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Reintroducing a QGIS technical supplement for *Mapping for a Sustainable World*

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Introduction: We present a new release (v2.0) of the open-source *QGIS Technical Supplement* to support instruction about cartographic design: https://github.com/uwcartlab/MappingSDGsTechnicalSupplement (Houtman, Baldrica-Franklin, and Roth 2025). Originally published in 2021 (Houtman & Roth 2021a, 2021b), the technical tutorials directly supplement the joint International Cartographic Association and United Nations publication *Mapping for a Sustainable World* (Kraak et al. 2020), which synthesizes cartographic principles and recommendations for mapping the United Nations Sustainable Development Goals (SDG) global indicator framework (United Nations 2015). Specifically, the technical supplement reconstructs the workflow conducted by the University of Wisconsin Cartography Lab for the creation of four SDG maps in the book, putting cartographic design recommendations from the book into practice. Here we describe background on the SDGs and the *Mapping for a Sustainable World* book, design and organization of the *QGIS Technical Supplement*, and our motivations for and execution of a revision to the tutorials in 2025.

Background: In 2015, the United Nations Member States adopted 17 ***Sustainable Development Goals*** as part of the 2030 Agenda for Sustainable Development (United Nations 2015). Each goal is organized by a shifting number of ***targets*** that monitor progress towards the broader goal and ***indicators*** that provide data measures for each target (Kraak et al. 2018). The global completeness and quality of these indicator datasets are highly variable, and an ongoing effort by the United Nations is underway to compile these data and make them publicly available through the Global SDG Indicators Database. Maps of SDG indicator datasets are essential for monitoring progress towards these goals, focusing discussion and policymaking about the SDGs upon global inequalities, interdependencies, and alternatives, and supporting public awareness about our planet's most pressing challenges. Accordingly, mapping the SDGs is drawing increasing attention from the cartographic community (Kent et al. 2020; Pirani et al. 2020; Gorte & Degbelo 2022; Ricker & Fish 2025), including creation of an ICA Working Group on Cartography & Sustainable Development.

2020 Book: The *Mapping for a Sustainable World* book project began as a partnership between the United Nations Geospatial Information Section and the International Cartographic Association to respond to the challenges of mapping the SDG indicator datasets (see Kraak et al. 2019 for the original design concept). Published in 2020, the book serves as both an overview of cartographic design principles and a guide for mapping the SDGs, and comprises four sections and 51 chapters on the topics of geospatial data, map design considerations, map and diagram techniques, and map use environments. The book itself was designed and produced by the University of Wisconsin Cartography Lab (Cart Lab), with UW faculty, staff, and students joining the editorial team and United Nations designers to create 227 unique maps and graphics (see Roth et al. 2025 for a description of the design process behind the book). The technical supplement we present here brings conceptual design principles from *Mapping for a Sustainable World* into practice, walking through the cartographic design workflow used by the Cart Lab to create three of the maps included in the book.

2021 Tutorials: The objective of the *QGIS Technical Supplement* was to enhance the cartographic design thinking described in the book with the technical knowledge needed to create SDG maps. Accordingly, the *QGIS Technical Supplement* followed several design tenets to make it accessible across varied instructional. First, we designed the tutorials to pair with, but not replicate, information included in *Mapping for a Sustainable World*. Accordingly, when developing the tutorials we followed the recommended cartographic design process and design guidelines outlined in the book and included the open-source definitions and figures from the book within the tutorials to reinforce connections between the two. Second, we prepared and formatted the text of the technical supplements as simply as possible to empower students and other readers with no prior cartography or GIS experience. We used direct language and italicized commands to provide step-by-step technical guidance, allowing the tutorials to be repurposed for variable instructional settings. The simple language also improved in-browser translation for an international audience.

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Third, we focused entirely on open-source data and software to remove the cost of making SDG maps. Specifically, QGIS is freely available to download and can be used on a Mac, Windows, Linux, or BSD operating systems. Finally, we hosted the technical supplement on the UW Cart Lab GitHub page, making them freely available to fork or download for repackaging as needed.

The resulting 2021 v1.0 of the *QGIS Technical Supplement* was divided into three sections, each demonstrating how to design a different type of thematic map from *Mapping for a Sustainable World*: "Tutorial 1: Choropleth Map" (p. 62), "Tutorial 2: Proportional Symbol Map" (p. 64), and "Tutorial 3: Nominal Map" (p. 60). Each tutorial walks through creation of a map from the book, providing a clear reference and end goal (Figure 1). The tutorials refer to the cartographic design principles detailed in *Mapping for a Sustainable World*, providing section numbers when needed for additional information. The 2021 Version 1.0 concluded with "Tutorial 4: Future Directions" to supply advice for instructors teaching the QGIS Technical Supplement in different contexts.

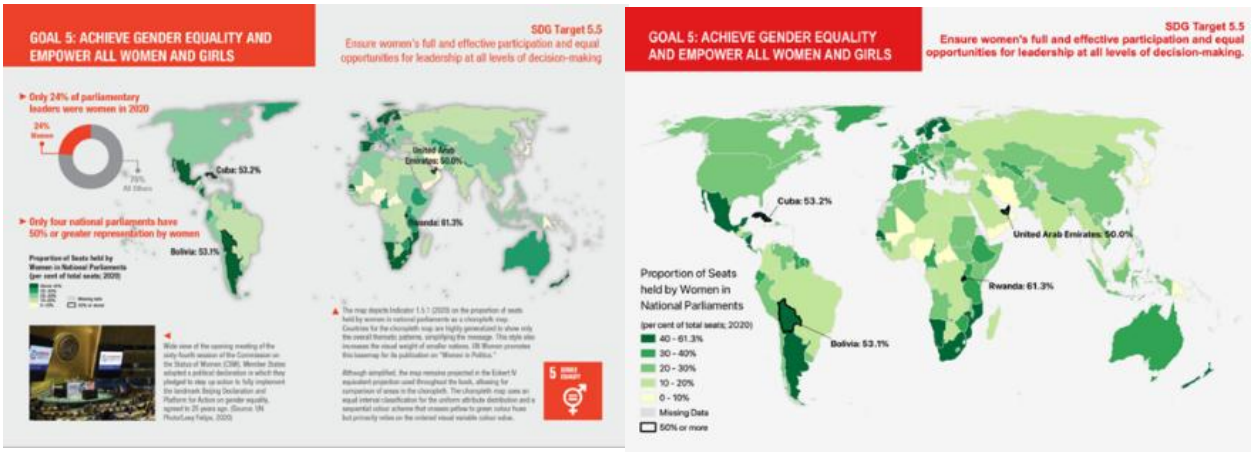

Figure 1: (Left) Map from Mapping for a Sustainable World. *(Right) The same map reproduced using the technical supplement*.

2025 Redesign: We launched a redesign of the QGIS Technical Supplement in 2025 to account for several updates to the SDG Indicators Database as well as feedback from running workshops using the tutorials in Harare, Zimbabwe (2023) and Vienna, Austria (2025). First, the United Nations published the UN Geodata Simplified dataset in GDB, GeoJSON, and SHP formats to their Geospatial Hub in 2023. This was a milestone for SDG mapping, as the UN Geodata Simplified dataset is the first open-source set of boundary files endorsed and maintained by the United Nations. Further, the UN Geodata Simplified dataset includes the M49 codes for joining attribute data from the Global SDG Indicators Database to these boundary files. Accordingly, we revised "Tutorial 1.3 Downloading Location & Attribute Data" to use an all-UN open-source workflow and revised "Tutorial 1.5 Creating a Project" to deemphasize projections in QGIS since the UN Geodata Simplified dataset is already projected into Eckert IV, moving this content into the "Future Directions" tutorials.

Second, the user interface to the Global SDG Indicators Database has improved since 2021 and enables download of many SDG indicators in multiple data transformations. Accordingly, we have updated all screenshots in "Tutorial 1.3: Downloading Location and Attribute Data" and "Tutorial 1.6: Adding & Joining Attribute Data" for 2025 and moved previous "Tutorial 1.7 Editing the Attribute Table" to "Future Directions" since the datasets we use in the tutorials are already normalized.

Finally, we have made several revisions or extensions based on workshop feedback. First, we have added "Tutorial 4: Dot Density" to recreate a fourth map from the *Mapping for a Sustainable World* book (p. 58) in QGIS. Second, we removed references to any proprietary statistical software in Tutorials 1-4 to follow our open-source ethos, switching from Microsoft Office to LibreOffice for data preview and processing. Third, we have added "Tutorial 5: Export" to describe the cartographic workflow for moving from QGIS to graphic design software using the open-source SVG format. Accordingly, the more advanced design and instruction guidance is now in "Tutorial 6: Future Directions". Finally, we added screenshots throughout the tutorials to better illustrate the more confusing points in the design workflow observed during the pair of workshops.

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Table 1: Revised table of contents for Mapping for a Sustainable World: QGIS Technical Supplement.
Asterisk(*) Indicates new or heavily revised tutorials in Version 2.0.

Introduction	
Tutorial 1 - Choropleth Map	
	1.1 - Overview and Project Planning
	1.2 - Downloading QGIS
	1.3 - Downloading Location and Attribute Data*
	1.4 - Cleaning Attribute Data*
	1.5 - Creating a Project*
	1.6 - Adding and Joining Attribute Data*
	1.7 - Classifying Attribute Data
	1.8 - Visual Accenting
	1.9 - Labeling and Leader Lines
	1.10 - Adding Elements to Layout View
	1.11 - Exporting the Map
	1.12 - Advanced Layout Styling
Tutorial 2 - Proportional Symbol Map	
	2.1 - Overview and Setup
	2.2 - Projecting Map and Adding Data
	2.3 - Extracting European Countries and Centroids
	2.4 - Setting Proportional Symbols
	2.5 - Adjusting Style
	2.6 - Creating the Legend
	2.7 - Advanced Layout Styling
Tutorial 3 - Nominal Map	
	3.1 – Overview and Setup
	3.2 – Selecting and Styling Data
	3.3 – Advanced Styling
Tutorial 4 - Dot Density Map	
	4.1 - Overview and Setup*
	4.2 - Adding and Joining Data*
	4.3 - Creating Dot Density Layer*
Tutorial 5 - Export	
	5.1 - Creating and Exporting QGIS Layout*
	5.2 - Preparing an SVG in Graphic Design Software*
Tutorial 6 - Future Directions	
	6.1 - Recommendations on Gathering Additional Data*
	6.2 - Recommendations for Reprojecting in QGIS*
	6.3 - Recommendations for Normalizing Data in QGIS*
	6.2 - Recommendations for Classroom Use

The *Mapping for a Sustainable World: QGIS Technical Supplement*, Version 2.0, is available for free use and extension at: https://github.com/uwcartlab/MappingSDGsTechnicalSupplement/ Table 1 provides an overview of the revised table of contents as released December 2025.

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References:

Gorte, V., and Degbelo, A. 2022. Choriented Maps: Visualizing SDG Data on Mobile Devices. *The Cartographic Journal,* 59:1, 35-54.

Houtman L., and R.E. Roth. 2021a. *Mapping for a Sustainable World: QGIS Technical Supplement*. The University of Wisconsin Cartography Lab. Version 1.0. doi.org/10.5281/zenodo.5585547

Houtman L., and R.E. Roth. 2021b. Introducing a QGIS Technical Supplement for *Mapping for a Sustainable World.* Abstract from 30th international Cartographic Conference, ICC 2019, Florence, Italy.

Houtman L, G. Baldrica-Franklin, and R.E. Roth. 2025. *Mapping for a Sustainable World: QGIS Technical Supplement*. The University of Wisconsin Cartography Lab. Version 2.0. doi.org/10.5281/zenodo.17968675

Kent, A.J., P. Vujakovic, G. Eades, & M. Davis. 2020. Putting the UN SDGs on the Map: The Role of Cartography in Sustainability Education, *The Cartographic Journal*, 57:2, 93-96.

Kraak, M.J., B.A. Ricker, & Y. Engelhardt. 2018. Challenges of mapping Sustainable Development Goals indicators data. *International Journal of Geo-Information*. 7(12): 482.

Kraak, M.J., B.A. Ricker, & R.E. Roth. 2019. Seeing the UN Sustainable Development Goals through Maps. Abstract from 29th International Cartographic Conference, ICC 2019, Tokyo, Japan.

Kraak M.J., R.E. Roth, B.A. Ricker, A. Kagawa, and G. Le Sourd. 2020. *Mapping for a Sustainable World*. United Nations: New York, NY (USA).

Pirani, N.; B.A. Ricker, & M.J. Kraak. 2020. Feminist cartography and the United Nations Sustainable Development Goal on gender equality: Emotional responses to three thematic maps. *The Canadian Geographer*, 64: 184–198

Ricker, B., and C. Fish. 2025. Special issue introduction for Cartography and Sustainable Development. *International Journal of Cartography*. 11(3): 295-298.

Roth, R. E., Iverson, A., Kagawa, A., Sourd, G. L., Ricker, B., Andersen, T., Baldrica-Franklin, G., Houtman, L., Ilunga, F., Lee, M, and Kraak, M-J. (2025). Making and remaking *Mapping for a Sustainable World*: A retrospective and prospective analysis as a case study in Processual Cartography. *International Journal of Cartography*, *11*(3), 388–427.

United Nations. *2030 Agenda for Sustainable Development*. 2015 [accessed 18 June 2021]; Available from: https://sdgs.un.org/2030agenda