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Sanitation Evolution and Waste Management Dynamics: A Comprehensive Study of Varanasi City's Infrastructure and Disposal Systems

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Abstract:

The data presented here offers a comprehensive insight into the sanitation infrastructure, waste disposal practices, and waste water disposal assessments conducted across various wards in Varanasi city. This detailed analysis encompasses multiple facets of sanitation, aiming to assess the city's overall cleanliness, infrastructure development, and waste management systems. The provided data chronicles the evolution and proliferation of diverse toilet facilities, including Community Toilets, Public Toilets, Urinal Toilets, Transgender Toilets, Pink Toilets, and combined Community & Public Toilets from 2000-01 to 2020-21. This expansion marks significant progress in sanitation infrastructure, addressing various community needs and promoting hygiene standards citywide. Further more, the data presents a breakdown of toilet usage patterns across different cleanliness wards, detailing the utilization of individual, public, and partnership toilets, along with instances of open defecation and non-responses among respondents. This analysis offers insights into the distribution and usage patterns of different toilet facilities in these areas. Additionally, the study delves into waste disposal and domestic water disposal systems across various wards, revealing prevalent practices such as open waste disposal methods, access to sewerage systems, the absence of specific waste disposal facilities, and non-responses among participants. This examination sheds light on the diverse waste management practices existing across different areas. Moreover, the assessment of waste water disposal conditions, as rated by respondents across different wards, provides crucial insights into the perceived quality of waste water disposal systems. This evaluation identifies areas requiring potential upgrades or interventions to enhance waste water management in various parts of the city.

Keywords: Toilets, Waste Management, Water Disposal, Community Toilets, Public Toilets

Introduction

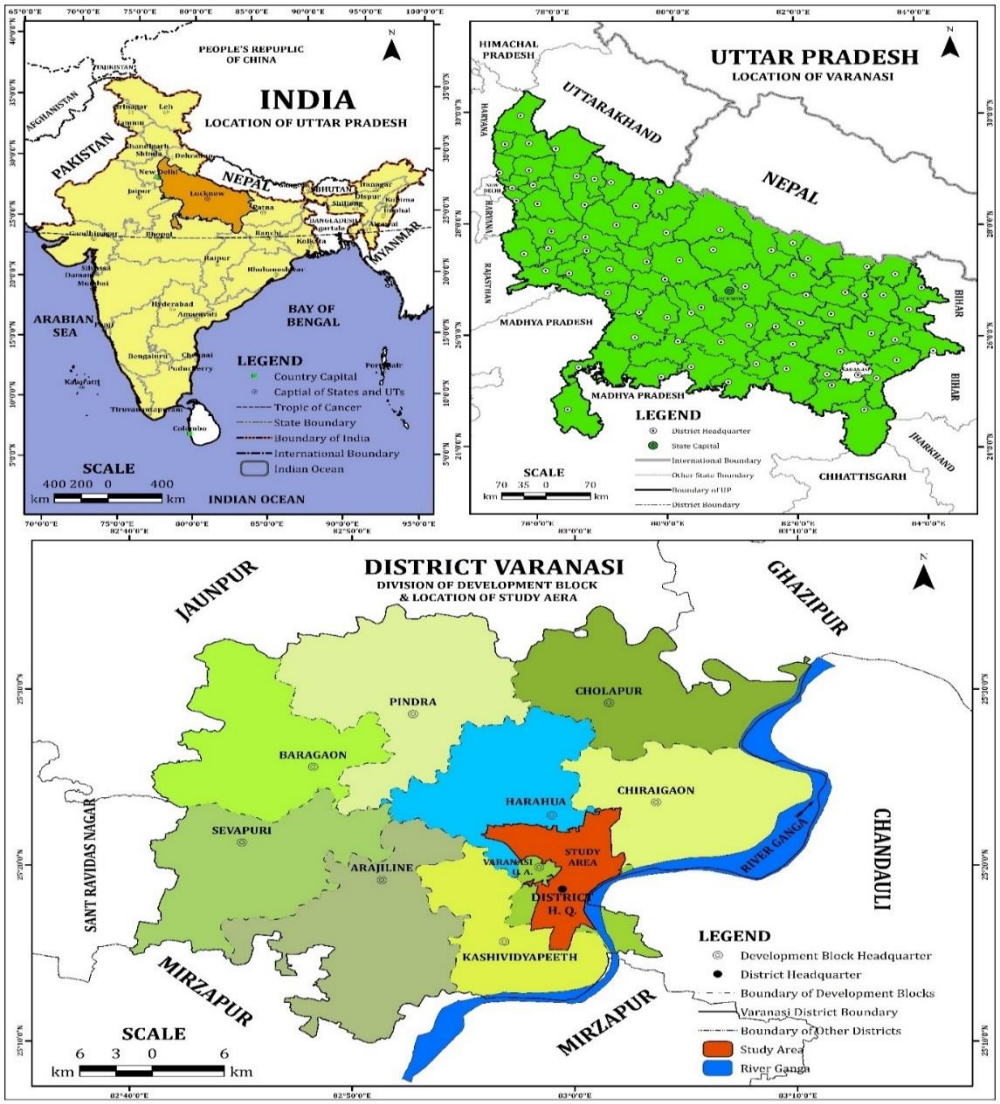
The data provided showcases a comprehensive overview of the sanitation infrastructure and waste disposal systems in Varanasi city, spanning various aspects such as toilet facilities, waste disposal methods, and waste water disposal status across different wards and years from 2000 to 2021. Starting with the evolution of toilet facilities, the statistics highlight a significant expansion in different types of toilets, including community toilets, public toilets, urinal toilets, transgender-specific facilities, pink toilets for women, and combined community and public facilities. These improvements indicate a progressive effort in catering to diverse sanitation needs, ensuring better access to sanitary facilities for the city's residents, and addressing specific requirements, such as transgender-friendly and women-centric amenities. Additionally, the data delves into waste disposal systems and domestic water disposal status across multiple wards within Varanasi. It delineates the distribution of respondents using various waste disposal methods like open waste disposal, sewerage systems, or those lacking specific waste disposal facilities. This analysis provides insights into the prevalence of different waste disposal practices and the availability of infrastructure for managing domestic water disposal in different areas of the city. Moreover, the study explores waste water disposal status across cleanliness wards, presenting respondents' perceptions of waste water disposal quality as Excellent, Good, Average, or Poor. This assessment offers a comprehensive view of how residents in different areas perceive the efficiency and quality of waste water disposal systems available to them. In summary, the data reflects a comprehensive examination of sanitation infrastructure, waste disposal practices, and waste water management in Varanasi, portraying a progressive trend towards enhancing sanitation facilities and addressing diverse community needs over the years.

Site and Situation

Varanasi city occupies an area of 174.20 sq. km with seven urban sub-units, and it is stretched between $25^0$14' North to $25^0$23”5' North latitude and $82^0$56' East to $83^0$3′ East longitude.

Administratively, Varanasi city has been divided into five zones- Varunapar zone, Adampur zone, Kotwali zone, Dashashwamegh zone and Bhelupur zone. All these zones constitute 90 wards collectively with a population of 12, 01,198. The wards have been further grouped into 16 sanitary sub-zones for the convenience of the services.

Map No.1



Methodology

The provided data reveals a comprehensive overview of sanitation infrastructure, waste disposal practices, and waste water disposal assessments across various wards in Varanasi city.

- **Toilet Facilities:** The data illustrates a significant increase in different types of toilets from 2000-01 to 2020-21, such as community, public, urinal, transgender, pink, and combined community & public toilets. This marks a positive progression and enhanced sanitation infrastructure catering to diverse community needs.
- **Toilet Usage Across Cleanliness Wards:** The data presents a breakdown of toilet usage patterns across different wards, indicating the utilization of individual, public, and partnership toilets, along with instances of open defecation and non-responses among respondents. This analysis showcases the distribution of toilet facilities in these areas.
- **Waste Disposal and Domestic Water Disposal Systems:** The study details the waste disposal practices and domestic water disposal systems across various wards. It highlights the prevalence of open waste disposal methods, access to sewerage systems, lack of specific waste disposal facilities, and non-responses among respondents. This sheds light on waste management practices in different areas.
- **Waste Water Disposal Assessment:** The assessment of waste water disposal conditions in different wards is conducted through respondents' ratings of waste water disposal as excellent, good, average, or poor. It offers

insights into the perceived quality of waste water disposal among residents in various areas.

Objectives

Improving Toilet Facilities: Tracking the growth of various toilets aims to enhance sanitation infrastructure and meet specific community needs, ensuring better hygiene standards citywide.

Understanding Toilet Usage: Analyzing toilet usage patterns in different wards helps allocate resources effectively to areas with unique sanitation requirements.

Assessing Waste Disposal Practices: Examining waste disposal methods aims to identify deficiencies and strategize improvements for better waste management across wards.

Evaluating Waste Water Disposal Quality: Gathering opinions on waste water disposal quality helps identify areas needing upgrades or interventions for improved waste water management.

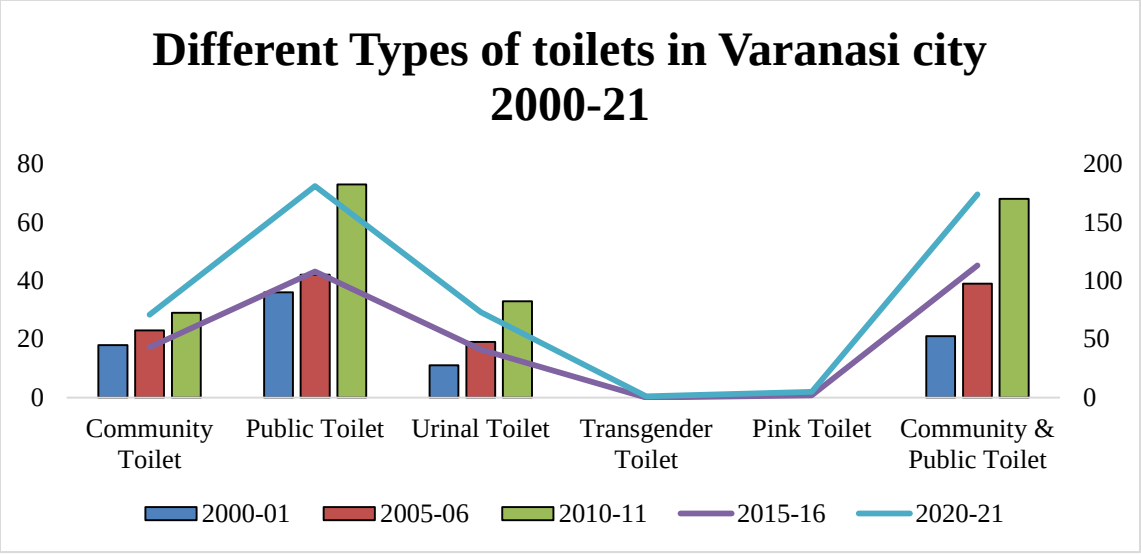
Guiding Sanitation Infrastructure Development: Comprehensive data aids city planners, policymakers, and sanitation authorities in formulating targeted interventions and strategies to enhance sanitation, waste management, and waste water disposal systems in Varanasi.

Types of toilets present in Varanasi city

The data illustrates the different types of toilets present in Varanasi city across various years from 2000 to 2021. In Varanasi, the various types of toilets include Community Toilets, Public Toilets, Urinal Toilets, Transgender Toilets, Pink Toilets, and a combination of Community and Public Toilets. Community Toilets: In 2000-01, there were 18 community toilets, which increased to 71 by 2020-21. Public Toilets: The count of public toilets rose from 36 in 2000-01 to 181 in 2020-21, reflecting a substantial increase. Urinal Toilets: There were 11 urinal toilets in 2000-01, which escalated to 73 by 2020-21. Transgender Toilets: This category, specifically for transgender individuals, started with none in 2000-01 but reached 1 by 2020-21. Pink Toilets: These specialized toilets for women showed growth, starting at 0 in 2000-01, and reaching 5 by 2020-21. Community & Public Toilets: These combined facilities numbered 21 in 2000-01, rising to 174 by 2020-21, showing a significant expansion over the years. The data signifies a progressive increase in the provision of various types of toilets in Varanasi city, catering to different community needs and specialized facilities, marking substantial growth and improvement in sanitation infrastructure over the years.

Different Types of toilets in Varanasi city 2000-21

Type of Toilet	2000-01	2005-06	2010-11	2015-16	2020-21
Community Toilet	18	23	29	43	71
Public Toilet	36	42	73	108	181
Urinal Toilet	11	19	33	41	73
Transgender Toilet	0	0	0	0	1
Pink Toilet	0	0	0	2	5
Community & Public Toilet	21	39	68	113	174



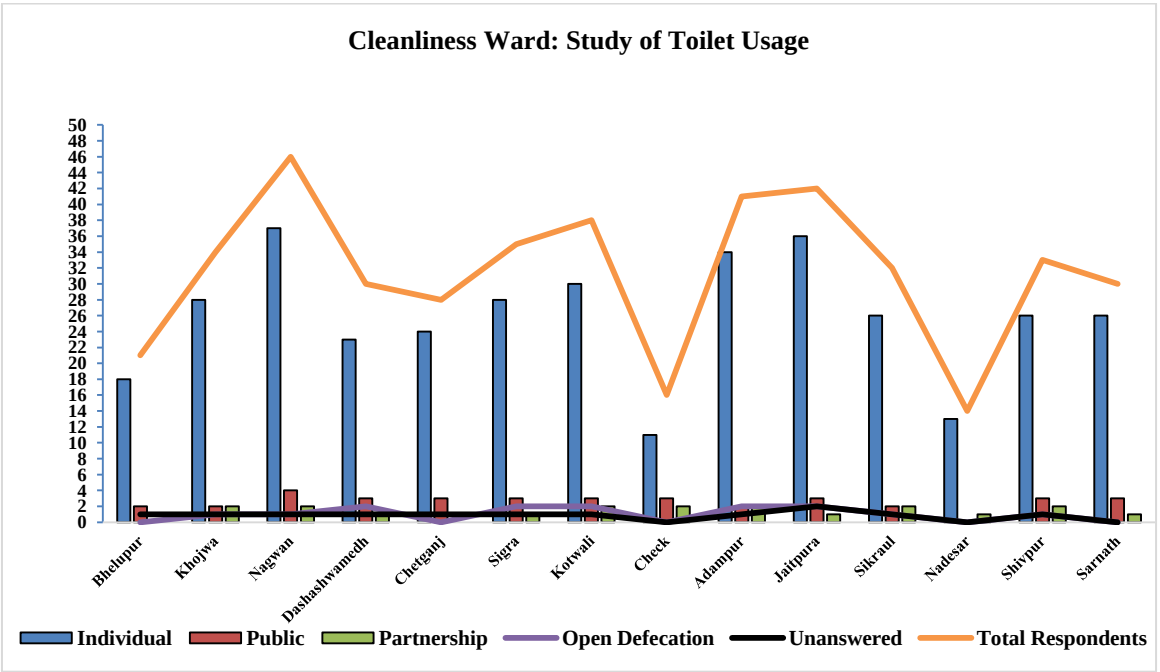
Toilet Facilities

The provided data presents the usage of different toilet facilities across various cleanliness wards. Let's discuss it more fluently. The table outlines the utilization of various types of toilet facilities in different cleanliness wards. Each row

represents a specific ward, and the columns signify different categories related to toilet usage, such as individual toilets, public toilets, partnership toilets, instances of open defecation, and the number of respondents who did not provide a response. Bhelupur: Recorded 18 individuals using private toilets, 2 using public facilities, none in partnership toilets, no instances of open defecation, and 1 unanswered response, totaling 21 respondents. Khojwa, Nagwan, Dashashwamedh, Chetganj, Sigra, Kotwali, Check, Adampur, Jaitpura, Sikraul, Nadesar, Shivpur, Sarnath: Similar categories of toilet usage were recorded in each ward, with varying numbers of respondents in each category.

Total Respondents: The total number of respondents across all wards in each category was 360 for individual toilets, 36 for public toilets, 19 for partnership toilets, 11 for open defecation instances, and 14 unanswered responses, totaling 440 respondents overall. This data provides insights into the usage of different toilet facilities within various cleanliness wards, highlighting the distribution of toilet usage patterns and responses across these areas.

Cleanliness Ward: Study of Toilet Usage						
Cleanliness Ward	**Individual**	**Public**	**Partnership**	**Open Defecation**	**Unanswered**	**Total Respondents**
Bhelupur	18	2	0	0	1	21
Khojwa	28	2	2	1	1	34
Nagwan	37	4	2	1	1	46
Dashashwamedh	23	3	1	2	1	30
Chetganj	24	3	0	0	1	28
Sigra	28	3	1	2	1	35
Kotwali	30	3	2	2	1	38
Check	11	3	2	0	0	16
Adampur	34	2	2	2	1	41
Jaitpura	36	3	1	2	2	42
Sikraul	26	2	2	1	1	32
Nadesar	13	0	1	0	0	14
Shivpur	26	3	2	1	1	33
Sarnath	26	3	1	0	0	30
-	360	36	19	11	14	440



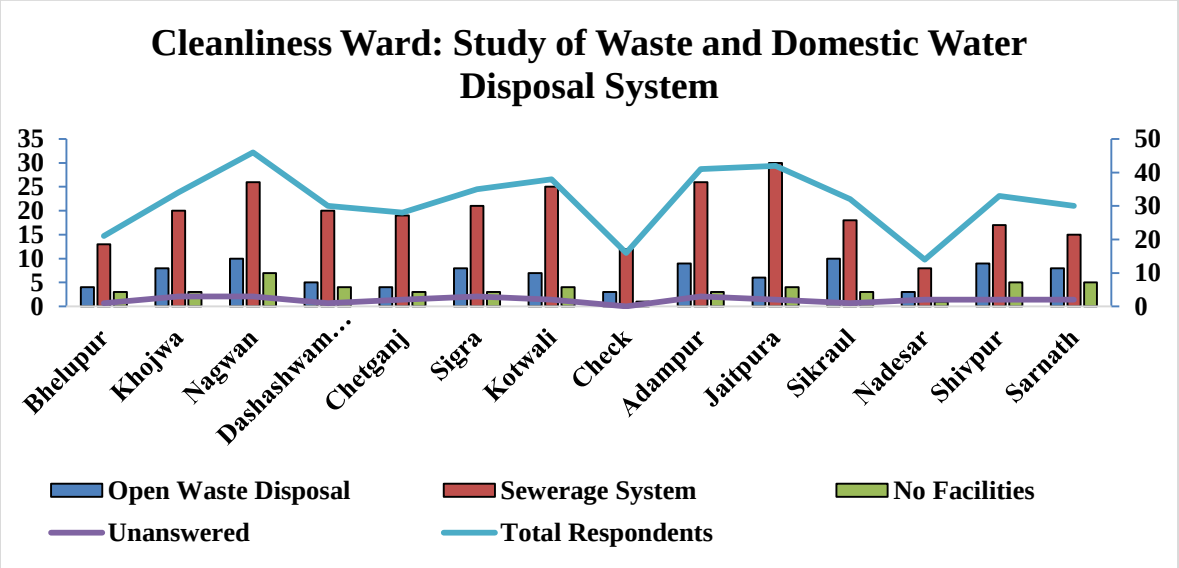
Waste disposal and domestic water disposal

The table presents a study on waste disposal and domestic water disposal systems across different wards, detailing the number of respondents falling into various categories within each ward. In Bhelupur, there were 21 respondents in total. Out of these, 4 people reported using an open waste disposal system, 13 had access to a sewerage system, 3 had no specific facilities for waste disposal, and 1 respondent did not provide an answer. Khojwa with a total of 34 respondents, 8 used open waste disposal methods, 20 had access to a sewerage system, 3 lacked specific waste disposal facilities, and 3 did not respond. Nagwan had the

highest number of respondents at 46. Among them, 10 used open waste disposal methods, 26 had access to a sewerage system, 7 had no facilities for waste disposal, and 3 did not answer. Dashashwamedh had 30 respondents, with 5 using open waste disposal, 20 using a sewerage system, 4 having no facilities, and 1 not responding. Chetganj, with 28 respondents, had 4 using open waste disposal, 19 using a sewerage system, 3 having no facilities, and 2 not providing an answer.

Sigra, with 35 respondents, had 8 using open waste disposal, 21 using a sewerage system, 3 having no facilities, and 3 not responding. In Kotwali, out of 38 respondents, 7 used open waste disposal, 25 used a sewerage system, 4 had no facilities, and 2 did not provide an answer.

Cleanliness Ward: Study of Waste and Domestic Water Disposal System					
Cleanliness Ward	**Open Waste Disposal**	**Sewerage System**	**No Facilities**	**Unanswered**	**Total Respondents**
Bhelupur	4	13	3	1	21
Khojwa	8	20	3	3	34
Nagwan	10	26	7	3	46
Dashashwamedh	5	20	4	1	30
Chetganj	4	19	3	2	28
Sigra	8	21	3	3	35
Kotwali	7	25	4	2	38
Check	3	12	1	0	16
Adampur	9	26	3	3	41
Jaitpura	6	30	4	2	42
Sikraul	10	18	3	1	32
Nadesar	3	8	1	2	14
Shivpur	9	17	5	2	33
Sarnath	8	15	5	2	30
-	94	270	49	27	440



Open Waste Disposal

Check had 16 respondents, out of which 3 used open waste disposal, 12 used a sewerage system, 1 had no facilities, and none failed to respond. Adampur, with 41 respondents, had 9 using open waste disposal, 26 using a sewerage system, 3 having no facilities, and 3 not responding. Jaitpura had 42 respondents, with 6 using open waste disposal, 30 using a sewerage system, 4 having no facilities, and 2 not responding. Sikraul, with 32 respondents, had 10 using open waste disposal, 18 using a sewerage system, 3 having no facilities, and 1 not providing an answer. Nadesar, with 14 respondents, had 3 using open waste disposal, 8 using a sewerage system, 1 having no facilities, and 2 not responding. Shivpur, with 33 respondents, had 9 using open waste disposal, 17 using a sewerage system, 5 having no facilities, and 2 not providing an answer. Sarnath had 30 respondents, with 8 using open waste disposal, 15 using a sewerage system, 5 having no facilities, and 2 not responding. In summary, across all wards surveyed, there were 94 respondents using open waste disposal, 270 using a sewerage system, 49 having no facilities, and 27 who did not respond to the survey, making a total of 440 respondents.

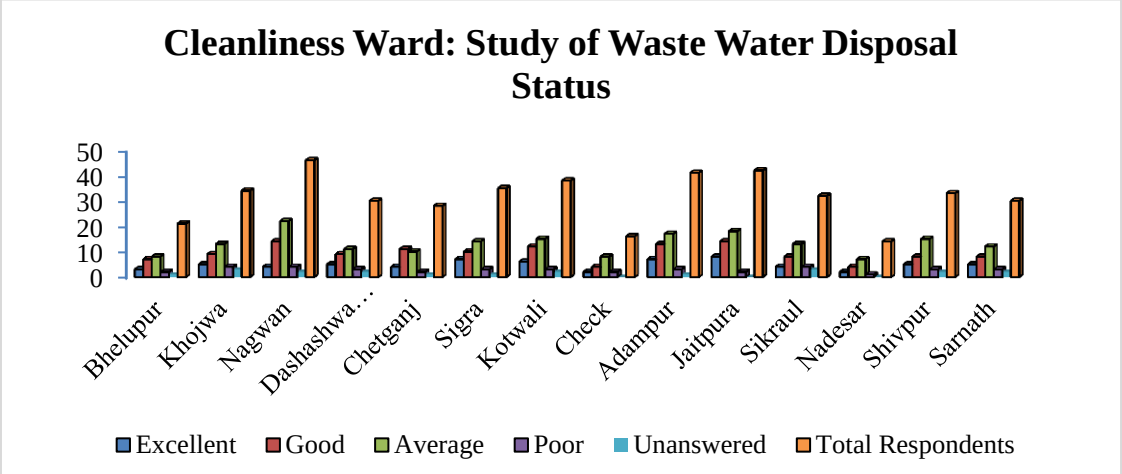
Status of Waste Water Disposal Across Different Cleanliness Wards

This table represents a comprehensive study on the status of waste water disposal across different

cleanliness wards. In Bhelupur, a total of 21 respondents participated in the survey. Among them, 3 respondents rated their waste water disposal as Excellent, 7 as Good, 8 as Average, 2 as Poor, and 1 did not provide a response. Moving to Khojwa, where 34 respondents shared their opinions, 5 respondents considered their waste water disposal as Excellent, 9 as Good, 13 as Average, 4 as Poor, and 3 did not provide a response. Nagwan had the highest participation with 46 respondents. Out of these, 4 rated their waste water disposal as Excellent, 14 as Good, 22 as Average, 4 as Poor, and 2 did not respond. In Dashashwamedh, 30 respondents expressed their views, with 5 considering their waste water disposal as Excellent, 9 as Good, 11 as Average, 3 as Poor, and 2 leaving the question unanswered. Chetganj had 28 respondents participating, where 4 rated their waste water disposal as Excellent, 11 as Good, 10 as Average, 2 as Poor, and 1 didn't respond. Sigra had 35 respondents. Among them, 7 rated their waste water disposal as Excellent, 10 as Good, 14 as Average, 3 as Poor, and 1 didn't answer. Kotwali had 38 respondents, with 6 considering their waste water disposal as Excellent, 12 as Good, 15 as Average, 3 as Poor, and 2 leaving the question unanswered. Check had 16 respondents. Among them, 2 rated their waste water disposal as Excellent, 4 as Good, 8 as Average, 2 as Poor, and none left the question unanswered. Adampur had 41 respondents. Out of these, 7 rated their wastewater disposal as Excellent, 13 as Good, 17 as Average, 3 as Poor, and 1 didn't respond. Jaitpura had 42 respondents, with 8 considering their waste water disposal as Excellent, 14 as Good, 18 as Average, 2 as Poor, and none left the question unanswered. Sikraul had 32 respondents. Among them, 4 rated their waste water disposal as Excellent, 8 as Good, 13 as Average, 4 as Poor, and 3 didn't respond. Nadesar had 14 respondents, with 2 rating their waste water disposal as Excellent, 4 as Good, 7 as Average, 1 as Poor, and none left the question unanswered. Shivpur had 33 respondents, where 5 considered their waste water disposal as Excellent, 8 as Good, 15 as Average, 3 as Poor, and 2 didn't respond. Sarnath had 30 respondents. Out of these, 5 rated their waste water disposal as Excellent, 8 as Good, 12 as Average, 3 as Poor, and 2 didn't answer.

Cleanliness Ward: Study of Waste Water Disposal Status

Cleanliness Ward	Excellent	Good	Average	Poor	Unanswered	Total Respondents
Bhelupur	3	7	8	2	1	21
Khojwa	5	9	13	4	3	34
Nagwan	4	14	22	4	2	46
Dashashwamedh	5	9	11	3	2	30
Chetganj	4	11	10	2	1	28
Sigra	7	10	14	3	1	35
Kotwali	6	12	15	3	2	38
Check	2	4	8	2	0	16
Adampur	7	13	17	3	1	41
Jaitpura	8	14	18	2	0	42
Sikraul	4	8	13	4	3	32
Nadesar	2	4	7	1	0	14
Shivpur	5	8	15	3	2	33
Sarnath	5	8	12	3	2	30
-	67	131	183	39	20	440



Findings:

The comprehensive data analysis reveals a notable advancement in sanitation infrastructure and waste management practices across Varanasi city. Key findings include:

1. **Toilet Facilities Evolution:** Over the years (2000-2021), there has been a significant increase in various types of toilets. Community toilets rose from 18 to 71, public toilets from 36 to 181, urinal toilets from 11 to 73, and specialized facilities like transgender and pink toilets also emerged. The expansion reflects a focused effort to address diverse sanitation needs in the city.
2. **Waste Disposal Diversity:** Waste disposal practices varied across different wards. A substantial number of respondents utilized sewerage systems (270) compared to open waste disposal (94). However, 49 respondents reported a lack of specific waste disposal facilities, emphasizing the need for infrastructure improvement.
3. **Waste Water Disposal Perceptions:** Respondents' opinions on waste water disposal quality varied across wards. While some rated it positively (Excellent/Good), a notable portion expressed concerns about average or poor waste water disposal conditions. Identifying these areas is crucial for targeted interventions.
4. **Challenges and Opportunities:** Despite progress in sanitation infrastructure, challenges persist in certain wards concerning waste management and waste water disposal quality. These findings present opportunities for focused improvements to enhance waste disposal facilities and waste water management in specific areas, ensuring more efficient and satisfactory services for residents.
5. **Guiding Interventions:** The data provides critical insights for policymakers, city planners, and sanitation authorities. It serves as a guide to formulate targeted interventions, directing resources towards areas requiring infrastructure upgrades, emphasizing the importance of improved waste management practices and waste water disposal systems for overall public health and environmental sustainability in Varanasi.

   Overall, the data underscores the importance of continued efforts to upgrade sanitation infrastructure, manage waste effectively, and improve waste water disposal systems, ensuring a healthier and more sustainable environment for the residents of Varanasi.

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