at the rayon level and determine where resources are most needed to meet the challenge.

The features of the web application lend themselves to use by individuals concerned with social services at both the regional and national level. Regionally, the application allows for rayon-level insights into the existing infrastructure as recorded by MOLSP and NSAA. It also integrates external data sources such as OpenStreetMap and healthsites.io to highlight populations lacking coverage by existing educational and healthcare facilities at the most granular levels. Nationally, the tool allows individuals to identify particular regions of concern and focus on anticipating future challenges using either existing or supplemental resources.

While the limited amount of granular historical data present in the current web application might limit its effectiveness somewhat, there is nothing to preclude subsequent iterations addressing such gaps. In the future, with additional data on outcomes within each rayon, such a tool can be further built out as a means of hypothesis testing and guiding improvements in social services penetration. Moreover, it opens the door for integration with applications of machine learning to identify patterns that suggest whether outcomes can be predicted based on historical trends. With these enhancements, such a tool could effectively be leveraged by individuals at both a rayon and national level to guide resource allocation and anticipate future concerns with due time for their effective alleviation.

Conclusion

The web application demonstrates the potential for combining open-source and government-provided data to craft a complete picture for social services decision makers. Moreover, through data visualizations, it affords additional insights beyond simple tables that allow for the identification of relevant trends. The added component of Geographic Information Systems integration allows those trends to be considered in the spatial dimension. Through such methods as well as future iteration, heightened data empowerment can lead to more effective decision making across all levels of the Moldovan social services network.

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