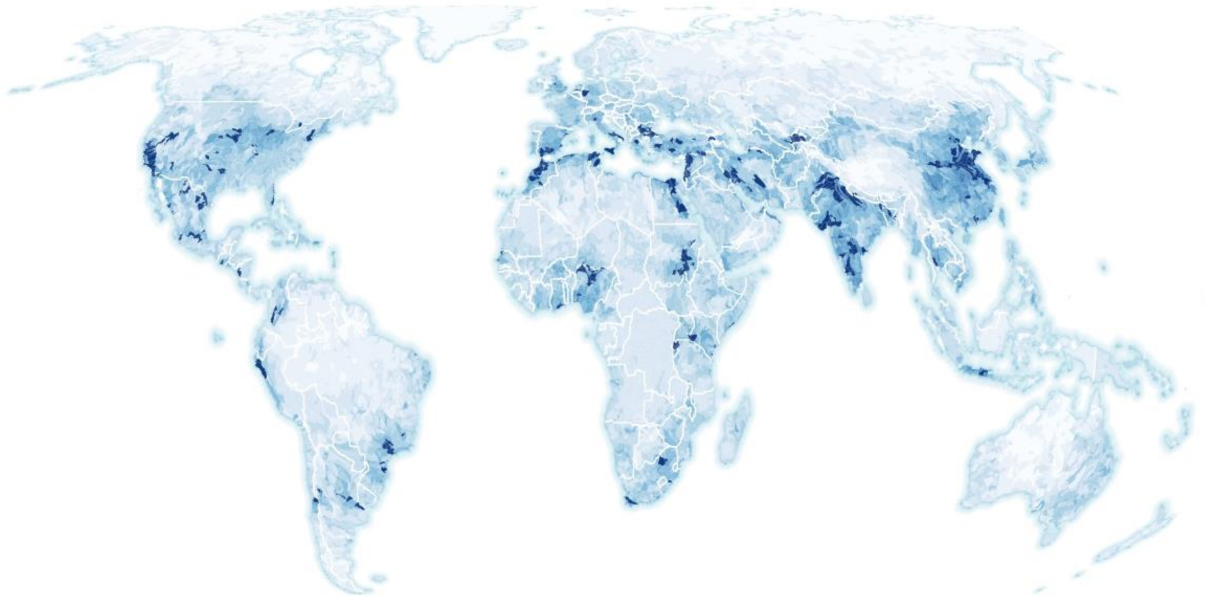
Mapping of Collective Action Opportunities for Water Stewardship

Rafael Camargo, Derk Kuiper, Hannah Baleta, Alexandro Fernandez Poulussen, Gregg Brill, Sarah Wade, Nicole Tanner, Thérèse Rudebeck, & Alexis Morgan. (2023). Mapping of Collective Action Opportunities for Water Stewardship (Version 1) [Data set]. Zenodo. https://doi.org/10.5281/zenodo.7782485



Collective action is certainly needed due to the scale of pressures in some river basins, but to make collective action work in practice, it is important to consider also whether businesses and other stakeholders are present and motivated to act in those river basins. With this global mapping exercise, we attempted to identify catchments with stronger need and potential of Collective Action for Water Stewardship. On the "need" side we considered a selection of water and biodiversity risk layers from the WWF Risk Filter Suite. On the "potential" side we considered economic factors such as value of crop production, density of business facilities (assets), and potential for cross-industry collaboration. The result is a global map (or a shapefile) of collective action opportunities, highlighting 350 catchments, across 100 river basins and 7 regions of the world, where multiple NGOs and the private sector shall work together to accelerate collective action for water stewardship. See the interactive map here.

This exercise was an iterative process in which we explored multiple data inputs, scale of analysis, approaches, and assumptions, till a point that we as a group felt comfortable with the output as an initial version, but of course, acknowledging that some limitations still remain and may be addressed in the future (see section Assumptions & Limitations). Also, conditions on the ground will certainly evolve as well as more data will become available, therefore, this mapping is intended to be updated regularly and become a living document. For transparency, reproducibility, as well as for future enhancements, the code is publicly available at https://github.com/rafaexx/collective_action_opportunities

Data & Methods

The structure of this data started basically with the shapefile of HydroSHEDS HydroBASINS (Lehner & Grill 2013), at the spatial resolution level 6, which represents 16,397 catchments of 8,200 km^2 average size. This global dataset of catchments delineation was then enriched with environmental and economic information, and finally with a collective action opportunity index, i.e., the main output. This index was produced following the same approach for all catchments globally, however, created region by region[1], to account for the contrasts in environmental and economic conditions among regions, and to ensure in the end an even global distribution of the index.

The index was based on two equally weighted layers – 1) economic factors and 2) water & biodiversity risk factors – but each layer based on multiple criteria, which were previously harmonized to same spatial resolution, i.e., HydroBASINS level 6, and same range of values, i.e, from 1 (low opportunity) to 5 (high opportunity).

Economic Factors layer

The economic factors layer was created as the result of the maximum value between the criteria: A) Value of crop production, B) Assets density, and C) Number of industries with high assets density.

A) Value of crop production

This criterion was used to depict the agriculture industry presence. Based on the Global Spatially-Disaggregated Crop Production Statistics Data for 2010 Version 2.0 (IFPRI 2019) we used the average value of production of all crops within catchments, and further classified it to values 1 (low value of crop production) to 5 (high value of crop production) based on natural breaks (Jenks)[2], excluding zeros to adjust for skewness, due to the fact that large regions of the world have basically no agricultural production.

B) Assets density

This criterion was used to depict all other industries presence. Based on the compilation of open asset-level data (Camargo, Salazar & Morgan 2023)[3] we used the density of business facilities within catchments, and further classified it to values 1 (low assets density) to 5 (high assets density) based on natural breaks (Jenks), excluding the lower 50^{th} percentile to adjust for skewness, due to the fact that large regions of the world have no or very little economic activity, e.g., deserts, forests, ice caps.

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[1] Using the World regions according to the World Bank.

[2] Natural breaks (Jenks) are "widely used within GIS packages, these are forms of variance-minimization classification. Breaks are typically uneven, and are selected to separate values where large changes in value occur. May be significantly affected by the number of classes selected and tends to have unusual class boundaries." Smith, Goodchild & Longley (2021). Geospatial Analysis, 6th Edition. Building Blocks of Spatial Analysis / Geometric and Related Operations / Classification and Clustering

[3] This compilation represents the location of sites (e.g., operation, manufacturing, processing facilities of global supply chains), as of December 2022. It includes data from 9 publicly available sources, that after data cleaning and harmonization, resulted in 189,075 data points, covering 15 industries. Note that this compilation is based on an extensive search, however, we acknowledge that there is a significant discrepancy in data coverage/comprehensiveness among the different industries. The industry "Textiles, Apparel & Luxury Good Production" is by far the most complete, while other are clearly far from complete, for example, "Construction Materials", "Agriculture (animal products)", "Agriculture (plant products)", "Oil, Gas & Consumable Fuels", "Water utilities / Water Service Providers", "Hospitality Services", "Fishing and aquaculture".

C) Number of industries with high assets density

This criterion was used to depict the potential for cross-industry collaboration. Again based on the compilation of open asset-level data (Camargo, Salazar & Morgan 2023), this time we counted the number of industries which have high assets density within catchments, and at the end, catchments with more than 5 industries with high assets density were capped to 5, so that values range from 1 (low potential for cross-industry collaboration) to 5 (high potential).

Water & Biodiversity Risk Factors layer

D) Number of risk layers above medium risk

This criterion was used to depict where there are multiple water & biodiversity risks (challenges) to nature, people, and businesses. Based on the selection of risk layers from the WWF Risk Filter Suite (see below), we counted the number of risk layers above medium risk, and at the end, catchments with more than 5 risk layers above medium risk were capped to 5, so that values range from 1 (few challenges) to 5 (more challenges).

D1) Water Scarcity[4]

D2) Flooding[5]

D3) Water Quality[6]

D4) Ecosystem Condition[7]

D5) Infrastructure & Finance (WASH)[8]

D6) Projected Change in Physical Water Risks[9]

Name of Basins

As mentioned above, the structure of this data is the HydroSHEDS HydroBASINS (Lehner & Grill 2013) level 6, which have only unique ids for the 16,397 catchments, but unfortunately no name of catchments or river basins. Therefore, to improve understanding and applicability of this data, we use the WMO Basins and Sub-Basins (GRDC 2020) to add to the final output the name of the river basin in which the catchments are located, e.g., to help users located themselves.

For consistency, across this document we use the term “catchments” to refer to the HydroSHEDS HydroBASINS (Lehner & Grill 2013) level 6, and the term “basins” or “river basins” to refer to the WMO Basins and Sub-Basins (GRDC 2020).

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[4] This risk layer can be visualized here. More details in the Water Risk Filter Methodology, pages 9-12.
[5] This risk layer can be visualized here. More details in the Water Risk Filter Methodology, pages 13-14.
[6] This risk layer can be visualized here. More details in the Water Risk Filter Methodology, pages 14-15.
[7] This risk layer can be visualized here. More details in the Biodiversity Risk Filter Methodology, page 59.
[8] This risk layer can be visualized here. More details in the Water Risk Filter Methodology, pages 22-23.
[9] This risk layer can be visualized here. More details in the Water Risk Filter Methodology, pages 29-36.

Assumptions & Limitations

We assumed that data quality of all input datasets is uniform for all geographies in the world. However, this is most likely untrue. Data quality is most likely skewed to further developed regions, and it may create bias in the output. Continuous improvements and validation of input datasets are critical to the improvement of this mapping exercise.

We haven't done any systematic validation whether global input datasets are representative of reality on the ground. Conversely, we used our expert eyes and experience in the field to assess whether the outputs "generally do make sense" and when so, we assumed that it is representative. However, local or regional datasets may provide some nuances. Continuous improvements and validation of input datasets are critical to the improvement of this mapping exercise.

We assumed that the three criteria in the economic factors are equally important. This may be generally true when considering the economic factors layer to depict opportunity for engagement of stakeholders. However, when considering the economic factors layer to understand the impact of industries on water, then agriculture generally has a much larger impact than other industries, therefore, criterion A should probably have higher weight than criteria B and C. A sensitivity analysis would help understanding potential differences and would provide a route for correction.

We assumed that the six risk layers are equally important. However, this is most likely untrue. Water Scarcity often drives other water and biodiversity risks. A sensitivity analysis would help understanding potential differences and would provide a route for correction.

We assumed that putting together economic and risk factors (each with their underlying criteria) results in the best understanding of the opportunity for NGOs and the private sector to address shared water challenges through collective action. While this sounds logical, we shall acknowledge what the resulting map really is. It is neither the catchments with highest economic factors nor the catchments that are most at risk. It is a map of catchments where the sum of economic and risk factors is highest. The notion that the resulting map depicts collective action opportunities is a clear assumption, however, it may not hold true. Other non-economic and non-risk factors may exert strong influence on the opportunities for collective action, e.g., freedom in society or level of capacity, including the NGOs capacity on the ground. Therefore, non-economic and non-risk enabling factors shall be discussed and considered. Furthermore, the mapping of NGOs capacity shall be continued and/or further detailed in terms of spatial resolution, as some datasets already exist, but at coarse resolution that it hinders its applications, e.g., at the resolution of countries or large river basins.

Finally, we assumed that selecting the top 50 catchments from each of the 7 regions of the world fairly represents where multiple NGOs and the private sector shall work together to accelerate collective action for water stewardship. However, these 350 catchments, which fall within 100 river basins, are an orientation. When it comes to projects on the ground, organizations are encouraged to also consider the local conditions, e.g., focusing more (or less) in certain parts of the basins, and/or including adjacent catchments that may have not been selected within the 350 selected catchments but may also have need or potential for collective action.