A Spatiotemporal Dataset of Urban Water Distribution Schedules

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Abstract

Urban water supply in many cities of Latin America is delivered intermittently, with utilities allocating limited water through rotating distribution schedules; scarcity is one driver of this practice, alongside infrastructure, operational, and institutional constraints. While household surveys document how intermittent supply is experienced, the schedules through which utilities plan and allocate service are rarely available as structured, longitudinal data. This study presents a reconstructed spatiotemporal dataset of municipal water distribution calendars for Tegucigalpa, Honduras, covering 2015 to 2020. Schedules issued by the municipal water utility (SANAA, now UMAPS) were obtained through a formal access-to-information request, extracted from their spreadsheet and PDF formats, harmonized to consistent neighborhood identifiers, and linked to a stable spatial neighborhood framework. The dataset provides indicators of scheduled water supply, in hours and days per neighborhood and month; it records planned schedules, not the water actually delivered to or received by users. The processing code is openly released to ensure transparency and reproducibility.

Background & Summary

Intermittent water supply (IWS), in which piped water reaches consumers for less than 24 hours a day or on only some days of the week, is a common mode of urban water service in many countries of the Global South[1, 2]. Water scarcity is one of the factors that lead to IWS, but intermittency also arises from limited infrastructure capacity, water losses, rapid population growth, and institutional and financial constraints[3]. In Tegucigalpa, these factors combine with steep topography and seasonal rainfall variability. To manage these constraints, the Unidad Municipal de Agua Potable y Saneamiento (UMAPS, formerly SANAA) publishes Water Distribution Calendars (WDC)[4], specifying scheduled water service across neighborhoods.

Intermittent water supply is not unique to Tegucigalpa. Cities such as Bogotá[5], Monterrey[6], La Paz (Mexico)[7], Quito[8], Lima[9], and Mexico City[10] have implemented rationing schemes and,

in some cases, published water distribution schedules during periods of water stress. In these contexts, rotational distribution enables utilities to allocate limited water resources while maintaining service under constrained supply conditions.

Data on intermittent supply are rarely released: utility records and survey data are generally analysed within individual studies, and the underlying data are not made available[11,12]. Benchmarking databases such as IBNET report continuity at the utility or national level; for Honduras, only national indicators for 2021–2023 are available[13]. Openly released water-service datasets describe mainly consumption, demand and water quality in continuously supplied systems[14]. To our knowledge, no openly available dataset records the distribution schedules of an intermittent system at neighborhood level over multiple years.

Most empirical evidence on intermittent supply comes from the demand side. Household surveys and residential water-use models record supply durations as experienced and reported by users and have been central to understanding how households adapt through storage, tanker water, and other alternative sources, as in several studies of Amman, Jordan[15,16,17]. Self-reported schedules, however, describe the sampled households at the time of the survey, are subject to recall error, and can be blurred by household storage, which masks when water is actually delivered[2].

The supply side, meaning how a utility plans and allocates intermittent service across a city, is far less documented as data. Official distribution schedules record the service the utility intends to provide to every distribution unit in every period, with complete spatial coverage and consistent definitions over time. Longitudinal records of this kind are needed to examine how scarce water is allocated across neighborhoods by design, how rationing responds to drought and seasonal conditions, and how planned service compares with what households report[18]. Without them, inequalities built into the schedule cannot be separated from those that arise during delivery or from household coping. Schedules and household surveys are therefore complementary: the former describe the service a utility plans, the latter the service households experience. In Latin America, several utilities publish distribution schedules[5-10] but as current operational notices or lookup tools rather than archived records.

One reason supply-side records remain scarce is that Water Distribution Calendars are commonly disseminated as administrative notices, PDF documents, or public communications rather than as structured, machine-readable datasets. Historical records are frequently dispersed across institutional archives and, in many cities, are not accessible through APIs, bulk-download services, or centralized digital repositories. Consequently, researchers must first recover, archive, and harmonize the original records before they can be systematically analyzed.

To address this gap, this study reconstructs the official Water Distribution Calendars issued by the utility between 2015 and 2020 into a standardized dataset at the scale of neighborhood and month. This allows planned service to be compared across neighborhoods within a given month and tracked for the same neighborhood across six years.

Such a record supports analyses that household data alone cannot. First, it documents how planned service is distributed across neighborhoods and how that allocation changes over time; data of this kind can serve as input to models of household water use and coping under intermittent supply, as supply-duration data have in residential water-use models[15]. Second, it allows the regularity of schedules to be assessed over time. Predictability is a key dimension of intermittent service[2], and advance knowledge of interruptions has been shown to reduce the psychosocial burden of intermittency on households[19]. Third, by recording the utility's side of the system, the dataset can be paired with household surveys to compare the perspectives of water managers and water users, which has been identified as a priority for resilience-oriented urban water management[20], and it can contribute to SDG 6 monitoring[21]. The reconstruction framework is reproducible and can be adapted by other cities facing similar data-access constraints.

Methods

Data Collection Overview

The original calendar documents (supplied as spreadsheet and PDF files; see Figure 1) are not included in this dataset, as they remain official administrative publications of the municipal water utility. These documents can be requested through official government transparency channels, including the Honduran transparency portal managed by the *Instituto de Acceso a la Información Pública* (IAIP)[22]. All calendars in this dataset were obtained through such a formal information request, as described below.

Each Water Distribution Calendar is a table issued by the utility for a defined period. Most calendars cover a month, but in some periods the utility issued calendars for half a month or for other partial periods (Figure 1). The header identifies the issuing unit, the title (*Redistribución de Horarios de Servicio de Agua Potable*, "redistribution of drinking-water service schedules"), and the period covered. A notice beneath the header states that the schedule refers to the time water is released from the distribution tank; the arrival of water at individual households depends on their location within the network and may be brought forward by one day depending on treatment-plant production. The calendar therefore records planned rather than delivered service. Each row corresponds to a distribution group: a set of neighborhoods (*Barrio o Colonia*) supplied together under a common schedule. The first three columns identify the water sector, the water source, and the distributor serving

the group. These are followed by the *Barrio o Colonia* column, the *Horario* column giving the group's supply window (for example, 6AM–5PM, or 5PM–6AM for windows that cross midnight), and one column per day of the period, labelled with the date and weekday. A mark in a day column indicates scheduled supply for that group on that day; calendars in this period mark scheduled days with an X. During processing, the sector, source, and distributor attributes are linked to each distribution group in the group catalog, kept separate from schedule parsing, and joined back at the final stage (see Catalog creation).

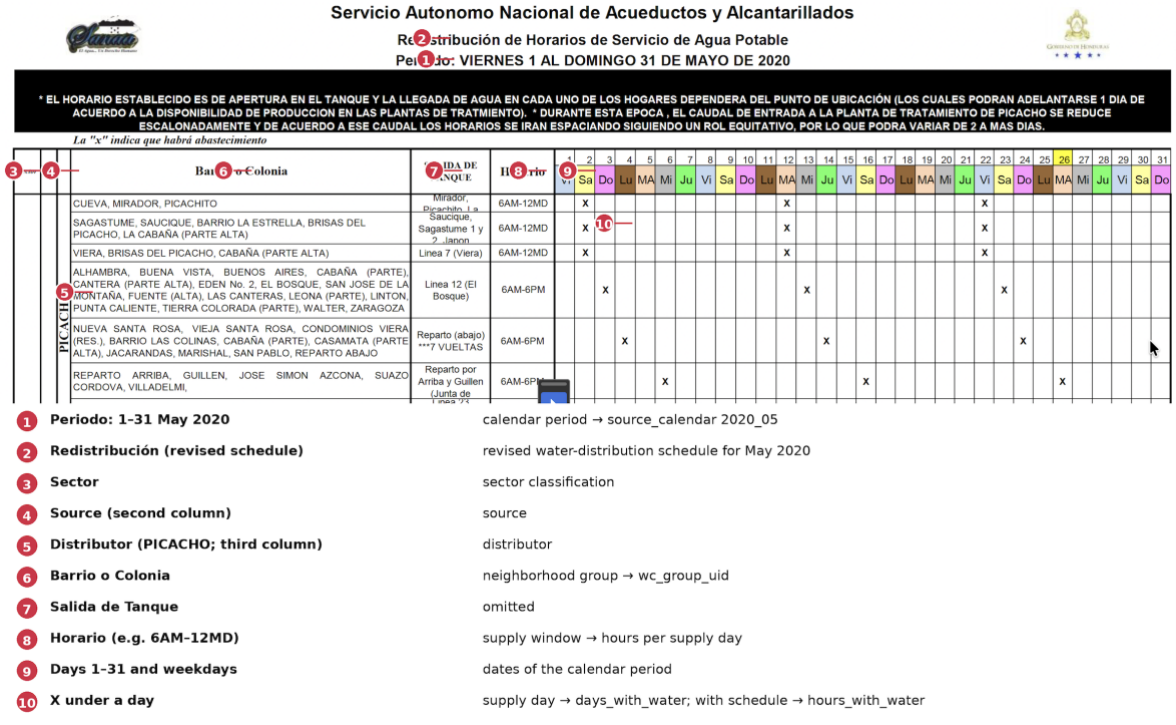


Figure 1 Example of a Water Distribution Calendar (WDC) for 1–31 May 2020, as provided by SANAA (now UMAPS) in response to information request SOL-SANAA-271-2021, with English annotations. The three leftmost columns give the water sector, water source, and distributor for each distribution group; Barrio o Colonia lists the neighborhoods in the group; Horario gives the supply window; day columns (Do–Sa = Sunday–Saturday) mark scheduled supply. The notice below the header states that schedules refer to the time water is released from the distribution tank.

The Water Distribution Calendars were obtained from the responsible utility through a single route. All calendars for the 2015–2020 period were obtained via a formal information request (No. SOL-SANAA-271-2021), submitted in 2021 through the Honduran government's electronic information-access platform, SIELHO[22], administered by the IAIP; the request was directed to the utility then operating as SANAA, now the Unidad Municipal de Agua Potable y Saneamiento (UMAPS). To obtain the same records, a requester registers on SIELHO, submits a request in Spanish selecting UMAPS as the requested institution, and provides a national ID or passport number, an email address, and a telephone number.

The response, delivered through SIELHO on 18 June 2021, was a single compressed archive containing 73 calendars, 47 as spreadsheets and 26 as PDF documents (processed as 75 calendar periods; see Data Processing Pipeline), covering 68 of the 72 months in the period. No calendar was provided for August, October and December 2015 or for February 2020, and the calendars for March 2020 (days 1–15) and June 2020 (days 8–30) cover only part of the month. The SHA-256 checksum of the archive and an inventory mapping every file to its month and period are provided with the dataset.

No public API, bulk-download facility, or centralized archive of these calendars existed at the time of collection; the original records as received cannot be redistributed by the author but remain obtainable from the issuing institution via the route described above.

Calendars supplied as spreadsheets were used as received; tabular content was extracted from the PDF calendars using iLovePDF[23] (conversion details in Supplementary Note 1). Because both the original and the converted spreadsheets follow the visual layout of the printed calendar rather than a row-and-column structure, all calendars were first brought into a canonical form, a predefined column structure required as the pipeline's entry condition. This step includes a human-in-the-loop review to reconcile neighborhood and group names that were split or garbled during conversion; it reorganizes the files without altering the schedule information (Supplementary Note 2). Each converted calendar was reviewed group by group against the original PDF, because conversion can add or drop separators between neighborhood names and split text wrapped across lines into separate rows; the manual steps applied to each calendar are recorded in a preparation log released with the dataset.

Following established practice for data provenance[24] and the FAIR principles for scientific data[25], the canonical-form files are then read by the first step of the pipeline, which converts them into a standardized tabular structure in which every record carries traceability fields identifying the source file, the processing date, and the pipeline version used to generate it, so that each output row can be traced back to the specific calendar and processing run it originated from. The pipeline begins from standardized spreadsheet files, which served as the input for subsequent harmonization, quality control, and spatiotemporal reconstruction procedures.

Data Processing

The software used to process the WDCs is publicly available through a GitHub repository archived on Zenodo[26]**.** The resulting derived dataset can be accessed from Zenodo[27].

Catalog creation

After extracting the raw Excel files, two reference catalogs were created: one for distribution groups, based on *Barrios o Colonias*, and another for the neighborhoods listed in the calendars. Each distribution group was assigned a unique group identifier (group_uid). Each neighborhood, or part of a neighborhood, as named in the calendars (for example, *Cabaña (parte alta)*) was assigned a stable water-calendar identifier (wc_uid). These identifiers keep names consistent across calendars and allow records to be linked reliably over time. Each wc_uid is later matched to the SDG11UID of the corresponding neighborhood polygon (see Georeferenced Neighborhoods).

The group catalog was then enriched with additional information from the original calendar documents, including the water sector, water source, and water distributor. These fields describe the operational hierarchy of the water system: distribution groups are organized within sectors, supplied by specific water sources, and served by assigned distributors.

Relationships among identifiers. UMAPS divides the city into supply sectors. Each sector may receive water from more than one source, and each source may serve more than one sector; the combination of sector and source determines the distributor, typically a large storage tank or a water treatment plant, through which water reaches neighborhoods. Within each distributor, the calendar lists one or more groups. Each group corresponds to one row of the calendar, defined by a supply window and the days on which supply is scheduled, and belongs to exactly one sector, source, and distributor; these attributes are assigned to each group during enrichment. Each group contains one or more calendar units (wc_uid), and each calendar unit is linked to one or more neighborhood polygons (SDG11UID). Supply sectors should not be confused with sector numbers that appear within neighborhood names (e.g., “Hato de Enmedio S1-9”), which are retained as part of the neighborhood label.

Let:

$$G \subseteq \texttt{wc_uid} \times \texttt{group_uid} \qquad (1)$$

be the group-membership relation, and

$$\mathrm{S} \subseteq \mathrm{wc}_{\mathrm{uid}} \times \mathrm{SDG11UID} \qquad (2)$$

be the relation linking calendar units to neighborhood polygons.

$$\forall g \in \texttt{group_uid},\ \exists u \in \texttt{wc_uid}: (u, g) \in G \qquad (3)$$

$$\forall u \in \texttt{wc_uid},\ \exists g \in \texttt{group_uid}: (u, g) \in G \qquad (4)$$

Constraint (3) states that every group contains at least one calendar unit, and (4) that every calendar unit belongs to at least one group. A single SDG11UID may correspond to several calendar units, for example when the utility schedules the upper and lower parts of a

neighborhood (*Alta* and *Baja*) separately. Less commonly, the same calendar unit may appear in more than one group, for example when a neighborhood is listed under two schedules from the same distributor. The same group may also be listed in more than one row of a calendar, with different schedules or different scheduled days; each row is kept as a separate entry. In the other direction, a calendar unit is identified by the neighborhood name as written in the calendar, so where a name corresponds to more than one polygon (a neighborhood divided into several polygons in the municipal layer, or several neighborhoods sharing the name) it is linked to each of them; S is therefore many-to-many, and the number of polygons linked to each calendar unit is recorded in count_sdg11uid. Not every SDG11UID is linked to a calendar unit.

Keeping this enrichment step separate from the initial parsing helped simplify the workflow. The core extraction focused on converting the calendars into structured records, while the hierarchy and metadata were added later in a controlled way. This made the dataset easier to validate and allowed the final outputs to support analysis of both scheduled water delivery and the organization of the water distribution system.

Data Processing Pipeline

The dataset was reconstructed with a multi-stage processing workflow developed for this study to convert Water Distribution Calendars (WDC) into standardized spatial and temporal records. Although the present implementation is tailored to water distribution calendars, its stages (structured standardization, identifier harmonization, validation, and aggregation) are not specific to water data and can be adapted to other fragmented or semi-structured urban operational records, such as other municipal service schedules. The adjustments required for such adaptation are described in Code Availability.

The pipeline was implemented as a configuration-driven processing framework and executed through a series of sequential steps (Figure 2).

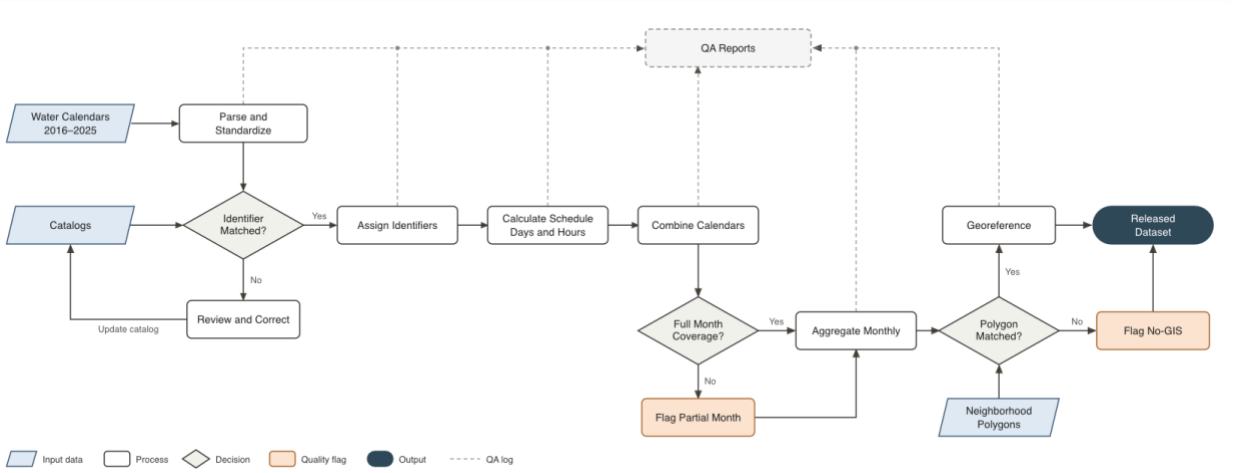


Figure 2 Processing pipeline, from raw calendars to aggregated outputs.

Raw Water Calendars

A complete worked example of the processing pipeline is provided in Supplementary Material 1, where the transformation of a single neighborhood is documented step by step. The example follows the "28 de Marzo" from September 2020 calendar. The example follows the neighborhood across its associated three distribution calendar groups, presenting the intermediate outputs generated at each processing stage, from the original Water Distribution Calendars through validation, harmonization, quality control, and the final standardized outputs.

Month/Year	2015	2016	2017	2018	2019	2020
1	51	53	53	54	54	56
2	51	53	53	54	54	
3	54	53	53	54	54	56
4	54	53	54	54	54	58
5	54	53	54	54	54	55
6	54	53	54	54	54	55
7	53	53	54	54	54	55
8		53	54	54	55	55
9	53	53	54	54	56	55
10		53	54	54	56	55
11	53	53	54	54	56	55
12		53	54	54	56	55

Table 1 Number of distribution groups per Water Distribution Calendar (WDC), by month and year. Blank cells: no calendar available.

The number of distribution groups per calendar remained between 51 and 58 (Table 1). In contrast, the number of neighborhood schedules per calendar varied across months and years (Table 2), reflecting differences in calendar structure and group composition.

A neighborhood can appear in two or three groups within the same calendar. For each neighborhood *n* and month *m*, let $\Gamma_{(n,m)}$ be the set of groups that serve at least one of its calendar units:

$$\Gamma_{n,m} = \{ g \in \text{group_uid} : \exists u \in \text{wc_uid}, (u,g) \in G \wedge (\mathbf{u},\mathbf{n}) \in \mathbf{S} \} \quad (5)$$

The groups appear to serve mutually exclusive parts of the neighborhood, but the calendars do not specify which households each group serves, so this cannot be verified from the source records. Group values are therefore combined as an unweighted mean rather than summed, which avoids overstating the supply received by any one household:

$$\bar{h}_{n,m} = \frac{1}{|\Gamma_{n,m}|} \sum_{g \in \Gamma_{n,m}} h_{g,m} \quad (6)$$

The minimum and maximum of $h_{g,m}$, the scheduled hours of group *g* in month *m* (defined in Eq. 8), over $\Gamma_{n,m}$ retain the range of scheduled service within the neighborhood, and $|\Gamma_{n,m}|$ identifies neighborhoods served by more than one group. Days are aggregated in the same way.

For each group *g* and month *m*, let $D_{g,m}$ be the set of days in month *m* on which the calendar marks scheduled supply for group *g*, and let $w_{g,t}$ be the total length in hours of the supply windows assigned to group *g* on day *t*. Scheduled days and hours are defined as:

$$d_{g,m} = |D_{g,m}| \quad (7)$$

$$h_{g,m} = \sum_{t \in D_{g,m}} w_{g,t} \quad (8)$$

The window length is computed from the scheduled start and end times as:

$$w_{g,t} = 24 - \left((\tau_{g,t}^{\text{start}} - \tau_{g,t}^{\text{end}}) \bmod 24 \right) \quad (9)$$

so that windows crossing midnight are counted correctly (for example, 5PM–6AM = 13 hours), and the full window is attributed to the day on which it starts. A window whose start and end times coincide (for example, 6AM–6AM) is counted as 24 hours. In the April 2020 calendar, the seven groups supplied from the El Hatillo tank (14 calendar entries) have no supply window; the calendar states that, owing to low flow at the sources, service will be provided every 22 days, and marks one day per group. Their scheduled days are recorded as in the calendar, and their hours are set to a nominal 12 per scheduled day, which should not be used in hour-based analyses. Because the window can differ between calendars issued within the same month, *w* is indexed by day. When the utility issued more than one calendar in a month, each calendar was identified by year, month and a letter suffix (for example, 2019_11a and 2019_11b), and each day was counted once, from the calendar covering that day. Calendars spanning two months (16 August–15 September and 16 September–15 October 2019) were assigned to the half-months they cover. For each month, coverage is

the number of days covered by its calendars divided by the number of days in the month; months with coverage below 0.9 are flagged as partially covered.
Records were validated against the following rules:

$$1 \leq d_{g,m} \leq N_m, \qquad 0 < h_{g,m} \leq 24 d_{g,m} \tag{10}$$

$$d_{g,m} > 0 \Rightarrow h_{g,m} > 0 \tag{11}$$

where N_m is the number of days in month m. Groups without scheduled supply in a month are not listed in that month's calendar, so every group present in a calendar should have at least one scheduled day and a positive number of scheduled hours. Group-months that violate (10), where supply days or hours could not be parsed from the source calendar, were excluded from the released dataset and are reported in scheduled_errors.csv.

Quality control procedures were applied to validate identifier consistency and detect missing or inconsistent records. Schedule information was subsequently transformed into quantitative indicators of scheduled supply, including days and scheduled hours. The resulting records were spatially linked to SDG11UID neighborhood polygons (a unique neighborhood identifier created from AMDC GIS[28] data and adapted for consistent use across datasets) and aggregated using summary statistics to account for cases where multiple calendar units correspond to a single spatial neighborhood. Where a Water Distribution Calendar was unavailable, schedule attributes were recorded as missing (NaN) rather than as numeric zero; these incomplete records were removed during quality control and are not included in the released dataset, which therefore contains only records with an available official schedule.

The pipeline produces standardized time-series datasets and enriched infrastructure catalogs, enabling reproducible analysis of urban water distribution patterns.

Higher counts in some months (for example, March 2019 and January 2020) reflect months in which the utility issued more than one calendar; each calendar was processed separately and its schedules assigned to the days of the month it covers.

The resulting neighborhood records were linked to the GIS neighborhood polygons from the SDG 11 spatial dataset. Because multiple Water Distribution Calendar (WDC) neighborhoods may correspond to a single spatial neighborhood, scheduled supply indicators were aggregated by SDG11UID using summary statistics, including the mean, minimum, and maximum values, together with the number of contributing calendar units. Supplementary Material 1 provides a complete worked example of this aggregation process, illustrating how multiple Water Distribution Calendar groups associated with the same neighborhood are consolidated into a single standardized spatial record.

Month/Year	2015	2016	2017	2018	2019	2020
1	674	669	688	689	704	1428†
2	673	669	688	689	708	
3	688	667	688	689	1420†	721
4	688	669	688	689	710	716
5	687	669	688	689	709	703
6	690	677	688	690	707	702
7	667	677	688	691	709	708
8		677	688	691	1415†	707
9	667	691	688	693	1357†	708
10		691	689	694	1260†	707
11	667	691	693	693	1280†	709
12		688	691	695	1416†	709

Table 2 *Number of neighborhood schedules per Water Distribution Calendar (WDC) by month and year. In months published as two half-month calendars (†), the schedules of both calendars are added*

The pipeline produces multiple levels of aggregated outputs describing scheduled supply patterns, including:

- Mapped-neighborhood indicators by SDG11UID (Merged_SDG11)
- Calendar-neighborhood indicators by wc_uid (Merged_WCuid)

These outputs provide standardized datasets suitable for longitudinal analysis of urban water distribution patterns.

Georeferenced Neighborhoods

Spatial reference data consisted of neighborhood boundary geometries used for spatial harmonization and aggregation. Neighborhood polygons were obtained from an openly available administrative boundary dataset published by the Alcaldía Municipal del Distrito Central[28]. Some of the original polygons were merged where calendar entries referred to commonly known neighborhoods rather than the most granular official units (e.g., Kennedy 1–4 were merged into a single Kennedy polygon), and each polygon in the resulting layer was assigned a unique identifier (SDG11UID). Each wc_uid was then matched to these polygons through a neighborhood reference catalog containing the corresponding SDG11UID.

To provide additional spatial context for analyses of water distribution patterns, elevation statistics were calculated for each neighborhood polygon using the 1 arc-second (~30 m) NASADEM V001 digital elevation model (DEM)[29]. Minimum, maximum, and mean elevation values were extracted for each neighborhood and stored as attributes in the spatial reference layer. These variables were not used in the derivation of the published water

distribution schedules; rather, they are provided as supplementary contextual information to facilitate future research on the relationship between topography and urban water distribution. The elevation attributes may support investigations of the operational challenges associated with supplying water across the steep and highly irregular terrain of Tegucigalpa, as well as integration of the dataset with future hydrological, infrastructure, and urban resilience studies.

Unmatched GIS Neighborhoods and Calendar Units

Matching between calendar entries and GIS polygons is incomplete in both directions. Polygons with no calendar observations are retained in the spatial layer, and wc_uid entries that do not correspond to a single polygon are retained without geometry and flagged as NOGIS. The number of NOGIS entries per calendar month ranges from 34 to 42, varying as the neighborhoods listed in each calendar change (Table 3).

Month/Year	2015	2016	2017	2018	2019	2020
1	35	34	35	35	36	38
2	35	34	35	35	36	
3	35	34	35	35	36	38
4	35	34	35	35	36	42
5	34	34	35	35	38	35
6	35	35	35	35	38	38
7	34	35	35	35	38	38
8		35	35	35	38	38
9	34	35	35	36	38	38
10		35	35	36	35	38
11	34	35	35	36	36	38
12		35	35	36	38	38

Table 3 Number of calendar neighborhoods (wc_uid) that could not be linked with certainty to a neighborhood polygon (SDG11UID), by month and year.

Resolution of Duplicate Neighborhood Names

A separate case arises when neighborhood names in the WDC correspond to multiple distinct geographic polygons in the GIS layer. This occurs because several neighborhoods share similar or identical names while representing different spatial areas within the city. In such cases, neighborhood assignments were reviewed using co-occurring contextual information from the calendar: each neighborhood belongs to a sector and appears alongside a characteristic set of neighboring neighborhoods within the same distribution schedule. Where same-named neighborhoods could not be distinguished in this way, the calendar unit is linked to each of the same-named polygons (see Relationships among identifiers), and users analysing individual polygons should take this into account.

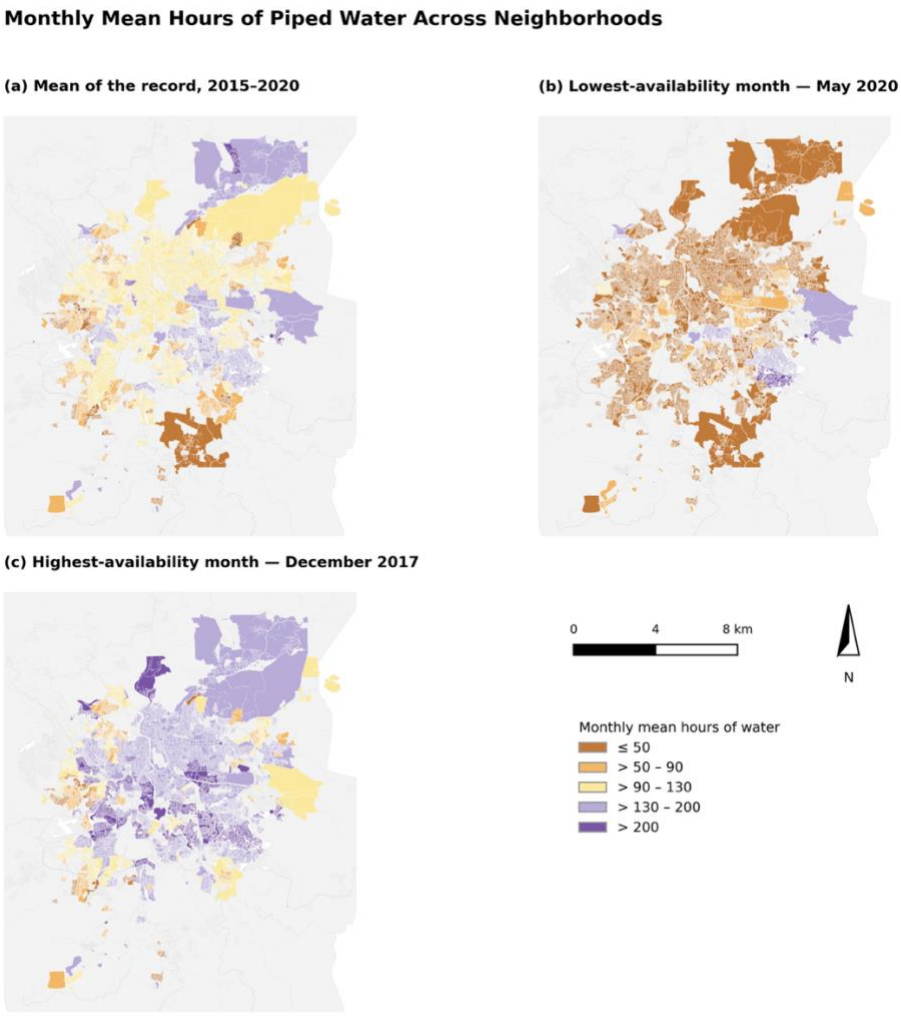


Figure 3 Monthly mean scheduled hours under contrasting conditions

The geographic coverage of the water calendars is illustrated in Figures 3 and 4, where values represent the mean number of scheduled hours or days of water supply per neighborhood in a given month, averaged across the distribution groups serving each neighborhood.

Figure 3 shows the spatial distribution of scheduled hours of piped water per month across neighborhoods. Panel (a) shows each neighborhood's mean over all months with a schedule in 2015–2020; panels (b) and (c) show the months with the lowest (May 2020) and highest (December 2017) city-wide mean in the record, where the city-wide mean of a month is the mean across neighborhoods. Warm tones indicate lower scheduled supply and cool tones higher supply; the middle class (> 90–130 h) represents typical conditions, so the map highlights deviations from it. Classes are applied to unrounded monthly means. Neighborhoods without a schedule are not colored.

Figure 4 shows monthly mean days of scheduled piped water supply under contrasting conditions: (a) the mean of the record (2015–2020), (b) the lowest-availability month (May 2020), and (c) the highest-availability month (December 2017). The middle class (> 8–10 days) contains the average scheduled supply over the record (~9.9 days per month); warmer tones indicate fewer and cooler tones more scheduled days of supply. The same months as in Figure 3 are shown to allow direct comparison; they were selected on scheduled hours (Figure 3), and their ranking as lowest and highest is the same for scheduled days.

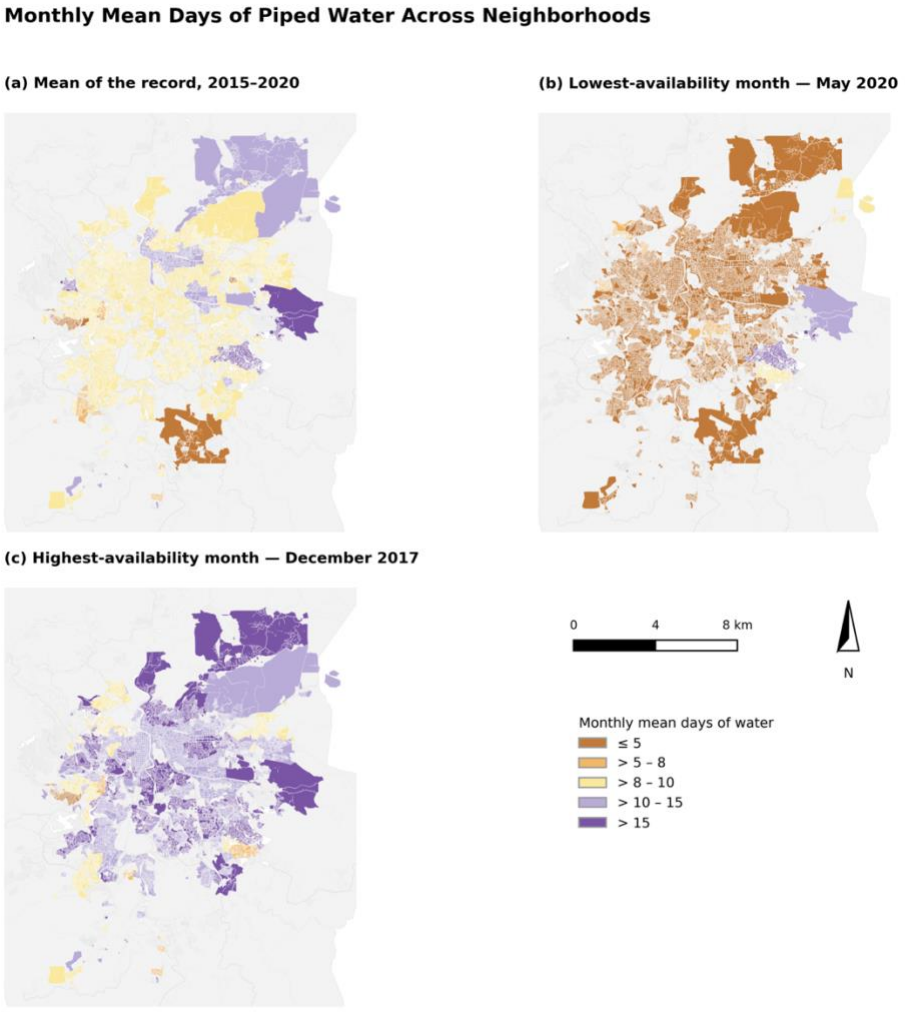


Figure 4 Monthly mean scheduled days under contrasting conditions

Data Record

All data produced in this study are openly available on Zenodo[27]. This dataset includes:

Data format: GeoPackage (GPKG), with the same layers also provided as GeoJSON and CSV files.
Spatial reference system: EPSG:32616 (WGS 84 / UTM zone 16N); the GeoJSON is provided in EPSG:4326
Spatial units: Neighborhood-level polygon linkage with unique identifiers
Temporal resolution: Water Calendar aggregated by Year-Month
Attributes: Different aggregated files that includes Year, Month, neighborhood and distribution-group identifiers, and water-availability indicators (days and scheduled hours). The complete field list for each file is provided with the published dataset.
Quality control: Rule-based validation (Eqs. 10–11); records that failed validation were removed and are reported in scheduled_errors.csv
Software environment: Dataset generated using open-source Python and GIS tools; full processing pipeline is publicly available via Zenodo[26].
File integrity: UTF-8 encoding; consistent field naming; reproducible exports

Table 4 provides an overview of the released files. The GeoPackage (gis/sdg6_tegucigalpa_2015_2020.gpkg, EPSG:32616) contains the neighborhood layer and the attribute tables, which are also provided as CSV files; the polygons are also provided as GeoJSON (EPSG:4326). The definition and unit of every field are given in data_dictionary.csv and in the README.

The dataset includes CSV files that contain the non-spatial attribute tables linked to the GeoPackage layers. These files are provided separately to accommodate researchers who prefer to work with the data outside of GIS software.

All indicators in the dataset (hours_with_water, days_with_water and their monthly aggregates) describe scheduled supply as stated in the distribution calendars. They do not measure whether water was delivered on the stated days and hours, nor the volume, pressure or continuity of supply received by users.

Layer / file	Data type	Description	Records	Fields	Notes
neighborhoods	Polygons (GeoPackage layer; GeoJSON)	Neighborhood polygons with SDG11UID	1,144	13 (+ geometry): SDG11UID, municipal code and name, sector, elevation statistics, area, perimeter	Spatial reference layer; MultiPolygon. Joined to the tables through SDG11UID.

all_hours	Table (GeoPackage layer; CSV)	All calendar entries	51,706	24: year, month, source_calendar, original_file, wc_uid, group_uid, SDG11UID, schedule, days_with_water, hours_with_water, …	One row per calendar entry (group × calendar neighborhood × calendar) and linked polygon; a group listed in several rows of a calendar gives one entry per row. Includes windows crossing midnight and conflict days. Every record carries source_calendar, original_file, processing_date and pipeline_version.
scheduled_errors	Table (GeoPackage layer; CSV)	Entries excluded during quality control	82	24 (as all_hours)	Entries whose days or hours could not be parsed; not treated as zero supply.
merged_sdg11	Table (GeoPackage layer; CSV: Merged_SDG11)	Aggregated by SDG11UID and month	35,728	18: SDG11UID, year_month, mean/min/max hours and days, count_wc_uid, source_calendars, coverage, …	Mapped-neighborhood level (Figures 3–4, Supplementary Figure 1). coverage < 0.9 flags partially covered months.
merged_wcuid	Table (GeoPackage layer; CSV: Merged_WCuid)	Aggregated by calendar neighborhood (wc_uid) and month	41,033	18: wc_uid, year_month, mean/min/max hours and days, count_sdg11uid, source_calendars, coverage, …	Calendar-neighborhood level (Figure 6). coverage < 0.9 flags partially covered months.
inventory	Table (GeoPackage layer; CSV: sol_sanaa_271_2021_inventory)	Files in the government response	83	7: year, month, period_covered, format, file_path, status, note	One row per file in the archive and per month without a calendar; status present, partial, missing or exclude.
manual_prep_log	Table (GeoPackage layer; CSV)	Manual preparation of each calendar	75	12: code, source_file, source_format, conversion, …	One row per calendar period; preparation steps applied before processing.
calendar_periods	CSV (output/qa_coverage/)	Period covered by each calendar	75	13: source_calendar, year_month, suffix, period, start_date, end_date, days_in_period, days_in_month, days_observed_min, days_observed_max, status, …	Start and end dates of every calendar period (whole month or half month) and days observed.

Table 4. Released files and GeoPackage layers of the dataset. The full list of fields, with definitions and units, is provided in data_dictionary.csv in the dataset.

Technical Validation

To illustrate the reconstruction workflow, a supplementary workbook (Supplementary Material 1) is provided in which each worksheet corresponds to one stage of the pipeline for a single neighborhood, tracing it from the original Water Distribution Calendar through parsing, standardization, and aggregation to the final standardized record.

Fidelity to the source calendars. Every identifier in the released data was traced to the pipeline stage that produced it: all 45,083 wc_uid and 4,061 group_uid calendar entries were present in their respective stages. A stratified sample of 58 records from 75 calendars, covering all years, both source formats, paired, cross-month and partial periods, and manually resolved names, was then traced to the original calendars, comparing identifiers, schedule, marked days and derived totals. Zero discrepancies were found. Because preparation alters calendar layout by design, the comparison was made at the record level rather than by automated file comparison. This validation tests fidelity to the published schedules, not whether service followed them.

These checks complement the quality control applied during processing: every distribution group in the processed calendars was matched to the group catalog (0 unmatched groups in the final run), calendar neighborhoods lost during conversion are detected because their group no longer contains its expected calendar units, and day headers were checked for repeated, missing or out-of-period labels.

Water Piped Network Consistency

To assess the spatial completeness of the reconstruction, the 2019 municipal water distribution network (Figure 5) was used as an independent reference. The rationale is that a neighborhood crossed by the utility's pipe network is supplied by the utility and should therefore appear in the distribution calendars. If such a neighborhood has no schedule in the reconstructed dataset, this indicates either an error in the reconstruction (for example, a calendar entry lost during PDF conversion, or a neighborhood name that could not be matched to its polygon) or a neighborhood that the utility does not include in its published calendars. The check therefore tests for omissions in the extraction and spatial linkage steps, not the accuracy of the schedules themselves.

For 2019, 338 of the 438 neighborhood polygons crossed by the distribution network (77.2%; ≥ 50 m of pipe within the polygon) carry at least one schedule assignment. Because the network layer and the calendars refer to the same year, differences cannot arise from network expansion or changes in the calendars over time. The check is a plausibility test of completeness; the reasons for individual mismatches (for example, pipes crossing a polygon without serving it, areas supplied by wells or community systems, or calendar units that could not be linked to a polygon) were not investigated.

The check is one-directional. Of the 504 neighborhoods with a schedule in 2019, 166 contain less than 50 m of the mapped network; these are reported without interpretation. The pipe network therefore serves as a lower-bound reference for completeness rather than a complete inventory of served neighborhoods.

The network layer is not included in the published dataset but is publicly available through the AMDC open data portal[28] and can also be requested from the municipality through SIELHO.

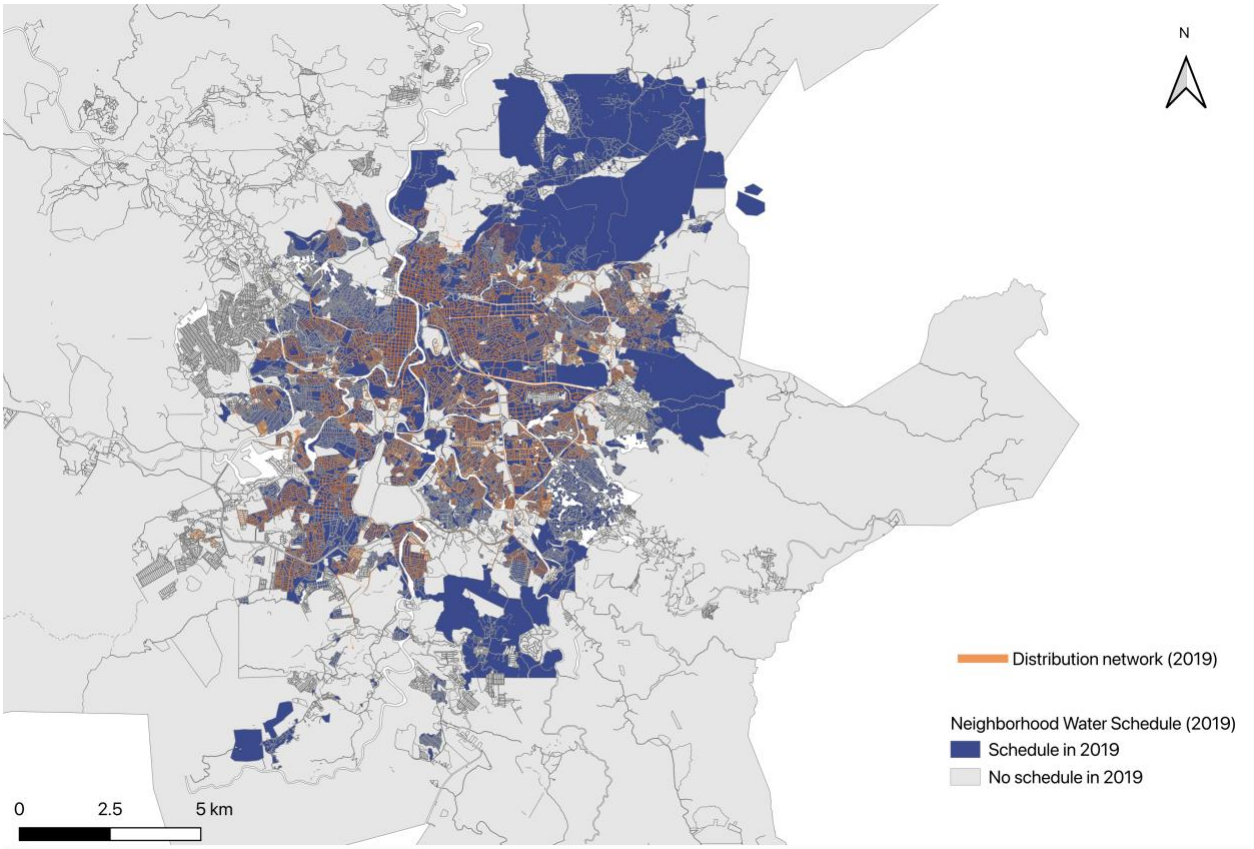


Figure 5 Distribution network (2019) and neighborhoods with water distribution schedules in 2019. Dark polygons have at least one schedule assignment in the 2019 calendars; light grey polygons have none; areas outside the neighborhood layer are shown in white. In the consistency check, a polygon is considered crossed by the network when it contains at least 50 m of pipe.

Distribution of Reconstructed Scheduled Supply Indicators

Indicators are computed at two levels. First, hours and scheduled days are calculated for each calendar entry, that is, each neighborhood or part of a neighborhood (wc_uid) within a distribution group, for each calendar (Eqs. 7–8). Second, these values are summarized by calendar neighborhood (wc_uid) and spatial unit (SDG11UID), producing the aggregated files described in Table 4. When a month was issued as two half-month calendars (days 1–15 and 16–end of month), values are first averaged across simultaneous entries within each calendar and then added across the two calendars, so each month represents its full length; the codes of the contributing calendars are kept in source_calendars. City-wide summaries

such as those in Figure 6 are derived from these records for illustration; the dataset itself is resolved at the level of individual neighborhoods and months.

Figure 6a–b shows the monthly distribution of scheduled hours and days across calendar neighborhoods (wc_uid) from 2015 to 2020. For each month, the shaded band spans the interquartile range across neighborhoods, and the black line joins the monthly medians. Each month is classified by its median relative to the mean ± one standard deviation of all monthly medians in the record (low, typical, or high availability); partially covered months are shown separately and are not classified. The lowest-availability months occurred between September 2019 and May 2020, when the median fell to between three and five supply days per month.

Figure 6c shows the coefficient of variation (CV) of scheduled hours between calendar neighborhoods for each month, a measure of heterogeneity relative to the overall level of supply. The CV remained close to 0.4 between 2015 and mid-2019 and reached about 1.0 during the 2019–2020 low-availability period. Reductions in scheduled supply were therefore distributed unevenly across neighborhoods: during low-availability months, relative differences between neighborhoods increased. These neighborhood-level patterns cannot be observed in a city-wide average and illustrate how the dataset can be used to examine how reductions in scheduled supply are distributed across the city.

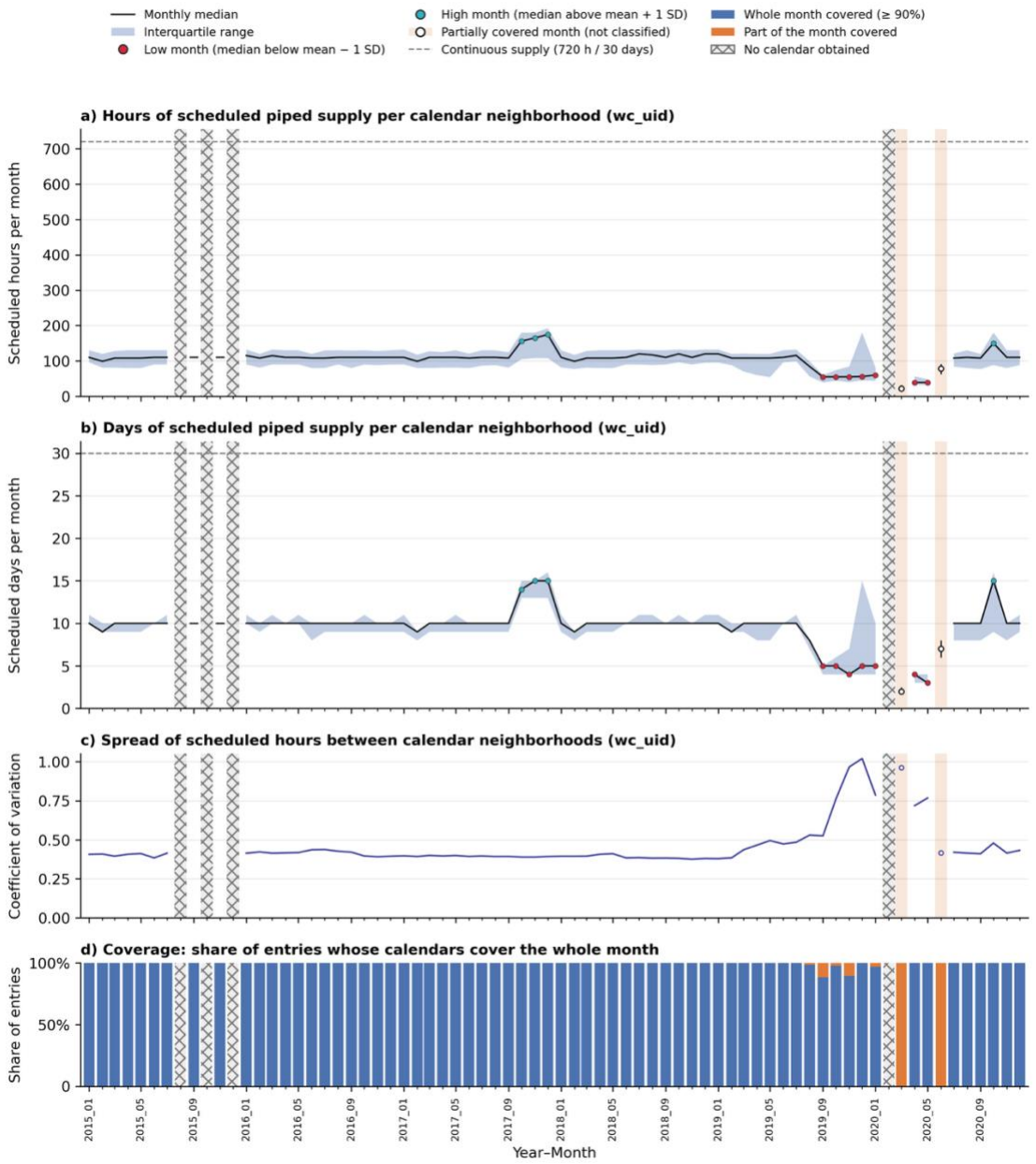


Figure 6 ***Monthly distribution*** *of scheduled piped water supply, 2015–2020. (a) Hours and (b) days of scheduled supply per calendar neighborhood (wc_uid) and month (Eqs. 7–8). Each value is the mean across the neighborhood's distribution groups; when a month was issued as two half-month calendars (days 1–15 and 16–end), their values are added. For each month, the shaded band spans the interquartile range across neighborhoods, and the black line joins the monthly medians; points mark months whose median lies below (low) or above (high) the mean ± 1 SD of all monthly medians. The dashed line marks continuous supply (720 h, 30 days) for reference. (c) Coefficient of variation (standard deviation divided by mean) of scheduled hours between calendar neighborhoods (wc_uid), using each neighborhood's mean across its distribution groups; variation between groups within the same neighborhood is therefore not included. (d) Share of entries per month whose calendars cover the whole month (coverage ≥ 0.9). Hatched bands mark months without a calendar (August, October and December 2015; February 2020); partially covered months (March and June 2020) are shaded and drawn as open points and are not classified.*

Usage Notes

The calendars are official plans, reproduced as issued. The schedule indicates when supply is planned; the water actually received may differ, as it depends on many factors. The dataset does not record whether the water was delivered as scheduled, and no independent operational or monitoring data were available to validate actual delivery. Analyses of water access, service levels, drought effects or inequality based on this dataset therefore refer to scheduled supply and should be interpreted accordingly.

Neighborhood-level records of delivered water volumes are not publicly available for Tegucigalpa, and part of household supply comes from tanker trucks and private wells outside the utility network; the scheduled hours and days in this dataset are therefore, to our knowledge, the only systematic neighborhood-scale record of scheduled service.

Reuse potential.

The dataset supports several types of analysis of planned service, each using fields included in the release.

Temporal changes in planned service. The monthly series of scheduled hours and days per neighborhood (Merged_WCuid, Merged_SDG11) allow changes in planned service to be traced over six years, including periods of reduced scheduled supply, recovery, and recurring seasonal patterns. These series can be related to hydrological records such as reservoir levels or rainfall, to examine how scarcity, one of the drivers of intermittent supply identified in the literature[1,3], is translated into schedules. Months flagged as partially covered (coverage < 0.9) should be excluded from such comparisons.

Spatial comparisons. Because each neighborhood carries the SDG11UID identifier and a polygon, scheduled supply can be mapped and compared across the city, and its dispersion between neighborhoods measured over time (Figure 6c). This supports studies of how planned service is distributed between areas, complementing household-level evidence on how intermittent supply is experienced and adapted to[17].

Linkage to topographic data. Neighborhood polygons can be joined to elevation models to examine whether scheduled supply varies with terrain, a factor relevant to pressure management in intermittent networks[30].

Linkage to socioeconomic data. Through SDG11UID, the schedules can be joined to other neighborhood-level datasets, such as census population and other datasets for the city that use the same identifier. This allows planned service to be related to housing and urban growth, and to indicators of urban water security[31].

Comparison with observed supply. The dataset provides the planned reference against which observed supply, from household surveys, field measurements or sensors, can be compared, to quantify the difference between scheduled and delivered service[18].

In all cases, results describe scheduled supply, not water delivered (see above).

Data Availability

The harmonized Water Distribution Calendar dataset, metadata, and supporting documentation are publicly available from the Zenodo[27] repository under the Creative Commons Attribution 4.0 International (CC BY 4.0) license. Original Water Distribution Calendars are not redistributed because they remain the property of the issuing institution. Researchers wishing to reproduce or extend the dataset may obtain the original schedules by submitting an information request through SIELHO, the transparency platform administered by the Instituto de Acceso a la Información Pública (IAIP), as described in Methods.

Code Availability

Custom scripts were developed to parse, clean, standardize, validate, and aggregate the water distribution calendars described in this study. The full processing pipeline—including schedule parsing, normalization routines, quality control procedures, neighborhood identifier matching, and temporal aggregation—is publicly available via Zenodo[26].

The pipeline relies on deterministic, rule-based procedures rather than machine learning models. All transformation logic is explicitly encoded in the scripts, ensuring transparency, interpretability, and reproducibility of the dataset reconstruction process.

The workflow is tailored to the locally formatted government documents and the region-specific administrative units of the study area and adapting it to another city would require adjustments concentrated in three components. The first is the initial parsing stage of the pipeline, which reads the converted calendar files and must accommodate the layout and conventions of a given municipality's published schedules. The second is the set of reference catalogs for distribution groups and neighborhoods: where a city does not organize service into groups, groups may be mapped one-to-one to neighborhoods, and attribute fields used here for water source and distributor may be repurposed to represent other locally relevant variables. The third is the matching of calendar neighborhoods to GIS neighborhood polygons; the granularity of this spatial matching is left to the data curator, and where multiple neighborhoods are associated with a single GIS unit their values are recorded as the mean, consistent with the aggregation procedure used in this dataset. Once a city's records are brought into the canonical form and processed by the first stage into the standardized tabular format, the remaining steps—harmonization, quality control, spatial linkage, and aggregation—operate on that common structure and are largely independent of the originating city, so the bulk of the pipeline can be reused without modification.

Code development was supported by AI-based code generation tools; however, all scripts were thoroughly reviewed, tested, and curated by the author prior to release. Language editing of the manuscript was assisted by an AI tool (Claude, Anthropic); the author reviewed all text and takes full responsibility for its content.

Declaration Of Competing Interests

The author declares no competing financial interests or personal relationships that could have influenced the work reported in this paper.

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