

Impact of Community-Led Total Sanitation (CLTS) on Hygiene and Sanitation Practices in Rural Ivorian Communities: Evidence from the Sub-Prefectures of Blapleu, Yorodoukou, Santa, and Sipilou (Western Côte d'Ivoire)

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Abstract

Open defecation is a significant sanitation issue in sub-Saharan Africa, with Community-Led Total Sanitation (CLTS) showing efficacy yet facing challenges in maintaining Open Defecation Free (ODF) status post-certification. To tackle this, a sub-prefectural strategy was implemented in the Biankouma and Sipilou departments of western Côte d'Ivoire, engaging rural communities and local authorities. This study evaluated the impact of this approach on sanitation practices and reducing open defecation rates through a quasi-experimental before-and-after design. Data were collected from 81 localities via household surveys, field observations, and stakeholder interviews. The results indicated notable improvements in sanitation conditions: latrine coverage rose dramatically from 19% to 78%, and open defecation rates decreased significantly across various locales by 56, 65, 45, and 34 percentage points in Blapleu, Santa (Biankouma), Sipilou, and Yorodougou (Sipilou), respectively. ODF certification was achieved in all localities in Blapleu, 78% in Santa, 74% in Yorodougou, and 47% in Sipilou. Additionally, the initiative led to better wastewater management practices and the development of local monitoring, governance, and community solidarity mechanisms, which were crucial for sustaining sanitation improvements. The findings emphasize that the long-term effectiveness of CLTS relies on not only enhancing access to sanitation facilities but also bolstering local governance and fostering community en-

gement. Thus, the sub-prefectural method presents a viable strategy for increasing ODF achievements and maintaining rural sanitation advancements in sub-Saharan Africa.

Keywords

Côte d'Ivoire, Departments of Biankouma and Sipilou, Local Governance, Open Defecation Free, Sub-Prefectural Approach

1. Introduction

Sanitation is a critical public health and sustainable development challenge, especially in sub-Saharan Africa, where access to safe sanitation services is severely restricted. As of 2024, reports from WHO and UNICEF [1] indicate that approximately 3.4 billion individuals do not have safely managed sanitation services, and around 354 million people are still engaging in open defecation, predominantly in low-income countries and rural regions. This deficiency in sanitation services is closely linked to the spread of waterborne and enteric diseases, with children being the most affected demographic [2]. In rural locales, the combination of insufficient sanitation infrastructure and economic as well as technical limitations is a significant factor driving the prevalence of open defecation practices [3] [4].

In Côte d'Ivoire, open defecation presents a considerable challenge, particularly in rural regions where access to sanitation services is severely limited [5] [6]. The lack of adequate water, hygiene, and sanitation infrastructures leads to detrimental health outcomes, including heightened susceptibility to diarrheal diseases and environmental enteropathy, which significantly affect the nutritional status of the population [7] [8]. To address this public health crisis, Community-Led Total Sanitation (CLTS) has been adopted as a central component of the National Rural Sanitation Strategy (NRSS). The integration of CLTS into national policies represents a proactive measure against open defecation [9]. Its successful implementation in various rural areas has prompted its adoption by multiple countries as a vital strategy aimed at improving rural sanitation and eradicating open defecation [10] [11].

Developed by Kamal Kar, the participatory approach aims to enhance collective awareness regarding the health and environmental repercussions of open defecation, facilitating sustainable behavioral changes [12]. Research has shown its effectiveness in decreasing open defecation and improving latrine access in rural locales [13] [14]. Despite these advancements in various countries, challenges persist concerning the long-term sustainability of open defecation elimination (ODE) initiatives, particularly in certain rural communities. Instances of reverting to open defecation have emerged, attributed to insufficient community monitoring, ineffective local governance, and the gradual decline of sanitation infrastructure [15]. These problems indicate that strategies centered solely on behavioral change

may fall short without robust institutional frameworks to ensure ongoing community monitoring.

In the Tonkpi region of western Côte d'Ivoire, specifically in the departments of Biankouma and Sipilou, a sub-prefectural approach has been devised to enhance previous programs aimed at achieving Open Defecation Free (ODF) status and to ensure sustainability in sanitation practices. This innovative approach emphasizes the active role of local administrative authorities, especially sub-prefects, in the oversight and coordination of CLTS initiatives. A key aspect of this strategy is the simultaneous engagement of all villages and settlements within a sub-prefecture, fostering a collective effort towards achieving and sustaining ODF status. To facilitate this, sub-prefectural monitoring committees have been established, which aim to bolster community mobilization, local governance, and oversight of sanitation infrastructure. By enhancing institutional oversight and community accountability, this approach seeks to promote the continuous adoption of good sanitation practices and mitigate the possibility of reverting to open defecation.

This study investigates the effects of implementing Community-Led Total Sanitation (CLTS) through sub-prefectural governance mechanisms in rural communities, particularly in the departments of Biankouma and Sipilou. Despite increased attention towards community-based sanitation methods, there exists a notable gap in research focused on the impacts of CLTS when aligned with local governance structures that integrate both rural communities and educational institutions. The research specifically targets access to sanitation infrastructure, improvements in hygiene practices, and the consequent reduction in open defecation within selected sub-prefectures—namely, Blapleu and Santa in Biankouma, as well as Sipilou and Yorodougou in Sipilou. The findings aim to provide insights into how such governance approaches can enhance sanitation outcomes in these rural areas.

2. Materials and Methods

The evaluation of CLTS implementation effects utilized a quasi-experimental design, comparing baseline survey indicators with post-intervention data. To strengthen the reliability of findings, the evaluation incorporated a triangulation method, gathering data from diverse sources, including households, field observations, and interviews with pertinent stakeholders. This multi-faceted approach ensured a comprehensive assessment of the intervention's impact.

2.1. Study Area

The study was conducted in the Sipilou and Biankouma departments, situated in the Tonkpi region of western Côte d'Ivoire, encompassing roughly 12,284 km² (**Figure 1**). Geographically, it lies between latitudes 6°34' and 8°04' North and longitudes 5°24' and 7°03' West. The climate in this area is classified as humid tropical, with annual rainfall fluctuating between 1300 to 1500 mm and average

temperatures ranging from 25°C to 30°C [16] [17].

This specific region was chosen because it was the first implementation site in Côte d'Ivoire for the sub-prefectural approach to CLTS, providing a crucial context for analyzing the effects of local governance on achieving Open Defecation-Free (ODF) status in rural communities. The localities involved in the CLTS initiative were selected from the operational database of the NGO ASAPSU (Association for Urban Health Self-Promotion Support), which spearheads the implementation and monitoring of this approach in the region [9]. The analysis focused on diverse factors such as project launch dates, the attainment of ODF status, and community monitoring mechanisms. The resulting harmonized data facilitated a thorough pre- and post-intervention comparison, considering local contexts and the duration since the project's initiation.

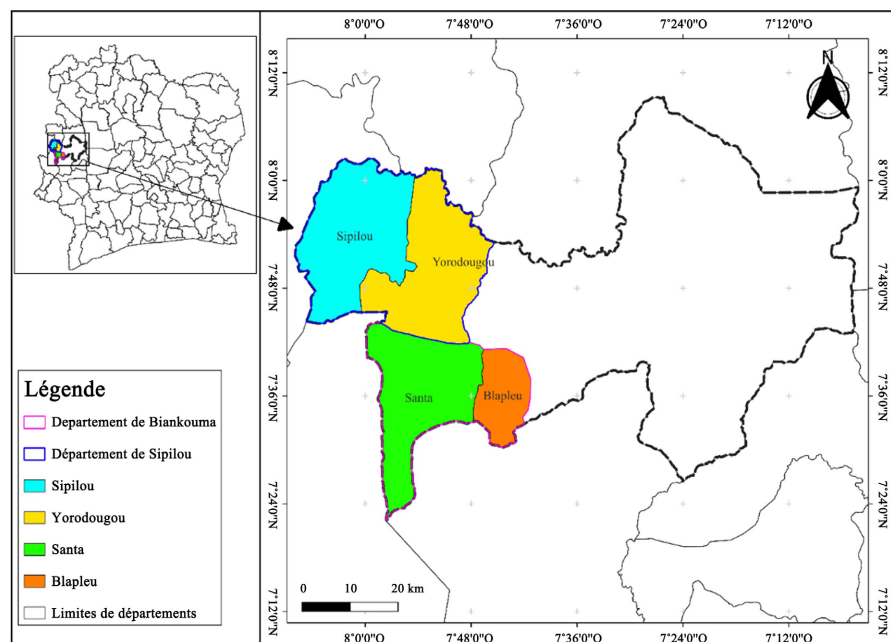


Figure 1. Map showing the study area.

2.2. Establishment of the Baseline

The establishment of a baseline was crucial prior to implementing the Community-Led Total Sanitation (CLTS) initiative. This baseline was formed through comprehensive surveys conducted beforehand, which were subsequently harmonized to ensure that the data gathered aligned with those collected following the intervention. Key indicators examined in this process included the open defecation rate (ODR), latrine coverage, types of sanitation facilities used, hygiene practices within the community, and the overall conditions of sanitation in the area. The ODR was defined as the proportion of households reporting the practice of open defecation within a given locality. A functional latrine was defined as an improved sanitation facility that was structurally safe, accessible, hygienically maintained, and consistently used by all household members for the safe containment

of human excreta.

In accordance with the Community-Led Total Sanitation (CLTS) Implementation Manual for Côte d'Ivoire [9], a locality was certified as ODF when all households had access to at least one functional latrine; all defecation pits were adequately covered to prevent vector transmission; all household members consistently used latrine facilities; each latrine was equipped with a functional handwashing station supplied with water and soap or an appropriate cleansing agent; community members demonstrated adequate knowledge of proper handwashing techniques and could identify at least two critical handwashing occasions; and no evidence of open defecation, including active defecation sites or human feces in the environment, was observed within the community.

ODF certification was based on a multistage verification process comprising community self-assessment, local verification, and independent external validation. Final verification and certification of ODF status were conducted by the Rural Sanitation Directorate under the Ministry of Hydraulics, Sanitation and Public Health (MINHAS), in accordance with national CLTS implementation guidelines. These elements are essential for accurately assessing the impact of the interventions introduced under CLTS. The baseline survey was conducted in February 2020 prior to the implementation of the Community-Led Total Sanitation (CLTS) program, followed by a post-intervention survey in January 2023. The study adopted a census-based approach, whereby all households within the intervention area were enumerated and assigned unique identification codes during the baseline survey. A total of 17,435 households were surveyed across the four study sub-prefectures: Blapleu (3400 households), Santa (6070 households), Sipilou (3413 households), and Yorodougou (4552 households). The same households were revisited during the post-intervention survey, ensuring data consistency and comparability between the two assessment periods. Consequently, the analysis was based on the entire target population rather than on a sampled subset.

2.3. Post-CLTS Data Collection

Data collection within the framework of the Community-Led Total Sanitation (CLTS) initiative employed a multifaceted approach integrating both quantitative and qualitative methods. A structured questionnaire was utilized for households, complemented by focus group discussions and semi-structured interviews involving community leaders, local committees, and administrative authorities. This comprehensive data gathering aimed to assess key aspects such as latrine coverage, management practices for excreta and wastewater, occurrences of open defecation, and community-driven sanitation mechanisms. Additionally, the data collection process included direct observations of available sanitation infrastructure and the general sanitary environment, further enriched by photographic documentation. Under the sub-prefectural CLTS approach, implementation is conducted at the scale of the entire sub-prefecture, whereby all constituent localities are systematically included in the intervention. Accordingly, the present study

covered all localities from the four targeted sub-prefectures: Blapleu (12 localities), Santa (27 localities), Sipilou (19 localities), and Yorodougou (23 localities), representing a total of 81 localities (**Table 1**). Complete records were available for all intervention localities in the ASAPSU database, allowing the analysis to be conducted on the full population of beneficiary localities rather than on a sampled subset. This exhaustive coverage minimized the risk of selection bias and enhanced the representativeness of the findings. Furthermore, ethical standards were upheld throughout the study. Prior to data collection, all participants were informed about the study objectives and procedures, and written informed consent was obtained. Participant confidentiality was ensured through data anonymization, and all information collected was used exclusively for research purposes. Signed informed consent and confidentiality agreements were obtained from all participants before their involvement in household surveys, individual interviews, and focus group discussions.

Table 1. Number of villages and settlements visited by sub prefecture.

Departments	Sub prefecture	Number of localities		Total
		Villages	Settlements	
Biankouma	Blapleu	7	5	12
	Santa	10	17	27
Sipilou	Sipilou	7	12	19
	Yorodougou	8	15	23
Total		32	49	81

2.4. Assessment of the Effects of Implementing the CLTS Approach on Sanitation Practices and the Community Environment

2.4.1. Analysis of the Temporal Dynamics of Access to Open Defecation Free (ODF) Status Following the Launch of the CLTS Approach

The study evaluated the progression of the Open Defecation Free (ODF) status through monthly monitoring of certified communities participating in the Community-Led Total Sanitation initiative from March 2020 to February 2021. Data collection occurred at the community level and was subsequently aggregated by sub prefecture. To determine ODF status, the proportion of certified communities was calculated by dividing the number of certified communities by the total number of monitored communities within each sub prefecture (Equation (1)). This method facilitated a comparative analysis of the Open Defecation Elimination process across sub-prefectures, accommodating variations in sample sizes, thereby providing a comprehensive view of the initiative's impact on community sanitation efforts over the specified period.

$$\text{ODF Status (\%)} = \frac{N_i}{N_{sp}} \times 100 \quad (1)$$

With:

N_i = number of localities achieved Open Defecation Free status for a given month;

N_{sp} = number of localities in the given sub prefecture.

2.4.2. Assessment of Latrine Coverage

The assessment of latrine coverage rates utilized a comparative quantitative method to evaluate changes in household access to individual sanitation facilities across the studied sub-prefectures. Data for this analysis were sourced from post-Community-Led Total Sanitation (CLTS) surveys, along with community registers and insights from local monitoring structures. To determine the latrine coverage rate, the total number of households equipped with at least one functional latrine was divided by the overall number of households documented in each sub-prefecture, as outlined in Equation (2). Additionally, a descriptive map illustrating latrine coverage levels was generated using QGIS software, enabling a visual representation of the territorial disparities identified among the sub-prefectures.

$$\text{Latrine coverage (\%)} = \frac{NL_{sp}}{NH_{sp}} \times 100 \quad (2)$$

With:

NL_{sp} = number of functional latrines in a given sub prefecture;

NH_{sp} = number of households in the sub prefecture.

2.4.3. Assessment of Open Defecation Practices in the Community Setting in the Period Following the CLTS Initiative

The assessment of open defecation practices was conducted post-implementation of Community-Led Total Sanitation (CLTS) according to national guidelines [9]. Surveys were executed at the community level with a standardized protocol, where communities with 200 households or fewer had 25 households surveyed. In larger communities, households were divided into clusters, each containing up to 200 households, from which a sample of 25 was selected per cluster. This methodological approach allowed for an aggregated estimation of the open defecation-free (ODF) status across different clusters.

Data collection methods included household interviews, direct observations of surveyed plots, and general observations of the community environment, aimed at enhancing the reliability of the gathered information. The outcomes of these assessments enabled the estimation of the proportion of communities that reached ODF status following the CLTS initiative. Moreover, the methodology for calculating the open defecation rate (ODR) during the period after the CLTS initiative at the sub-prefecture level was detailed in Equation (3), providing a quantitative analytical framework for evaluating the intervention's effectiveness.

$$\text{ODF Status (\%)} = \frac{NH_{odf}}{TNH_{sp}} \times 100 \quad (3)$$

With:

NH_{odf} = number of households practicing open defecation in the sub-prefecture;

TNH_{sp} = total number of households in the sub prefecture

To evaluate the effectiveness of community-led total sanitation (CLTS), researchers compared the average open defecation rates (ODR) following the implementation of CLTS with baseline values collected prior to the initiative, as indicated in initial surveys. The absolute difference in ODR between these two periods served as a metric for assessing the reduction in open defecation, thereby allowing for an evaluation of behavioral changes attributable to CLTS in various sub prefectures. To analyze the differences in the surveyed variables across the two periods, the chi-square test (χ^2) was employed. A significance threshold was established at $p < 0.05$, facilitating the identification of statistically significant differences. When such differences emerged, the strength of the associations between the variables was quantified using Cramer's V, a statistic derived from the chi-square results. Cramer's V values range from 0 to 1, where higher values signify stronger relationships between the implementation of CLTS and shifts in sanitation behaviors, offering insights into the effectiveness of the initiative in promoting improved sanitation practices.

2.4.4. Evaluation of Wastewater Management Practices in the Post-CLTS Community Setting

Data on household wastewater management practices were gathered through structured questionnaires and direct observations of drainage systems at the household level. Each surveyed household's primary disposal method was categorized into two main operational types: 1) disposal into a pit, labeled as an improved practice, and 2) direct discharge into the environment, deemed a high-risk practice. For each sub prefecture, the proportions of households using each disposal method were calculated by dividing the number of households in each category by the total number of surveyed households (Equation (4)). The analysis focused on changes in sanitary effluent management practices following a community-led total sanitation initiative, comparing post-initiative results to baseline data collected prior to the initiative. The observations indicated a reduction in high-risk discharge practices into the environment, serving as an indicator of improved sanitary effluent management over the assessed periods.

$$\text{Disposal method}(\%) = \frac{\text{NHpe}}{\text{TNHSp}} \times 100 \quad (4)$$

With:

NHpe = number of households adopting a method of disposing of toilet wastewater into a pit or into the environment;

TNHSp = number of households surveyed in the sub prefecture.

2.4.5. Analysis of Community Normative Changes Induced by the CLTS

The implementation of community-led total sanitation (CLTS) involved significant social and institutional changes, which were explored using a qualitative approach reinforced by semi-quantitative indicators. Data was gathered through semi-structured interviews with community leaders, CLTS facilitators, and local committees, alongside field observations and the examination of community doc-

uments. This methodology aimed to uncover the development of collective norms concerning sanitation, the mechanisms of social control, and the dynamics of local governance.

An institutional analysis further elucidated the community structures that emerged within the CLTS framework, focusing on their functions in coordinating, monitoring, and regulating sanitation practices. Additionally, documented solidarity mechanisms highlighted how vulnerable households received support through the mobilization of local resources and the active participation of community groups.

The study also investigated the evolution of community participation and collective initiatives, shedding light on the social cohesion dynamics tied to CLTS. To enhance the robustness of the findings, all collected information underwent source triangulation, thereby reinforcing the validity of the analysis.

2.4.6. Assessment of the Impacts of Community-Led Total Sanitation on the Population

The analysis of the perceived effects of implementing Community-Led Total Sanitation (CLTS) utilized a descriptive qualitative approach, supported by quantitative survey data from communities that achieved Open Defecation Free (ODF) status. This study sought to document community perceptions of changes across environmental, health, social, and socioeconomic dimensions resulting from the adoption of these sanitation practices.

Data collection involved household interviews, focus groups, and consultations with administrative authorities, community leaders, educators, and health professionals. The investigations specifically targeted perceived improvements in the living environment—such as village cleanliness and the reduction of environmental nuisances—as well as the overall well-being of the population.

Additionally, social and psychosocial aspects were examined through qualitative indicators that measured dignity, social recognition, community engagement, and the sense of security afforded by sanitation facilities. The gathered information underwent triangulation to evaluate the reliability of the findings and to ascertain the potential sustainability of the observed effects within the community context.

2.4.7. Data Analysis

The data from questionnaire-based surveys were systematically coded and grouped by variables such as latrine coverage, latrine characteristics, and latrine maintenance. Descriptive analyses were performed to characterize practices before and after the implementation of community-led total sanitation (CLTS). The analysis included calculating absolute and relative frequencies, as well as proportions for each category, as outlined in Equation (5).

$$F(\%) = \frac{X}{Y} \times 100 \quad (5)$$

With:

F = frequency (%);

X = Number of cases in the category under consideration;

Y = Total number of cases in the category under consideration.

The arithmetic mean was employed to estimate the average values for several critical variables, including latrine coverage, latrine characteristics, latrine maintenance, defecation sites, and wastewater management. The calculation was performed using Equation (6) as follow.

$$\bar{X} = \frac{1}{n} \times \sum_{i=1}^n X_i \quad (6)$$

With:

$\bar{X}$ = Mean value of the variable in question;

n = Total number of households surveyed;

x_i = Variable in question.

Next, the distributions observed before and after the Community-Led Total Sanitation initiative were compared to assess the changes associated with the implementation of the approach. Differences between the categories of the variables studied were analyzed using the chi-square test (χ^2). The threshold for statistical significance was set at $p < 0.05$. When significant differences were observed, the strength of the association between the survey period and sanitation practices was estimated using Cramer's V , derived from the chi-square statistic. The V values, ranging from 0 to 1, allowed for an assessment of the strength of the observed associations, with higher values indicating a stronger association between the implementation of community-led total sanitation and changes in sanitation practices. The interpretation thresholds used are: $V < 0.10$ (weak), $0.10 \leq V < 0.30$ (weak to moderate), $0.30 \leq V < 0.50$ (moderate), and $V \geq 0.50$ (strong). Statistical analyses were performed using the R software.

3. Result

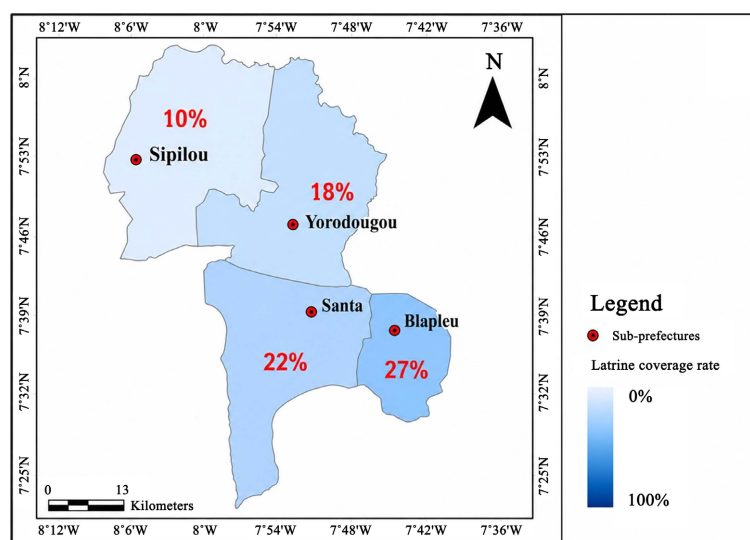
3.1. Changes in Latrine Coverage Rates in Localities

Figure 2 and **Table 2** illustrate the spatial changes in household latrine coverage before and after the implementation of community-led total sanitation in the studied sub prefectures. Prior to the initiative, latrine coverage varied significantly, with rates from 10% to 27%, leading to an overall coverage estimated at 19.4% of households. Notably, Blapleu had the highest coverage rate at 27%, followed by Santa at 22%. Conversely, Sipilou and Yorodougou had the lowest latrine coverage, at 10% and 18%, respectively.

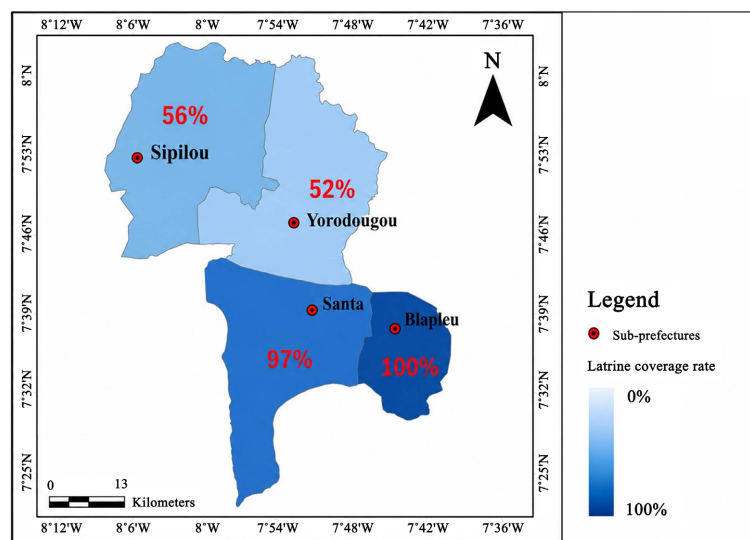
Following the implementation of community-led total sanitation, there was a marked improvement in functional latrine coverage across the sub prefectures. Blapleu achieved 100% coverage, while Santa reached 97%. Sipilou and Yorodougou saw lower but notable increases, arriving at 56% and 52% respectively. The increases in coverage were substantial, ranging from 34 to 75 percentage points across the regions, with the most significant gains observed in Santa (+75 points) and Blapleu (+73 points).

Table 2. Statistics on the household latrine coverage rate in the localities of the study area before and after the implementation of community-led total sanitation (CLTS).

Localities	Before-CTLS			After-CTLS	
	Number of households	Households with latrines	Rate (%)	Households with latrines	Rate (%)
Blapleu	3400	916	27	3400	100
Santa	6070	1335	22	5899	97
Sipilou	3413	328	10	1909	56
Yorodougou	4552	802	18	2367	52
Total	17,435	3381	19	13,575	78



(a)



(b)

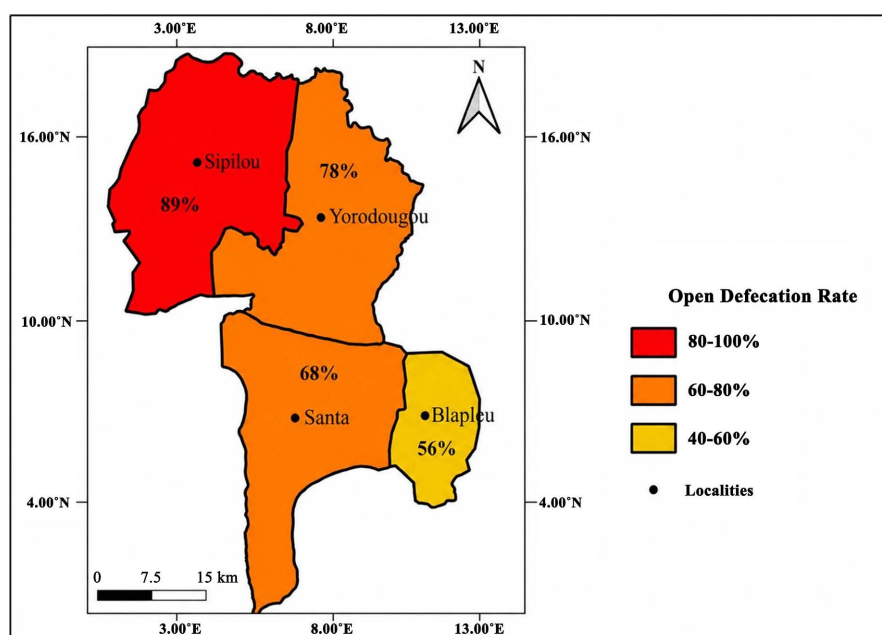
Figure 2. Spatial distribution of latrine coverage across the sub prefectures of Blapleu, Santa, Sipilou, and Yorodougou. (a) = state of latrine coverage prior to the implementation of the community-led total sanitation (CLTS) initiative, (b) = situation following the introduction of the CLTS approach.

Statistical analyses corroborated these findings, demonstrating a significant overall increase in latrine coverage post-intervention across all sub prefectures (χ^2 ; $p < 0.05$). Additionally, Cramer's coefficients assessed the strength of the relationship between the intervention and latrine coverage, revealing a strong association in Santa ($V = 0.74$) and Blapleu ($V = 0.71$), a moderate association in Sipilou ($V = 0.50$), and a weaker association in Yorodougou ($V = 0.35$).

3.2. Status of Defecation Practices in the Communities

Figure 3 illustrates the trend in open defecation rates in various sub prefectures before and after the introduction of community-led total sanitation (CLTS). Prior to the intervention, the rates of open defecation were alarmingly high, averaging 56% in Blapleu, 68% in Santa, 78% in Yorodougou, and 89% in Sipilou. Following the implementation of CLTS, there was a significant decrease in open defecation rates across all studied locales. Specifically, Blapleu experienced a complete cessation of open defecation, with recorded post-intervention rates of 3% in Santa and 44% in both Sipilou and Yorodougou.

At a more granular level, open defecation rates post-intervention showed a range from 0% to 48% in Santa, 0% to 49% in Sipilou, and 0% to 43% in Yorodougou. The absolute reductions in average rates were remarkable, showing declines of 56 percentage points in Blapleu, 65 points in Santa, 45 points in Sipilou, and 34 points in Yorodougou. Statistical analyses confirmed a significant reduction in open defecation following the CLTS implementation (χ^2 ; $p < 0.05$). Furthermore, Cramer's V statistics illustrated a very strong association between the time period of the intervention and open defecation practices in Blapleu ($V = 0.808$), a strong association in Santa ($V = 0.734$) and Sipilou ($V = 0.503$), and a moderate association in Yorodougou ($V = 0.333$).



(a)

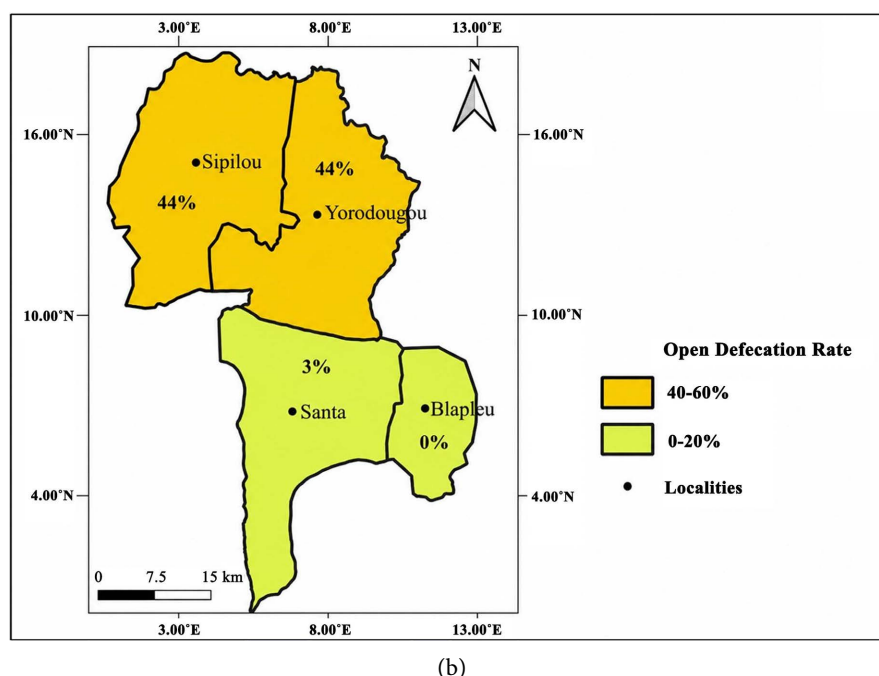


Figure 3. Mapping of open defecation practices (ODP) in the sub prefectures of Blapleu, Santa, Sipilou, and Yorodougou; (a) = ODP prior to the implementation of community-led total sanitation (CLTS); (b) = ODP following the implementation of CLTS.

3.3. Timeline of Achieving Open Defecation Free (ODF) Status Following the Launch of the CLTS

The timeline for achieving Open Defecation Free (ODF) status across the sub prefectures of Blapleu, Santa, Sipilou, and Yorodougou post-launch of Community-Led Total Sanitation (CLTS) is depicted in **Figure 4**. Initially, during the first six months, no sub préfecture obtained ODF certification. The first certifications emerged in October 2020, with certification rates varying: Sipilou had 5%, while Blapleu and Yorodougou reported 17%. Progress was observed as the number of certified localities gradually rose across all areas, albeit at different rates of achievement. By February 2021, Blapleu achieved 50% certification, Santa 48%, Sipilou 32%, and Yorodougou 22%. By the end of the monitoring period, Blapleu reached 100% ODF status, followed by Santa at 78%, Yorodougou at 74%, and Sipilou at 47% (**Table 3**).

3.4. Wastewater Management Practices Observed Following the CLTS Initiative

Table 4 outlines the changes in sanitary effluent disposal practices following the implementation of the Community-Led Total Sanitation (CLTS) program. Initially, the predominant practice across sub prefectures was the direct discharge of effluent into streets or the environment, with discharge rates reported at 70% in Blapleu, 75% in Santa, 80% in Sipilou, and 78% in Yorodougou. Post-intervention, effluent disposal in pits became the leading method in all sub prefectures, achieving disposal rates of 93.62% in Blapleu, 84.26% in Santa, 81.24% in Yorodougou,

and 77.21% in Sipilou. The transition from direct discharge into the environment decreased by 57 to 47.31 percentage points, depending on the region.

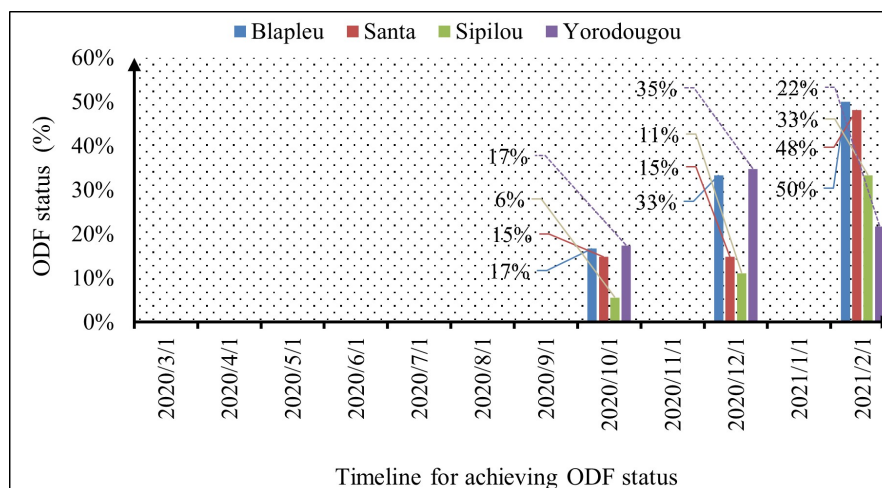


Figure 4. Overall temporal trends in Open Defecation Free (ODF) status in the sub prefectures of Blapleu, Santa, Sipilou, and Yorodougou following the launch of Community-Led Total Sanitation.

Table 3. Summary of trends in the acquisition of Open Defecation Free (ODF) status in villages and settlements in the sub prefectures of Blapleu, Santa, Sipilou, and Yorodougou.

	Blapleu		Santa		Sipilou		Yorodougou	
	ODF Locality	Rate (%)	ODF Locality	Rate (%)	ODF Locality	Rate (%)	ODF Locality	Rate (%)
Oct-20	2	17	4	15	1	5	4	17
Dec-20	4	33	4	15	2	11	8	35
Feb 2021	6	50	13	48	6	32	5	22
Total	12	100	21	78	9	47	17	74
Location by sub prefecture	12	-	27	-	19	-	23	-

Statistical analyses confirmed a significant uptick in the use of pit latrines for excreta disposal across all sub prefectures after the CLTS program was introduced (χ^2 ; $p < 0.05$). Moreover, Cramer's V statistics indicated varying strength of associations between localities, with the most pronounced relationships noted in Blapleu ($V = 0.611$) and Sipilou ($V = 0.576$). Moderate associations were observed in Santa ($V = 0.476$) and Yorodougou ($V = 0.388$), highlighting differing impacts of the intervention across various areas.

3.5. Normative Changes Brought about by Community-Led Total Sanitation (CLTS) in Communities

The implementation of Community-Led Total Sanitation (CLTS) in the sub-prefectures of Blapleu, Santa, Yorodougou, and Sipilou has led to the development of

community-based mechanisms to regulate sanitation and hygiene practices. Field surveys have documented significant progress, including collective commitments to eliminate open defecation (**Figure 5**), with some localities demonstrating this through public community declarations and written commitments to administrative authorities.

Table 4. Proportion of households by sanitary effluent disposal method in the sub prefectures of Blapleu, Santa, Sipilou, and Yorodougou; A = disposal rate before CLTS; B = disposal rate after CLTS.

Sub prefecture	Before CLTS initiative		After CLTS initiative	
	Discharge rate into a pit (%)	Discharge rate into the environment (%)	Discharge rate into a pit (%)	Discharge rate into the environment (%)
Blapleu	30	70	93.62	6.38
Santa	25	75	84.26	15.74
Sipilou	20	80	77.21	22.79
Yorodougou	22	78	69.31	30.69

Furthermore, the establishment of local sanitation monitoring systems has been noted, encompassing village CLTS committees, community boards, and sub-prefectural monitoring mechanisms. These entities are primarily tasked with overseeing latrine construction, coordinating village sanitation initiatives, and managing previously used open defecation sites. Notably, in Yorodougou, community brigades play a crucial role in the ongoing monitoring of areas that were historically associated with open defecation.

In various localities, surveys uncovered community regulations against open defecation, often complemented by local enforcement strategies and financial penalties for those who fail to comply. Certain communities mandated that each household possess a latrine to be permitted permanent settlement within the village. Additionally, the findings underscored the presence of community solidarity schemes that aid vulnerable households in accessing sanitation facilities. These initiatives primarily depended on local financial contributions, community labor efforts, and the active participation of women's groups in promoting hygiene awareness and managing children's excreta.

Further, several localities showcased the emergence of collective efforts pertaining to sanitation, education, and community infrastructure development. Initiatives included the construction of latrines for schools, housing provisions for teachers, and the restoration of specific public infrastructure. In Guegouin (Blapleu), surveys highlighted the community's mobilization of resources for road construction and the refurbishment of educational facilities. These activities reflect a comprehensive approach to improving community health and infrastructure through collective effort and resource sharing.

Interviews conducted in various localities revealed a collaborative dynamic between host and migrant communities in participating in collective activities and local community management structures. Nevertheless, the degree of involvement from both groups varied significantly across the different studied areas, indicating localized differences in community engagement and integration efforts.



Figure 5. Sign created by the village of Yepleu highlighting the importance of Open Defecation Free (ODF) status for the village's development, shortly after the initiative was launched.

3.6. Impacts of Community-Led Total Sanitation (CLTS) on the Population

Surveys conducted in areas achieving Open Defecation Free (ODF) status indicate a largely positive view of Community-Led Total Sanitation (CLTS) among the surveyed households. About 95% of respondents expressed satisfaction with the initiative, citing improvements in sanitation and the overall village environment. Key effects noted include enhanced village sanitation, reduced odors linked to excreta, fewer flies, and a decreased presence of mosquito breeding sites.

Households reported a decline in open defecation practices and increased utilization of latrines. Furthermore, respondents observed a reduction in illness frequency within their households, correlating this to decreased health care expenses and an overall enhancement in family living conditions. It is important to note that these findings stem from self-reported perceptions rather than quantified health data.

Several respondents emphasized the association between owning a functional latrine and an enhanced sense of dignity and social recognition within the community. Women and children highlighted a heightened sense of security, stemming from the reduced necessity of venturing into the bush for defecation. Additionally, in certain areas, households linked the achievement of “clean village” status with an elevated image of their village, as well as increased engagement in community sanitation initiatives. However, perceptions regarding these benefits

varied in intensity and nature, depending on the specific locality and the demographic categories of the respondents interviewed.

4. Discussion

The study's findings indicate a marked enhancement in sanitation practices due to the implementation of community-led total sanitation (CLTS) in the examined sub prefectures, although results vary according to local contexts. The journey toward achieving open defecation-free (ODF) status illustrates the gradual changes resulting from this initiative. Initially, no localities attained certification shortly after the program's launch, underscoring the time necessary for communities to take ownership of the sanitation standards, build infrastructure, and sustainably adopt the promoted behaviors. This aligns with the core principles of CLTS, which emphasize a gradual transformation of both individual and collective behaviors, rooted in community awareness, household empowerment, and the development of new social norms, rather than necessitating immediate improvements in sanitation practices [12].

The temporal variations in sanitation practices are closely linked to the socio-economic characteristics of the Biankouma and Sipilou departments, which primarily depend on cash crops like cocoa and coffee [18]. During intense agricultural periods, the mobilization of family labor and financial resources tends to hinder latrine construction and reduce participation in community sanitation efforts. In contrast, periods associated with the harvesting and marketing of these crops generally lead to increased household incomes, fostering investment in sanitation infrastructure. This economic dynamic helps elucidate the varied rates of achieving open defecation-free (ODF) status across the studied sub prefectures. Notably, Blapleu and Santa exhibited better sanitation outcomes than Sipilou and Yorodougou, indicating that local economic capacity significantly influences the adoption of sanitation facilities and the effectiveness of community-led total sanitation (CLTS) initiatives, consistent with findings from Swiss TPH [19].

The implementation of community-led total sanitation has significantly increased latrine coverage and reduced open defecation (ODF) in rural areas, affirming its effectiveness in fostering improved sanitation practices. This study corroborates findings from researchers like Pickering *et al.* [13], Hoteyi *et al.* [20], and Odagiri *et al.* [14], who noted that such community-led initiatives facilitate latrine adoption through collective mobilization, social pressure, and changing community norms. The pronounced increases in latrine coverage and reductions in ODF across various sub-prefectures reflect the ability of this approach to inspire substantial behavioral changes on a large scale. Nonetheless, some localities continue to show residual open defecation levels, underscoring the approach's limitations in environments marked by economic constraints, challenging geographic accessibility, or households lacking the capacity for sustainable infrastructure investments. Similar findings have been reported by Venkataramanan *et al.* [21], Osman [22], and Abubakari *et al.* [23], emphasizing that achieving an open defe-

cation-free status does not guarantee the complete eradication of open defecation practices.

The results indicate a significant correlation between the implementation of the sub-prefectural approach and observed outcomes. The active involvement of all villages and settlements within a sub-prefecture, along with the participation of local administrative authorities, has notably enhanced community mobilization and sustained efforts following the attainment of Open Defecation Free (ODF) status. A competitive dynamic among localities striving for ODF status has fostered social comparison mechanisms, which likely expedite the adoption of the promoted sanitation practices. These findings support earlier research by Lawrence *et al.* [24], Cavill *et al.* [25], and Crocker *et al.* [26], underscoring the critical roles of local monitoring, institutional commitment, and community ownership in maintaining the successes of community-led total sanitation initiatives. Furthermore, the involvement of administrative authorities in monitoring serves as a strategic lever to strengthen the effectiveness of sanitation interventions in rural contexts.

The study emphasizes significant improvements in excreta and wastewater management resulting from the implementation of community-led total sanitation initiatives. It notes a decline in direct wastewater discharges into the environment, indicating a gradual transformation in household sanitation behaviors. This change reflects increased awareness of the environmental risks associated with poor sanitation practices. Such improvements could potentially diminish transmission routes for fecal pathogens, thereby reducing the risks of waterborne and fecal-oral diseases, as cited by the WHO [27] and Prüss-Ustün *et al.* [28]. However, the study also highlights disparities among subprefectures, suggesting that the long-term sustainability of these sanitation practices is heavily dependent on the availability of appropriate infrastructure and the economic and technical resources of households.

The findings of the study extend beyond mere sanitation practices, indicating notable social and organizational changes within the communities under investigation. Notably, the development of community rules, the establishment of local monitoring frameworks, and the implementation of solidarity measures for at-risk households illustrate how community-led total sanitation initiatives can enhance local governance and foster collective action [29]. Furthermore, the significant participation of women in activities aimed at raising awareness, monitoring, and promoting hygiene is highlighted as a key element in the successful adoption and sustainability of effective sanitation practices. This observation aligns with the works of Caruso *et al.* [30] and Tribbe *et al.* [31], reinforcing the crucial role that female engagement plays in sanitation efforts.

Based on the surveyed households, community-led total sanitation is closely linked to enhancements in village hygiene and the perceived benefits of reduced disease rates, as well as increased feelings of dignity, security, and community belonging. These observations, while primarily rooted in personal perceptions ra-

ther than objective health metrics, reflect a strong social acceptance of the community-led sanitation initiative. The findings indicate that the long-term success of efforts to eliminate open defecation is influenced by several interrelated factors, including household economic conditions, local governance structures, community engagement, and effective institutional oversight of sanitation measures. This aligns with existing research that emphasizes the importance of fostering social norms through community involvement to ensure the sustainability and ownership of sanitation practices [21] [32].

5. Conclusions

This study evaluated the effects of Community-Led Total Sanitation (CLTS) implemented via a sub-prefectural model in the regions of Biankouma and Sipilou, located in western Côte d'Ivoire. The findings highlight a marked enhancement in sanitation conditions throughout all assessed sub-prefectures. Specifically, latrine coverage surged from 19% to 78% within the study area. Concurrently, the rates of open defecation diminished significantly, dropping between 34 to 65 percentage points depending on the specific sub-prefecture. This positive trend was further supported by advancements in wastewater management practices and the attainment of open defecation-free (ODF) status in a notable number of the impacted localities.

Beyond the reported outcomes, the study emphasizes the crucial role of local governance structures in ensuring the effectiveness and long-term viability of sanitation initiatives. Key elements include the active participation of local administrative bodies, the creation of community monitoring frameworks, and the implementation of shared regulations concerning sanitation. Furthermore, the development of solidarity mechanisms within communities has been instrumental in enhancing local engagement and ownership of these initiatives. This indicates that the observed advancements extend beyond mere latrine construction; they hinge significantly on the communities' capacity to foster enduring changes in behaviors and social norms associated with sanitation practices.

The results indicate that the sustainability of open defecation status is significantly influenced by both the enhancement of local governance mechanisms and the improvement of access to sanitation infrastructure. In this framework, the sub-prefectural approach is identified as a potent tool for facilitating behavioral change, bolstering post-certification monitoring, and solidifying the advancements made through Community-Led Total Sanitation initiatives. By engaging communities and administrative authorities towards a unified objective, this approach cultivates a collective dynamic that enhances the sustainability of the outcomes achieved.

However, the differences observed among sub prefectures serve as a reminder that the performance of Community-Led Total Sanitation remains influenced by local socioeconomic conditions, the accessibility of the areas, and households' investment capacity. Furthermore, the health benefits cited by local residents are

based primarily on perceptions and should be confirmed by health and environmental data collected over the long term.

Further research should focus on the long-term sustainability of gains achieved after a community is certified for open defecation elimination. This research must delve deeper into the interactions between local governance, community cohesion, and the ongoing maintenance of effective sanitation practices. The study underlines that the permanent elimination of open defecation relies not only on infrastructural availability but also on the capabilities of local institutions and communities to uphold collective hygiene and sanitation standards over time. In this context, the sub-prefectural approach emerges as a promising strategy for sustainably enhancing sanitation trajectories in rural sub-Saharan Africa.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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