

Designing Gender-Specific Toilet and Urinal Needs Calculation Templates for Rural and Urban Schools: Lessons from the Republic of Benin

Tèko Augustin Kouévi

Department of Economics, Social-Anthropology and Communication for rural development, Faculty of Agricultural Sciences, University of Abomey-Calavi, Republic of Benin

Florent K. Okry

School of Rural Sociology and Agricultural Extension, National University of Agriculture (UNA), Republic of Benin

Hector Kpangon

Water and Sanitation for Africa (WSA), Benin-chapter, Republic of Benin

Akouavi Chantal Kouévi

Hermione Amoukpo

Faculty of Arts and Human and Social Sciences, University of Abomey-Calavi, Republic of Benin

Lubine Hounkpatin

Department of Economics, Social-Anthropology and Communication for rural development, Faculty of Agricultural Sciences, University of Abomey-Calavi, Republic of Benin

Edmond Attakin

Water and Sanitation for Africa (WSA), Benin-chapter, Republic of Benin

Cocou Rigobert Tossou

Department of Economics, Social-Anthropology and Communication for rural development, Faculty of Agricultural Sciences, University of Abomey-Calavi, Republic of Benin

Enoch Achigan-Dako

Department of Crop Sciences and Technics, Faculty of Agricultural Sciences, University of Abomey-Calavi, Republic of Benin

Marie-Paule Kestemont

Catholic University of Louvain (UCL), Belgium

[Doi:10.19044/esj.2024.v20n2p101](https://doi.org/10.19044/esj.2024.v20n2p101)

Submitted: 13 November 2023

Accepted: 13 January 2024

Published: 31 January 2024

Copyright 2024 Author(s)

Under Creative Commons CC-BY 4.0

OPEN ACCESS

Cite As:

Kouévi T.A., Okry F.K., Kpangon H., Kouévi A.C., Amoukpo H., Hounkpatin L., Attakin E., Tossou C.R., Achigan-Dako E. & Kestemont M.P. (2024). *Designing Gender-Specific Toilet and Urinal Needs Calculation Templates for Rural and Urban Schools: Lessons from the Republic of Benin*. European Scientific Journal, ESJ, 20 (2), 101.

<https://doi.org/10.19044/esj.2024.v20n2p101>

Abstract

Gender equity, quality education, and sanitation in rural and urban areas are widely considered development imperatives. Therefore, many developed countries have scientifically and technically developed norms for the calculation and the design of toilet and urinal needs of their students, which is not yet the case in most developing countries, including the Republic of Benin, that lack socio-culturally adapted gender-specific toilets and urinal needs calculation and design norms. This paper fills this scientific and gender-specific norms gap, by discussing the process and the results of the design of school toilet and urinal needs calculation templates and norms in the Republic of Benin. The study that led to this design took place between June 2013 and October 2015 and consisted mainly of observing and recording defecation and urination needs satisfaction in toilets and open spaces by 8,160 female and 13,263 male students of 13 schools purposively selected in four agroecological and sociocultural areas of Benin. The main data recorded related, among other data, to the start and end times of the use of the toilets and open spaces; the needs satisfied; the peak times and durations of breaks and of toilet needs satisfaction; the numbers of female and male students and non-students who use and who can potentially use the toilets and urinals. These raw data were processed to infer and calculate eight parameters used in each template. This process led to the design of eight area-, gender-, and disability-specific templates and norms in use since 2016, in the target areas. Further studies will assess and report on the performance of these templates and norms.

Keywords: Agroecology; Culture; Gender equity; Secondary schools; Toilet and urinal needs' calculation templates; West Africa

Introduction

This paper addresses the gendering of public school toilets and urinals in the Republic of Benin, West Africa. Toilet and urinal needs are among the basic needs that women and men, with and without disabilities cannot sustainably and safely prevent themselves from satisfying (Drewko, 2007; Health and Safety Executive, 2011; Human_Rights_Council, 2011; Plante and Soulie, 2006; Serment and Guys, 2005). Therefore, many public health, hygiene, and sanitation decision-makers from around the world have constantly kept taking relevant decisions for the effective and sustainable

satisfaction of toilet and urinal needs of their citizens, however, with various levels of consideration for gender equity (Bichard and Knight, 2011; Department for Education and Skills, 2007; Eau-Hygiène-Assainissement de l'UNICEF-Mali, 2012; Kyanssem, 2010; Ministère des Enseignements Primaire, Secondaire et de l'Alphabétisation, 2009; Restroom Association, 2013; Sheikh, 2008; State of Florida Seal, 2012; US Department of Justice, 2009; Vinel, 2008; Water Aid Bangladesh, 2006; Water Supply and Sanitation Collaborative Council, 2013). About this subject matter, the Republic of Benin has also gone through its gender equity consideration in the construction of public and institutional toilets as reported in the following sections (Clegbaza, 2010; COWI-Afric Performances, 2008; Direction de l'Hygiène et de l'Assainissement de Base, 2006 and 2010; Sossou and Agossou, 2005; Tonouhewa and Fourn, 2009). This design paper discusses the process and the results of the design of region- and gender-specific templates for the calculation of toilet and urinal needs of women, men, and people with disabilities (PWD) in secondary schools, in Benin. It fills a knowledge gap in this field in the sense that the existing literature is abundant on gender-specific toilet design norms of developed countries but very poor on developing countries including Benin. This paper aims also to inspire readers from developing countries about the scientific approach used for the design of the target templates. The collaborative action research that led to this paper took place from 2013 to 2015, within the framework of phase 2 of the Pluriannual Water and Sanitation Programme (*Programme Pluriannuel d'appui au secteur de l'Eau et de l'Assainissement*) (*PPEA 2*) funded by the Dutch Royal Embassy in Benin. This program aimed, among other things, to reduce inequity, discrimination, and shortcomings of previous public infrastructure construction approaches, through the provision of more and better quality toilet facilities to female and male students and PWD, in the target schools (Ambassade des Pays-Bas, 2012). The following sections respectively address the research methodology, results, discussion, and conclusion.

Methodology

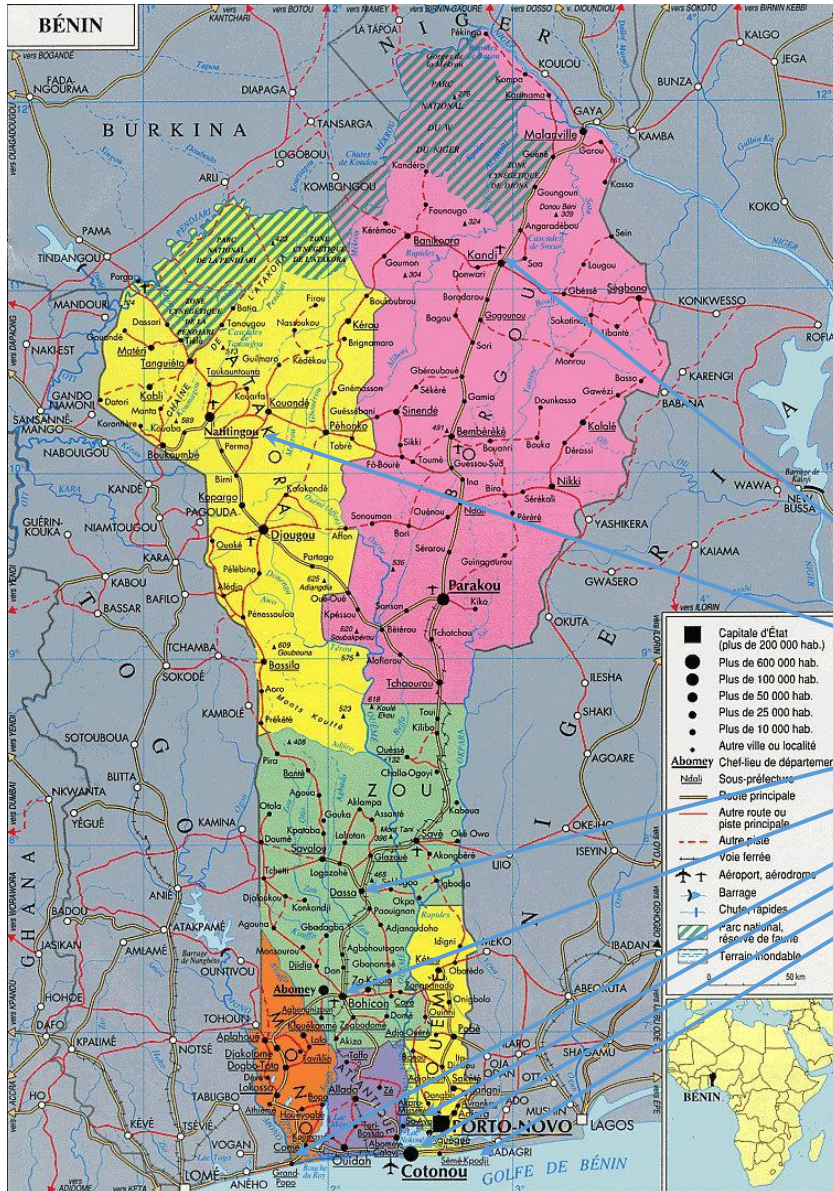
This section discusses strategies used to select the study areas and schools and to analyse and discuss the data collected.

Study period and areas

This study is part of a series of studies that started in June 2013 and ended in October 2015. These studies were carried out in four agroecological, sociocultural, and economic areas selected with the help of schools and hygiene and sanitation administration authorities. These areas composed of Northern Sahelian, Central Sudanian, Coastal, and Lake zones, were considered representatives of the whole of Benin country from agroecological,

sociocultural (ethnic, cultural group, and religions), and economic points of view.

- The Northern Sahelian area was represented by the municipalities of Natitingou and Kandi where one can meet many ethnic groups (including in the majority the Bariba and Dendi), religions (Endogenous, Muslim, and Evangelist), and large and less populated spaces (see map in figure 1 below);
- the Central Sudanian area was represented by the municipalities of Dassa-Zoumè and Bohicon where there are fewer ethnic groups (Idaatcha, Nagot, Mahi, and Fon), many religions (Endogenous, Evangelist, and Muslim), and moderately large and populated spaces;
- The coastal zone represented by the municipalities of Grand-Popo, Cotonou, and Sèmè-Kpodji where there are many ethnic groups (Xwula or Popo, Xwela or Pedah, Fon, Goun, Nagot, etc.), many religions (Endogenous, Evangelist, and Muslim), sea areas, few wetlands and moderately few but very populated lands; and,
- the lake areas represented by the municipalities of Grand-Popo and Sô-Ava, where one can meet fewer ethnic groups (Xwula/Popo, Xwela, Fon, Goun, Nagot, etc.), many religions (Endogenous, Evangelist, and Muslim), lakes, lagoons, few wetlands, and moderately few and populated spaces (see figure 1 showing Benin Map including the target areas).



Study areas

Source: https://www.formad-environnement.org/img/carte_benin2.jpg, retrieved and adapted on January 2, 2024

The choice of these areas was suggested by the Coordinators of the regional Basic Hygiene and Sanitation Centres (CDC-HAB), and the Directors and technical authorities of the regional secondary education (DDES) directorates.

It is however worth noting that, this paper is essentially based on data collected between November 2014 to October 2015.

Sampling

In total 13 public secondary schools were purposively selected for the study. They were suggested by the literature, the coordinators of the regional basic hygiene and sanitation centers (CDC-HAB), hygiene and sanitation agents (AHA), Directors and Technical authorities of regional secondary education directorates (DDES), and Directors of rural and urban secondary schools, per target area. Table 1 below gives details on the schools sampled. Key criteria used to select these schools were: the existence of toilets, the number of users, and representativeness. Thus, these schools were those with higher numbers of potential toilet users.

Table 1. Public secondary schools (CEG) studied

| N° | Area | School and location | Number of ladies observed | Number of men observed | Number of classrooms | Number of pedagogic groups | Observation time |
|---------------|-------------------------|---------------------------------|---------------------------|------------------------|----------------------|----------------------------|--------------------|
| 1 | Rural Coastal Lake area | CEG <i>Gbéhoue</i> (Grand-Popo) | 257 (76.49%) | 432 (70.13%) | 14 | 18 | 7:00 am to 7:00 pm |
| 2 | Rural Sudanian area | CEG Sodohome (Bohicon) | 234 (50%) | 463 (50.05%) | 16 | 32 | 7:00am to 19:00pm |
| 3 | Rural Sudanian area | CEG Kere (Dassa) | 192 (94.12%) | 726 (89.63%) | 23 | 20 | 7:00am to 19:00pm |
| 4 | Rural Sahelian area | CEG Perma (Natitingou) | 251 (87.46%) | 634 (87.45%) | 21 | 24 | 7:00 am to 7:00 pm |
| 5 | | CEG Sonsoro (Kandi) | 145 (72.86%) | 267 (72.75%) | 8 | 11 | 7:00am to 19:00pm |
| 6 | Suburban Lake area | CEG So-Ava | 192 (56.47%) | 639 (56.65%) | 20 | 32 | 7:00 am to 7:00 pm |
| 7 | Urban Sudanian area | CEG1 Bohicon | 1359 (68.02%) | 1749 (63.76%) | 50 | 71 | 7:00am to 19:00pm |
| 8 | | CEG 2 Dassa | 501 (87.13%) | 893 (87.12%) | 27 | 31 | 7:00am to 19:00pm |
| 9 | Urban Sahelian area | CEG1 Natitingou | 1249 (67.40%) | 2163 (66.01%) | 48 | 70 | 7:00 am to 7:00 pm |
| 10 | | CEG1 Kandi | 886 (95.78%) | 1405 (95.77%) | 45 | 47 | 7:00am to 19:00pm |
| 11 | Urban Coastal Lake area | CEG Grand-Popo | 481 (97.37%) | 702 (86.99%) | 54 | 97 | 7:00 am to 7:00 pm |
| 12 | Urban Coastal area | CEG Zogbo (Cotonou) | 780 (63.31%) | 1279 (63.35%) | 38 | 60 | 7:00am to 18:00pm |
| 13 | | CEG Suru-Lere (Cotonou) | 1633 (58.51%) | 1911 (63.57%) | 56 | 94 | 7:00am to 19:00pm |
| Totals | | | 8160 (71.03%) | 13263 (72.96%) | | | |

Source: Field data and estimations (2014-2015)

Data collection

Data collected for the design of the templates, related mainly to the gender and visible disabilities of users, the times and durations of use, and the reasons (defecation, urination, menstruation management, etc.) for the use of the toilets. Data collection methods consisted of discreet observations, recording of start and end of use times, and short interviews with purposively selected users. Reasons for the choice of these methods were to influence as little as possible the toilet use behaviors of the users, and to collect as natural and valid data as possible, on real-time use of the toilets by the people observed. As shown in Table 1 above, data collection took place continuously on days and times when the schools were open to students. While the opening days were the same from school to school, the opening times varied from 7 am to 6 pm and from 7 am to 7 pm. The same data were collected on the students who used the toilets, as well as on those who, for one reason or the other, used open spaces or bushes to satisfy their toilet needs. The main reason for gathering data on students who did not use the toilets but satisfied their toilet needs in nature was to integrate them into the calculation of the real toilet needs of all the students because they were all supposed to use the toilets and urinals.

Data related to the numbers and genders of students, teachers, food sellers, Watchers, classrooms, and pedagogic groups were also collected per school. In total, 6 schools in rural areas, 7 schools in urban areas, and 8,160 female and 13,263 male students who represented 72% of the total numbers of the selected schools were observed. Variations among the percentages of the students observed, account for the quality (attractiveness) of the existing toilets, and the extent to which students socio-culturally like using or not the public toilets, from one area to the other.

In all, these data recorded helped to identify and calculate parameters needed for the toilet and urinal needs calculation templates. These templates were validated by representatives of all stakeholders in November 2015.

Data analysis and discussion

After collecting the above data, the research team transcribed them into Excel sheets and proceeded with the calculation per school and study area, of the total number of toilet users per gender and ten-minute intervals corresponding to the minimum duration of breaks and toilet use peaks in the schools. The maximum duration of defecation and urination per gender were also estimated based on data recorded on toilet and urinal uses. These data in addition to the number of students recorded during the observations led to the determination of the key parameters considered in the design of the templates for the calculation of the number of toilets and urinals needed by the students in each area. These parameters are:

- Minimum time available for breaks and corresponding to peaks of toilet and urinal use needs;
- Maximum time used for urination, for the calculation of the number of urination needs that can be satisfied within the break and peak times;
- Maximum time used for defecation, for the calculation of the number of defecation needs that can be satisfied within the break and peak times;
- Maximum time used to urinate per gender and area (because this influences peaks);
- Maximum time used to defecate per gender and area (because this influences peaks);
- Percentage of students per gender urinating during peak times: calculated based on real-time use observations; and,
- Percentage of students per gender defecating during peak times: calculated based on real-time use observations.

Due to sociotechnical exclusion reasons and the absence of many people with disabilities (PWD) in most of the schools during the data collection period, by realism and positive discrimination or equity concern, the study systematically booked a minimum of 1 toilet per gender for these people, as one can see it in the templates. The templates obtained are user-friendly so that users only need to estimate and insert the maximum number reached by the students on the highest peak day and time.

Data discussion consists of highlighting important results, comparing them to existing experiences and knowledge, and emphasizing their policy implications.

Ethical clearance and study limits

Ethical principles were respected throughout the study, and the Ministry of Public Health which is the institutional body in charge of ethical clearance in medical research in Benin was also part of the research process. With more financial resources and time, the study would cover more areas and schools, such as to generate more robust templates. However, the templates obtained are expected to be continuously refined and adapted per school where necessary.

Results

This section presents the characteristics of the toilets and urinals in use in the field during the study period, templates, and norms for the calculation of toilet and urinal cabin needs, and shows examples of the use of the templates.

Characteristics of the schools' toilets and urinals during the study period

The toilets of the schools studied were in general made of four (04) to ten (10) cabins. Most of them were of Ventilated Improved Pit (VIP) type (figure 1), and few were of Ecosan¹ type (figure 2).



Figure 1. A VIP latrine of 4 cabins equally distributed per gender, in a school of Hilla-Condji, Grand-Popo, July 2013



Figure 2. An Ecosan latrine in a school of Hilla-Condji, Grand-Popo, July 2013

VIP toilets are infrastructure that collect and pre-treat fecal materials, urines, and other liquid wastes. They are mostly composed of one or more pits and ventilated with the help of ventilation pipes.

¹ Ecological Sanitation

ECOSAN toilets exist in definite or wood materials, and are made of:

- a half-buried or a surface pit that collects feces and wood ashes or any other desiccant and cleaning stuff. An orifice is opened on the pit such as to allow the evacuation of fecal plus ash or desiccant materials for compost or other needs;
- a ventilation pipe inserted in the pit;
- a can for the storage of urines (often used as urea in agriculture); and,
- stairs to access the toilet cabin.

In some places, one-half of the total number of toilet cabins was attributed to female students, and the second half to male students. In other places, there was no distribution of the number of cabins among female and male students. In all, the schools' managers used to keep at least one cabin for themselves and teachers, and no specific attention was paid to people with disabilities.

Apart from the toilet cabins of managers and teachers which were relatively kept clean (often cleaned by some students as punishment), those of the students were hardly cleaned and attractive. Therefore, due to dirtiness and unattractive smells, 37% of surveyed female students declared that they prefer satisfying their latrine and urine needs in open but hidden spaces where they can be able to slightly hide their nakedness, or in the toilets of neighbouring houses. The remaining 63% of interviewed students mentioned that they sometimes use school toilets, especially to satisfy at least two pressing needs, which are feces, and urine, and rarely for changes of menstrual diapers.

Parameters recorded and calculated

The following Table 2 presents parameters recorded and collected near the schools and the students observed.

Tableau 2. Parameters recorded and calculated about the use and needs of toilets and urinals of secondary schools (CEG) per study area

| Area | School name and location | Peak times | Maximum duration of urination (ladies) (in min) | Maximum duration of urination (men) (in min) | Maximum duration of defecation (ladies) (in min) | Maximum duration of defecation (men) (in min) | Percentage of ladies urinating at peak times | Percentage of men urinating at peak times | Percentage of ladies defecating at peak times | Percentage of men defecating at peak times |
|-------------------------|--------------------------|---|---|--|--|---|--|---|---|--|
| Rural coastal Lake area | CEG Gbéhoué | 10:01- 10:11 am; and 10:02-10:12 am | 2 | 2 | 7 | 3 | 1.95% | 1.16% | 0.78% | 0.46% |
| Suburban lake area | CEG So-Ava | 7:49 – 7:59 am; and 8:30-8:40am | 1 | 1 | 7 | 11 | 1.04% | 0.63% | 2.08% | 2.19% |
| Urban Coastal Lake area | CEG Grand-Popo | 4:55 – 5:05 pm; 16:57 – 17:07 | 2 | 2 | 8 | 12 | 1.25% | 0.85% | 1.66% | 0.57% |
| Urban coastal area | CEG Zogbo | 9:56 – 10:06am; 15:59 – 16:09pm | 2 | 1 | 3 | 5 | 2.82% | 1.80% | 0.51% | 0.08% |
| | CEG Suru-Lere | 13:04 -13:14pm; 14:42 -14:52pm | 1 | 2 | 3 | 3 | 0.98% | 0.73% | 0.06% | 0.06% |
| Rural Soudanian area | CEG Sodohome | 10:08 – 10:18 am; and 10:10-10:20 am | 1 | 2 | 4 | 3 | 1.71% | 2.16% | 1.71% | 0.43% |
| | CEG Kere | 9:42 – 9:52 am; and 17:02-17:12 pm | 2 | 1 | 5 | 7 | 2.60% | 1.38% | 0.52% | 0.28% |
| Urban Soudanian area | CEG1 Bohicon | 16:49-16:59pm; 16:58–17:08 pm ; and 17:03 – 17:13 pm | 2 | 2 | 3 | 3 | 1.32% | 1.32% | 0.15% | 0.06% |
| | CEG Dassa | 8:39 – 8:49 am ; 9:46-9:56 am; 10:10 – 10:20am; and 17:03 – 17:13pm | 1 | 2 | 7 | 7 | 0.60% | 2.69% | 0.20% | 0.11% |

| | | | | | | | | | | |
|------------------------------------|------------------------|---|------|------|------|------|-------|-------|-------|-------|
| Rural Sahelian area | CEG Perma (Natitingou) | 7:56- 8:06am; 9:47 - 9:57am; 14:58-15:58pm; 16:49-16:59pm; 16:51 - 17:01pm, 16:56 - 17:06pm | 1 | 2 | 4 | 4 | 0.40% | 0.16% | 2.39% | 0.47% |
| | CEG Sonsoro | 9:47 - 9:57am; and 16:50 - 17:00pm | 1 | 2 | 3 | 5 | 0.69% | 0.37% | 2.76% | 1.12% |
| Urban Sahelian area | CEG1 Natitingou | 10:01 - 10:11am; 16:56 - 17:06 pm | 2 | 1 | 4 | 5 | 0.08% | 0.05% | 0.24% | 0.32% |
| | CEG1 Kandi | 10:10 - 10:30am; 15:02- 15:12pm; 15:47 - 15:57pm; 16:20-16:30pm, 16:54 - 17:04pm; | 2 | 1 | 3 | 7 | 0.45% | 0.07% | 0.23% | 0.36% |
| General trends and averages | | 7:45 - 8:50am; 9:45-10:30am; 15:45 -16:30pm; 16:45 - 17:15pm | 1.54 | 1.62 | 4.69 | 5.77 | 1.22% | 1.03% | 1.02% | 0.50% |

Source: Field data and calculations, 2014-2015

According to Table 2, the secondary school students intensively use the toilets and urinals:

- Between 7:45 and 8:50 am mainly in suburban and less developed areas where most houses lack latrines and urinals. Students from those areas keep their morning toilet needs until they satisfy them at school. This was the case in the CEGs of Perma and Sô-Ava.
- Between 9:45 and 10:30 am; and 3:45 and 5:15 pm in all the studied schools. These times were situated around the break times (which are 9:55 – 10:10 am; 4:00-4:10 pm; or 4:55 –5:05 pm) of the schools.

Toilet and urinal cabin numbers calculation templates

In total, eight (8) templates were designed for the secondary schools, considering the parameters presented in Table 2 above. The following Table 3 shows all 8 templates related to the study areas. Each of the templates contains:

- empty fields (line A) to be filled with the maximum number reached by the students at peak time;
- three parameters (lines B to D) recorded and fixed per area;
- two parameters (lines E and F) calculated and fixed per area;
- three empty fields (line G to I) that generate automatically the numbers of toilet cabins and urinals needed per school, after the maximum number of students at peak time is inserted; and,
- three other fields (lines J to L), summarising the total numbers of toilets and urinals needed per gender and disability.

Thus, each of these templates contains standardised parameters, and the only gaps to fill in to get the number of toilet cabins required per gender, are the maximum numbers of males and females reached at a peak time (in line A). As earlier mentioned, the number of cabins for PWDs is fixed for now at 1 PWD toilet cabin per gender, although, there are very few PWDs attending the schools.

Tableau 3. Synthesis of the templates for the calculation of gender and disability specific latrines and urinals

| | Parameters | Rural coastal lake area | | Urban coastal lake area | | Suburban lake area | | Urban coastal areas | | Rural Sudanian area | | Urban Sudanian area | | Urban Sahelian area | | Rural Sahelian area | | Observations |
|---|--|-------------------------|---------|-------------------------|-----|--------------------|-----|---------------------|-----|---------------------|-----|---------------------|-----|---------------------|-----|---------------------|-----|--|
| | | Ladies (L) | Men (M) | L | M | L | M | L | M | L | M | L | M | L | M | L | M | |
| A | Maximum Number reached on a peak day | (to be filled) (TBF) | TBF | TBF | TBF | TBF | TBF | TBF | TBF | TBF | TBF | TBF | TBF | TBF | TBF | TBF | TBF | Include teachers, administration staff, and other users in the school |
| B | Minimum time availed for breaks on a school day | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | This time corresponds to the smallest duration of breaks, running from 4:00-4:10 pm or 4:55-5:05 pm. |
| C | Maximum time used to urinate (recorded after observations) | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | This time in minutes corresponds to the highest duration for urination recorded near the students. |

| | | | | | | | | | | | | | | | | | | |
|---|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---|
| D | Maximum time used to defecate (recorded after observations) | 7 | 3 | 8 | 12 | 7 | 11 | 3 | 5 | 5 | 7 | 7 | 7 | 4 | 7 | 4 | 5 | This time in minutes corresponds to the highest duration for defecation recorded near the students. |
| E | Percentage of students who urinate at peak times (estimated after observations) | 1.95% | 1.16% | 1.25% | 0.85% | 1.04% | 0.63% | 2.82% | 1.80% | 2.60% | 2.16% | 1.32% | 2.69% | 0.45% | 0.07% | 0.69% | 0.37% | These rates were obtained after dividing the highest number of students urinating within the 10 min breaks by the total number of students in the schools per gender, and multiplying the results by 100. |

| | | | | | | | | | | | | | | | | | | |
|---|--|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| F | Percentage of students who defecate at peak times (estimated after observations) | 0.78% | 0.46% | 1.66% | 0.57% | 2.08% | 2.19% | 0.51% | 0.08% | 1.71% | 0.43% | 0.20% | 0.11% | 0.24% | 0.36% | 2.76% | 1.12% | These rates were obtained after dividing the highest number of students defecating within the 10 min breaks by the total number of students in the schools per gender, and multiplying the results by 100. |
| G | Number of urinals needed (NU)= $A * E / (B / C)$ | Automatically generated after inserting a number in the A cell above (AG) | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | Results here were obtained with the formula $(A * E / (B / C))$. Females' urinals are converted into latrines. |
| H | Number of WC cabins needed (NWC)= $A * F / (B / D) - I$ | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | Results here are obtained with the formula $(A * F / (B / D) - I)$. |

| | | | | | | | | | | | | | | | | | | | |
|---|----------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|--|
| I | Number of cabins needed for PWD | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | These are fixed numbers. They should be constructed and equipped such as to welcome PWDs of all genders. |
| J | TOTAL NUMBERS OF WC FOR PWDs | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Summary of number of cabins to construct. They are Automatically generated after inserting a number in the A cell above. |
| K | TOTAL NUMBERS OF WC FOR NON-PWDs | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | | |
| L | TOTAL NUMBERS OF URINALS | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | AG | | |

Remark: Relevant conditions may be created in the cabins to allow ladies and PWDs to manage all their toilet needs. Especially accessibility, cleanliness, water and soap, materials for easy management of menstruations, and relevant and discrete dust bins are key for PWDs and female students.

Source: Field data and calculations, 2013-2015.

Legend: AG= Automatically Generated or calculated by the templates after filling cells in line A with required data.

TBF= To be filled

The templates are designed such that fixed parameters cannot be changed.

Table 3 shows that the recorded and calculated parameters vary among genders and from area to area. However, the most important differences are observed at the level of percentages of students who use the toilets at peak times. Thus, the percentages of female students who use the toilets or open spaces to urinate vary between 0.08% and 2.82%, while those of male students vary from 0.05% to 2.69%. The lowest percentages were observed in most populated schools of the Sahelian areas where there were wide open spaces used by the students for their toilet needs. The highest percentages of toilet use for urination were recorded in Lake, Coastal, and Sudanian areas, where there were very few open spaces for toilet needs satisfaction by the students.

With regards to defecation, percentages of toilet users recorded varied from 0.06% to 2.76% for ladies and 0.06% to 2.19% for men. Here, the highest percentages were recorded in rural Sahelian areas, while the lowest were observed in Coastal, Lake, and Sudanian areas, which confirmed the hypothesis according to which, school toilets are most used for defecation than for urination in rural Sahelian and Lake areas where very few students have toilets in their houses. These trends also confirmed the hypothesis according to which, toilets in most populated urban schools are mostly used for pressing defecation needs because of their generally poor attractiveness due to poor cleaning habits.

The templates have been used according to the area of location of the target secondary schools. Their use consists of simply estimating the highest number of female and male students reached in the schools on the busiest day and time of the week, and inserting such numbers in the appropriate template, in the cells of the top and the first line labeled A. Once the numbers are inserted, the template automatically generates the numbers of toilet cabins and urinals needed per gender and disability as shown in the following section.

Results of the test of the templates

The following Table 4 presents the results of the test of the templates. The test consisted of estimating and inserting the required data in the cells of line A. These data were calculated with the help of school databases.

Tableau 4: Results of the tests of the templates

| Paramètres | CEG Gbehoue | | CEG Grand-Popo | | CEG So-Ava | | CEG Suru-Lere | | CEG Kere de Dassa | | CEG Bohicon 1 | | CEG Natitingou 1 | | CEG Sonsoro | |
|---|-------------|-------|----------------|-------|------------|-------|---------------|-------|-------------------|-------|---------------|-------|------------------|-------|-------------|-------|
| | F | G | F | G | F | G | F | G | F | G | F | G | F | G | F | G |
| A Maximum Number reached on a peak day | 336 | 616 | 494 | 807 | 340 | 1128 | 2791 | 3006 | 204 | 810 | 1998 | 2743 | 1853 | 3277 | 199 | 367 |
| B Minimum time availed for breaks on a school day | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| C Maximum time used to urinate (recorded after observations) | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 |
| D Maximum time used to defecate (recorded after observations) | 7 | 3 | 8 | 12 | 7 | 11 | 3 | 5 | 5 | 7 | 7 | 7 | 4 | 7 | 4 | 5 |
| E Percentage of students who urinate at peak times (estimated after observations) | 1.95% | 1.16% | 1.25% | 0.85% | 1.04% | 0.63% | 2.82% | 1.80% | 2.60% | 2.16% | 1.32% | 2.69% | 0.45% | 0.07% | 0.69% | 0.37% |
| F Percentage of students who defecate at peak times (estimated after observations) | 0.78% | 0.46% | 1.66% | 0.57% | 2.08% | 2.19% | 0.51% | 0.08% | 1.71% | 0.43% | 0.20% | 0.11% | 0.24% | 0.36% | 2.76% | 1.12% |
| G Number of urinals needed (NU)= A*E/(B/C) | 0 | 2 | 0 | 2 | 0 | 1 | 0 | 11 | 0 | 4 | 0 | 15 | 0 | 1 | 0 | 1 |

| | | | | | | | | | | | | | | | | | |
|----------|--|---|---|---|---|---|----|----|----|---|---|---|----|---|---|---|---|
| H | Number of WC cabins needed (NWC)= $A * F / (B / D) - I$ | 4 | 1 | 8 | 6 | 6 | 28 | 21 | 2 | 3 | 3 | 9 | 3 | 4 | 9 | 3 | 3 |
| I | Number of cabins needed for PWD | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| J | TOTAL NUMBERS OF WC FOR PWDs | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| K | TOTAL NUMBERS OF WC FOR NON-PWDs | 4 | 1 | 8 | 6 | 6 | 28 | 21 | 2 | 3 | 3 | 9 | 3 | 4 | 9 | 3 | 3 |
| L | TOTAL NUMBER OF URINALS | 0 | 2 | 0 | 2 | 0 | 1 | 0 | 11 | 0 | 4 | 0 | 15 | 0 | 1 | 0 | 1 |

Table 4 confirms that needs vary from area to area, from school to school, and among gender and PWD. Therefore, systematically constructing the same numbers of toilet and urinal cabins for all genders and PWD may discriminate against people less represented and with specific needs, as this used to happen before.

School toilet cabins and urinals need calculation norms for the study areas

Table 5 provides norms for the calculation of the number of toilet cabins and urinals in the study areas. These norms were derived from the templates used to estimate the number of female, male, and PWD students required per toilet cabin and urinal.

Table 5. Toilet and urinals’ needs calculation norms for secondary schools

| Nº | Areas | Number of female students per WC cabin | Number of WC cabins for female PWDs | Number of male students per WC cabin | Number of male students per urinal | Number of WC cabins for male PWDs |
|----|--------------------------|--|-------------------------------------|--------------------------------------|------------------------------------|-----------------------------------|
| 1 | Rural lake areas | 107 | 1 | 720 | 432 | 1 |
| 2 | Rural Sudanian areas | 73 | 1 | 331 | 232 | 1 |
| 3 | Rural Sahelian areas | 85 | 1 | 178 | 1335 | 1 |
| 4 | Suburban lake areas | 64 | 1 | 41 | 1598 | 1 |
| 5 | Urban Sudanian areas | 247 | 1 | 1276 | 186 | 1 |
| 6 | Urban Sahelian areas | 537 | 1 | 401 | 1405 | 1 |
| 7 | Urban coastal-lake areas | 63 | 1 | 146 | 585 | 1 |
| 8 | Urban coastal areas | 139 | 1 | 2558 | 278 | 1 |

Source: Field data and estimations, 2013-2015

Analysis of table 5 indicates that norms vary per area and gender, in the secondary schools. These variations may be due to differences in demographic, sociocultural, and availability of open spaces, between areas and between urban, suburban, and rural areas. Norms are higher in areas where

more open spaces are available and used by the students for most of their toilet and urination needs, than in space-less areas.

Discussion

This paper shows, in general, that toilet and urinal needs vary from area to area and among genders and people with disabilities. The study findings revealed that these need variations are mainly due to variations of demographics, cultures or habits, disabilities, and physiological specificities of ladies, men, PWDs, schools, and areas. The findings logically highlighted that schools, areas, and people with high toilet and urinal needs, require high numbers of toilet and urinal cabins technically adapted to the biophysical and biophysiological abilities and disabilities of potential users. However, the toilet and urinal needs of students are not just matters of quantity, they are also matters of quality. This means that people in charge of hygiene and sanitation in the target schools are required to make sure that the toilets and urinals meet the quality conditions desired by the students and other users. If such quality conditions are not satisfied, toilets and urinals can fail to be used, and hygiene and sanitation issues in schools will remain (Kouévi & Okry, 2015; Kpangon *et al.*, 2014).

Conclusion

This paper discusses a process towards the design of templates and norms for the calculation of toilet and urinal cabins needs of secondary school students of rural, suburban, urban, Sahelian, Sudanian, Lake, and Coastal areas of the Republic of Benin. The study from which it was derived took place from 2013 to 2015, and in four steps, across the study areas. This article reported on the third step built on the results from the first and the second steps of the study to design the templates presented in this paper, which may allow sanitation and school decision-makers to easily and quickly calculate the numbers of toilet cabins and urinals required for the target schools, per gender and disability, no matter their toilet needs calculation skills. To obtain the templates, the study observed real-time toilet and urination needs satisfaction by more than 20,000 female and male students through 13 secondary schools distributed in four agroecological areas of the Republic of Benin. The data recorded from the observations were processed in Excel sheets to derive and calculate about five parameters used for the calculation of the toilet and urinal needs of the target students. In total 8 templates have been generated and into use since 2016 in secondary schools in Benin, and they have easily helped to calculate many gender-specific toilet needs, contributing then to the achievement of sustainable development goals (SDG) number 6, 3, 4, 5, 10, 11, and 16. The study and the templates revealed differences in the use and the needs of toilets and urinals among areas, genders, and people with disabilities.

Therefore, relevant templates may be used for the toilet and urinal needs calculation in secondary schools, and required effort may be deployed for the quality design and maintenance of these toilets and urinals for their effective and sustainable use by students. Humans' needs and contexts are dynamic, further effort may be developed to monitor the use and update the templates, where needed. A further paper will report on the performance of these templates.

Acknowledgments

We acknowledge the valuable contributions of all the people and institutions who participated in the success of the surveys. We are also thankful to the Dutch Royal Embassy in Benin which funded this study through COWI-IGIP, the Ministry of Public Health (MSP) of Benin, and the Benin Chapter of Water and Sanitation for Africa (WSA).

Conflict of Interest: The authors reported no conflict of interest.

Data Availability: All of the data are included in the content of the paper.

Involvement of humans: This research has followed Helsinki and Benin Ethical Principles For Medical Research Involving Human Subjects. The research was approved by the relevant institutional body.

References:

1. Ambassade des Pays-Bas (2012). Programme pluriannuel d'appui au secteur de l'eau et de l'assainissement phase II 2013-2016 (PPEA-II): Document de programme. Cotonou, Bénin.
2. Bichard, J. A., & Knight, G. (2011). *Publicly accessible toilets: An inclusive design guide*. Royal College of Art Helen Hamlyn Centre for Design. https://researchonline.rca.ac.uk/440/1/Toilet_LoRes.pdf
3. Clegbaza, G. M. (2010). Sanitation Sector Status and Gap Analysis: Benin. *Global Sanitation Fund and Water Supply & Sanitation Collaborative Council, Benin*, 39p. https://www.pseau.org/outils/ouvrages/wsscc_sanitation_sector_status_benin.pdf
4. COWI-Afric Performances (2008). Mission de Suivi-Évaluation Externe Périodique no 2 du Programme pluriannuel d'appui au secteur Eau et Assainissement (PPEA). *Rapport provisoire de Débriefing du 23 juin 2008, Bénin*, 45p. <https://gwppnebenin.org/deuxieme-mission-de-suivi-evaluation-externe>
5. Department for Education and Skills (2007). Toilet in schools: Standards specifications, layouts, and dimensions. *Crown, Sherwood*

- Park Annesley*, Nottingham, 52p. <https://www.school-toilets.co.uk/sitesdocs/Department-for-education-and-skills-SSLD-toilets-in-schools.pdf>
6. Direction de l'Hygiène et de l'Assainissement de base (DHAB) (2010). Appui à la maîtrise d'ouvrage communale : Guide d'élaboration et de mise en œuvre du Plan d'Hygiène et d'Assainissement Communal. *Programme Eau Potable-GTZ, Bénin*, 99p.
https://www.pseau.org/outils/ouvrages/mineau_bj_guide_plan_hygiene_assainissement_communal_fiches_techniques.pdf
 7. Direction de l'Hygiène et de l'Assainissement de base (DHAB) (2006). *Document de promotion de l'hygiène et de l'assainissement (PHA)*, Bénin, 77p.
https://www.pseau.org/outils/ouvrages/dhab_demarche_promotion_hygiene_assainissement_benin.pdf
 8. Drewko, A. (2007). Resource-oriented public toilets in developing countries: Ideas, design, operation, and maintenance for Arba Minch, Ethiopia. *Hamburg University of Technology, Hamburg*, 148.
 9. Eau-Hygiène-Assainissement (WASH) de l'UNICEF-Mali (2012). Promotion de l'hygiène en milieu scolaire : Guide pratique pour les ONG. *UNICEF, DANIDA, Dubai-Cares*, 71p.
<https://reliefweb.int/report/mali/promotion-de-1%E2%80%99hygi%C3%A8ne-en-milieu-scolaire-guide-pratique-pour-les-ong>
 10. Health and Safety Executive (2011). Welfare at work: Guidance for employers on welfare provisions. UK, 4p.
<https://www.hse.gov.uk/pubns/indg293.pdf>
 11. Human Rights Council (2011). Resolution 18/1 on the human right to safe drinking water and sanitation. *UN*, 5p. <https://www.right-docs.org/download/7076/>
 12. Keihas, L. (2013). L'hygiène menstruelle dans les écoles de deux pays francophones d'Afrique de l'Ouest : Burkina Faso et Niger, Etudes de cas. *UNICEF*, 79p.
https://www.pseau.org/outils/ouvrages/unicef_l_hygiene_menstruelle_dans_les_ecoles_de_deux_pays_francophones_d_afrique_de_l_ouest_2013.pdf
 13. Kouévi, T. A., & Okry, F. (2015). Grilles consolidées d'estimation des besoins en latrines sexo et handi spécifiques des Collèges d'Enseignement Général publiques du Bénin et résultats de tests. Cotonou : COWI-IGIP, EAA, & DNSP, 32p.
 14. Kpangon, H., Kouévi, T. A., & Okry, F. (2014). Etude des pratiques et facteurs socioculturels affectant la construction des latrines sexo et

- handi spécifiques dans les écoles, les marchés et les gares routières au Bénin. Cotonou : Eau et Assainissement pour l’Afrique (EAA), & COWI-IGIP, 78p.
15. Makanguile, M. (2010). Etude des conditions de diffusion des ouvrages d’assainissement autonome en milieu rural sahélien. *Eau-Vive, Mali*, 84p.
https://www.pseau.org/outils/ouvrages/eauvive_etude_diffusion_ouvrages_assainissement_mali.pdf
 16. Plante, P., & Soulie, M. (2006). Urologie. Cours, DCEM III, Marseille, 70p.
 17. Restroom Association (2013). Guide to Better Public Toilet Design and Maintenance. *Third Edition 2013*, Singapore, 81p.
<https://hanswesterveld.files.wordpress.com/2015/09/guidebetterpublictoilet.pdf>
 18. Serede Kyanssem, A. M. (2010). Guide du Maire pour la promotion de l’assainissement durable dans les communes : L’essentiel pour comprendre, mettre en œuvre, suivre et évaluer les programmes et projets communaux d’assainissement. *CREPA, RCR, SEI-EcosanRes*, Burkina Faso, 34p.
https://www.pseau.org/outils/ouvrages/crepa_sei_guide_du_maire_pour_la_promotion_de_l_assainissement_durable_dans_les_communes_2010.pdf
 19. Serment, G., & Guys, J. M. (2005). Orientation diagnostique devant : Troubles de la miction (341). DCEM 3 – Module Pluridisciplinaire n° 13, Néphrologie – Urologie, Faculté de Médecine de Marseille, 18p.
<https://www.yumpu.com/fr/document/read/24865242/orientation-diagnostique-devant-troubles-de-la-miction-341>
 20. Sheikh, S. (2008). *Public toilets in Delhi: an emphasis on the facilities for women in slum/resettlement areas* (No. 192). CCS Working Paper.
<https://ccs.in/sites/default/files/2022-10/Public%20Toilets%20in%20Delhi%20An%20Emphasis%20on%20the%20Facilities%20for%20Women%20in%20Slum%20Resettlement%20Areas.pdf>
 21. Sossou, P., & Agossou, G. (2005). Inventaire, typologie et description des pratiques liées aux divers usages de l’eau au Bénin, Rapport final. *PNE-Bénin et Protos*, 118p.
https://www.pseau.org/outils/ouvrages/pne_snv_rapport_de_l_etude_sur_l_inventaire_et_la_caracterisation_des_problematiques_gire_dans_le_delta_de_l_oueme_2020.pdf
 22. State of Florida Seal (2012). 2012 Florida Accessibility Code for Building Construction. Florida, 234p.

- https://www.floridabuilding.org/fbc/committees/accessibility/aac/Changes_to_Law/2012_Florida_Accessibility_Code_Final%20.pdf
23. Tonouhewa, A., & Fourn, E. (2009). Etude portant sur genre et gestion intégrée des ressources en eau au Bénin. *DGEau et PNE*, 226p.
 24. US Department of Justice. (2009). Americans With Disabilities Act of 1990, As Amended.
 25. Vinel, V. (2008). Mémoires de sang: transmission et silences autour des menstrues (France urbaine). *Errefe. La ricerca folklorica*, 58, 79-90. <https://shs.hal.science/halshs-00864977/document>
 26. Water Aid Bangladesh (2006). Step by Step implementation guidelines for Public Toilets. Bangladesh, 33p.
 27. Water Supply & Sanitation Collaborative Council (2013). Hommage à la femme : Comment une meilleure gestion de l'hygiène menstruelle conduit à une meilleure santé, plus de dignité et d'épanouissement professionnel. *Conseil de concertation pour l'approvisionnement en eau et l'assainissement, Londres et Malaisie*, 24p. https://www.pseau.org/outils/ouvrages/wsscc_hommage_a_la_femme_2013.pdf