

Table S1 Quantitative economic performance standards for village weights

Criteria	Indicators	Description	Value
Economic affordability	R11 Initial investment	Village are suitable for constructing sanitation and toilets, with a small amount of site preparation work, and a low level of initial investment demand.	1
		Village are relatively suitable for constructing sanitation and toilets, with a relatively small amount of site preparation work, and a relatively low level of initial investment demand.	2
		Rural areas allow for the sanitation and toilets, with an average workload for site preparation and an average level of initial investment demand.	3
		Village are relatively unsuitable for constructing sanitation and toilets, involving a relatively high workload for site preparation, and a relatively high level of initial investment demand.	4
		Village are unsuitable for constructing sanitation and toilets, involving a high workload for site preparation, and a high level of initial investment demand.	5
	R12 Capital cost	Villages possess favorable basic conditions, facilitating the construction of sanitation facilities at a low level of difficulty and cost. Moreover, there exist ample financing channels for such construction projects, with the associated fundraising challenges being minimal.	1
		Villages exhibit favorable basic conditions, resulting in a relatively low level of difficulty and cost for constructing sanitation and toilets. Furthermore, there is a greater abundance of financing channels available for such construction projects, with the associated fundraising challenges being relatively low.	2
		Villages have moderate basic conditions, resulting in an average level of difficulty and cost for constructing sanitation and toilets. Additionally, there are typical financing channels available for such construction projects, with the associated fundraising challenges being average.	3
		Due to the inadequate basic conditions of villages, the construction of sanitation facilities poses challenges and involves relatively high costs. Additionally, there is a limited financing channels available for sanitation construction, with the associated fundraising challenges being relatively difficult.	4
		Due to the inadequate basic conditions of villages, the construction of sanitation facilities poses challenges and involves high costs. Additionally, there is a scarcity of financing channels available for sanitation construction, making fund-raising a difficult task.	5
	R13 Pipeline network costs	The village's topography features a slope of $\leq 0.5\%$, facilitating the easy installation of the pipe network. By leveraging the existing pipe network, it is feasible to offset more than 40% of the construction workload associated with the pipe network.	1
		The village's topography features a slope of $> 0.5\%$, making the installation of the pipe network challenging. By leveraging the existing pipe network, it is possible to offset more than 40% of the construction workload associated with the pipe network. Or the topography slope of the village is $\leq 0.5\%$, it is convenient to lay the pipe network. By leveraging the existing pipe network, it is possible to offset a pipe network construction workload ranging from 30% to 40%(including 40%).	2
		The village's topography features a slope of $> 0.5\%$, making the installation of the pipe network challenging. By leveraging the existing pipe network, it is possible to offset a pipe network construction workload ranging from 30% to 40%(including 40%). Or the topography slope of the village is $\leq 0.5\%$, it is convenient to lay the pipe network. By leveraging the existing pipe network, it is possible to offset a pipe network construction workload ranging from 20% to 30%(including 30%).	3
		The village's topography features a slope of $> 0.5\%$, making the installation of the pipe network challenging. By leveraging the existing pipe network, it is possible to offset a pipe network construction workload ranging from 20% to 30%(including 30%). Or the topography slope of the village is $\leq 0.5\%$, it is convenient to lay the pipe network. By leveraging the existing pipe network, it is possible to offset a pipe network construction workload ranging from 10% to 20%(including 20%).	4
		The village's topography features a slope of $> 0.5\%$, making the installation of the pipe network challenging. By leveraging the existing pipe network, it is possible to offset a pipe network construction workload lower than 20%(including 20%). Or the topography slope of the village is $\leq 0.5\%$, it is convenient to lay the pipe network. By leveraging the existing pipe network, it is possible to offset a pipe network construction workload lower than 10%(including 10%).	5
	R14 Operation and maintenance costs	Rural residents can afford to operate and maintain technologies that cost more than \$0.0279/t (including \$0.0279/t) of treatment	1
		Rural residents can afford operation and maintenance that costs between \$0.0210/t and \$0.0279/t (including \$0.0210/t) of treatment	2
		Rural residents can afford to operate and maintain technologies that cost between \$0.0140/t and \$0.0210/t (including \$0.0140/t) of treatment	3
		Rural residents can afford to operate and maintain technologies that cost between \$0.0070/t and \$0.0140/t (including \$0.0070/t) of treatment	4
		Rural residents can afford to operate and maintain technologies that cost less than \$0.0070/t of treatment	5

Note: The quantitative criteria for the indicators in the table are based on the relevant studies and standards(Hu et al., 2021; MOHURD of China, 2011, 2012, 2019b; MOHURD of China & SAMR of China, 2019; MOHURD of China, 2010; NHC of China & Standardization SAC, 2012; SAMR of China, 2018; Spuhler et al., 2020; Vidal et al., 2019).

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Criteria	Indicators	Description	Value
Economic affordability	R15 Availability of financial subsidies	The combination of government financial subsidies for the technology and funds raised by village governments can exceed 50% of the total construction cost.	
		The combination of government financial subsidies for the technology and funds raised by village governments can reach 40%-50%(including 50%) of the total construction cost.	
		The combination of government financial subsidies for the technology and funds raised by village governments can reach 30%-40%(including 40%) of the total construction cost.	
		The combination of government financial subsidies for the technology and funds raised by village governments can reach 20%-30%(including 30%) of the total construction cost.	
		The combination of government financial subsidies for the technology and funds raised by village governments can reach lower than 20%(including 20%) of the total construction cost.	
Environmentally friendly	R21 Low contamination of the air	Villages are located in GB 3095 Class III areas, the maximum permissible concentration of exhaust emissions from wastewater treatment facilities to implement the GB 3095 in Class III standards.	1
		Villages are located in the GB 3095 Class II area, the maximum permissible concentration of exhaust emissions from wastewater treatment facilities to implement the GB 3095 Class II standards, or based on the need to choose the implementation of Class II standards.	2
		Villages are located in the GB 3095 Class I area, the maximum permissible concentration of exhaust emissions from wastewater treatment facilities to implement the GB 3095 Class I standards, or based on the need to choose the implementation of Class I standards.	3
	R22 Low noise pollution	Villages with high levels of industrial activity or heavy traffic flow, should implement GB 3096-2008 noise control standards for functional areas designated as Class 2 acoustic environments.	1
		In villages that have industrial activities or are traversed by traffic arteries, approximately 1/3 to 2/3(including 1/3) of the area should adhere to the GB 3096-2008 noise control standards for Class 2 acoustic environment functional areas. The remaining portion of the area should comply with the GB 3096-2008 noise control standards for Class 1 acoustic environment functional areas.	2
		In villages that have industrial activities or are traversed by traffic arteries, less than 1/3 of the area should adhere to the GB 3096-2008 noise control standards for Class 2 acoustic environment functional areas. The remaining portion of the area should comply with the GB 3096-2008 noise control standards for Class 1 acoustic environment functional areas..	3
		Villages should adhere to the GB 3096-2008 noise control standards for Class 1 acoustic environment functional areas.	4
		Villages should adhere to the GB 3096-2008 noise control standards for Class 0 acoustic environment functional areas.	5
	R23 Energy conservation and low carbon materials	Energy efficiency requirements for village buildings are higher than 65% (including 65%) and renewable energy substitution rate is less than 2%.	1
		Energy efficiency requirements for village buildings are higher than 70% (including 70%) or renewable energy substitution rate is more than 2% (including 2%).	2
		Energy efficiency requirements for village buildings are higher than 70% (including 70%) or renewable energy substitution rate is more than 4% (including 4%).	3
		Energy efficiency requirements for village buildings are higher than 75% (including 75%) or renewable energy substitution rate is more than 6% (including 6%).	4
		Energy efficiency requirements for village buildings are higher than 75% (including 75%) and renewable energy substitution rate is more than 8% (including 8%).	5

Note: The quantitative criteria for the indicators in the table are based on the relevant studies and standards(Arroyo & Molinos-Senante, 2018; Hu et al., 2021; MOHURD of China, 2011, 2012, 2019b; MOHURD of China & SAMR of China, 2019; MOHURD of China, 2010; NHC of China & Standardization SAC, 2012; SAMR of China, 2018; Sutherland, 2023).

Table S1 Quantitative environmental performance standards for village weights

Criteria	Indicators	Description	Value
Environmentally friendly	R24 Water conservation and recycling	The villages belong: Villages with annual precipitation of 800mm or more (including 800mm), where water sources such as alpine snow water, groundwater, surface water can be used to meet the water demand for production and daily life, or where the demand for recycling of water resources is low.	1
		Villages with annual precipitation between 600mm and 800mm (including 600mm), where water sources such as alpine snow water, groundwater, surface water can be used to meet the water demand for production and daily life, or where the demand for recycling of water resources is relatively low..	2
		Villages with annual precipitation within 400mm-600mm (including 400mm), where water sources such as alpine snow water, groundwater, surface water can be used to meet part of the water demand for production and daily life, or villages with a general demand for recycling of water resources.	3
		Villages with annual precipitation within 200mm-400mm (including 200mm), where water sources such as alpine snow water, groundwater, surface water can only be used to meet daily life, or where the demand for recycling of water resources is relatively high.	4
		Villages with annual precipitation of less than 200mm, where water sources such as alpine snow water, groundwater, surface water cannot be used to meet daily life, or where the demand for recycling of water resources is high.	5
	R25 Potential for nutrient recycling	The villagers have limited practice experience in using manure as fertilizer and low willingness to recover and recycle nutrients.	1
		The villagers have relatively limited practice experience in using manure as fertilizer and relatively low willingness to recover and recycle nutrients.	2
		The villagers have extensive experience and willingness to recover and recycle nutrients.	3
		The villagers have relatively extensive experience in using manure as fertilizer and relatively high willingness to recover and recycle nutrients.	4
		The villagers have extensive experience in using manure as fertilizer and high willingness to recover and recycle nutrients.	5
	R26 Beneficial landscape integration	The Green Assessment score of the village on T/CECS 629-2019 is lower than 30 points (including 30) .	1
		The Green Assessment score of the village on T/CECS 629-2019 is between 30 and 40 points (including 40) .	2
		The Green Assessment score of the village on T/CECS 629-2019 is between 40 and 50 points (including 50) .	3
		The Green Assessment score of the village on T/CECS 629-2019 is between 50 and 60 points (including 60) .	4
		The Green Assessment score of the village on T/CECS 629-2019 is more than 60 points	5

Note: The quantitative criteria for the indicators in the table are based on the relevant studies and standards(Arroyo & Molinos-Senante, 2018; Hu et al., 2021; MOHURD of China, 2011, 2012, 2019b; MOHURD of China & SAMR of China, 2019; MOHURD of China, 2010; NHC of China & Standardization SAC, 2012; SAMR of China, 2018; Sutherland, 2023)

Table S1 Quantitative technological performance standards for village weights

Criteria	Indicators	Description	Value
Technological adaptability	R31 Adaptability to changing temperature conditions	Village classified under types IVA, IVB, V A and V B area according to the GB 50178-93 standard and the annual amplitude of temperature of the village is less than 16 °C area.	1
		Village classified under types IVA, IVB, V A, and V B area according to the GB 50178-93 standard and the annual amplitude of temperature of the village is more than 16 °C (including 16°C) area.	2
		Village classified under types IIIA,IIIB, and IIIC area according to the GB 50178-93 standard and the annual amplitude of temperature of the village is less than 24 °C area.	3
		Village classified under types IIIA,IIIB, and IIIC area according to the GB 50178-93 standard and the annual amplitude of temperature of the village is more than 24 °C (including 24°C) area, or the altitude of the village is between 2000m and 3000m (including 2000m).	4
		Village classified under types I A, I B, I C, I D, II A, II B, VIA, VIB, VIC, VIIA, VIIB, VII C, and VII D area according to the GB 50178-93 standard, or village with an altitude of more than 3,000m.	5
	R32 Available treatment capacity	Villages produce a daily volume of manure and wastewater more than 1000 m ³ (including 1000 m ³).	1
		Villages produce a daily volume of manure and wastewater ranging from 500 to 1000 m ³ (including 500 m ³).	2
		Villages produce a daily volume of manure and wastewater ranging from 100 to 500 m ³ (including 100 m ³).	3
		Villages produce a daily volume of manure and wastewater ranging from 100 to 5 m ³ (including 5 m ³).	4
		Villages produce a daily volume of manure and wastewater less than 5m ³ .	5
	R33 Discharge limits	The village is not situated within a nature reserve and other designated special areas. Its wastewater undergoes treatment and is discharged into a secondary sewage treatment plant within the sanitation system. The wastewater discharge must meet the requirements of the GB8978 Class III standard.	1
		The village is situated within a nature reserve and other designated special areas. The treated sewage is discharged in compliance with GB 3838 standards for IV and V waters, or with GB 3097 standards for the third level of sea areas. The wastewater discharge must meet the requirements of the GB8978 Class II standard.	2
		The village sewage is discharged into GB 3838 Class III waters, except for delineated protected and swimming areas. The treated wastewater is discharged into GB 3097 Class II waters and must meet the requirements of the GB8978 Class I standard.	3
		The village is situated within the protected areas outlined in GB 3838 for Class I and II waters, as well as Class III waters. The treated wastewater is discharged into Class I waters specified in GB 3097, while ensuring the total amount of pollutants is controlled in compliance with the functional requirements of water bodies, without the introduction of new outfalls.	4
	R34 Complexity of operation and management	The technical staffs in the village responsible for maintaining and managing the sanitation and toilet facilities are sufficient and well-staffed. The head technician possesses a Class II qualification in wastewater treatment at least.	1
		The technical staffs in the village responsible for maintaining and managing the sanitation and toilet facilities are relatively sufficient and well-staffed. The head technician possesses a Class III qualification in wastewater treatment at least.	2
		The village has an appropriate number of technical staff responsible for maintaining and managing the sanitation and toilet facilities. The head technician possesses a Class IV qualification in wastewater treatment at least.	3
		The village has an appropriate number of technical staff responsible for maintaining and managing the sanitation and toilet facilities. The head technician possesses a Class V qualification in wastewater treatment at least.	4
		The village has inadequate number of technical staff responsible for maintaining and managing the sanitation and toilet facilities.	5

Note: The quantitative criteria for the indicators in the table are based on the relevant studies and standards(Firmansyah et al., 2021; Hashemi, 2020; Hu et al., 2021; MOHURD of China, 2011, 2012, 2019b; MOHURD of China & SAMR of China, 2019; MOHURD of China, 2010; NHC of China & Standardization SAC, 2012; SAMR of China, 2018; Sutherland, 2023; Vidal et al., 2019).

Table S2 Quantitative standards for technological weights

Criteria	Indicators	Description	Value
Economic affordability	R11 Initial investment	The technology requires extensive site preparation and a significant initial investment proportional to the total investment. Additionally, the cost of using the technology has a high initial investment.	1
		The technology requires relatively extensive site preparation and a relatively significant initial investment proportional to the total investment. Additionally, the cost of using the technology has a relatively high initial investment.	2
		The technology has standard site preparation requirements, with the initial investment representing an average proportion of the total investment. Additionally, the initial investment cost for using the technology is also average.	3
		The technology requires relatively minimal site preparation and a relatively low initial investment proportional to the total investment. Additionally, the cost of using the technology has a relatively low initial investment.	4
		The technology requires minimal site preparation and a significant low initial investment proportional to the total investment. Additionally, the cost of using the technology has a low initial investment.	5
	R12 Capital cost	The technology entails a high cost for equipment procurement, present difficulty in construction, and incurs high overall construction expenses.	1
		The technology entails a relatively higher cost for equipment procurement, presents relative difficulty in construction, and incurs comparatively high overall construction expenses.	2
		The technology incurs equipment procurement costs, construction difficulty, and overall construction expenses that are on par with industry averages.	3
		The technology entails a relatively low cost for equipment procurement, and incurs a relatively low construction expenses.	4
		The technology entails a relatively low cost for equipment procurement, presents, and incurs low construction expenses.	5
	R13 Pipeline network costs	The technology has a minimum daily treatment capacity exceeding 1,000 m ³ /d and demands a high-performance sanitation network to function effectively.	1
		The technology has a minimum daily treatment capacity of between 500 m ³ /d and 1,000 m ³ /d (including 1000 m ³ /d) and demands a relative high-performance sanitation network to function effectively.	2
		The technology has a minimum daily treatment capacity of between 100 m ³ /d and 500 m ³ /d (including 500 m ³ /d) and the accompanying sewage network necessitates standard requirements.	3
		The technology has a minimum daily treatment capacity of between 5 m ³ /d and 100 m ³ /d (including 5 m ³ /d) and the supporting sewage network requiring relative minimal specifications.	4
		The technology has a minimum daily treatment capacity is less than 5 m ³ (including 5 m ³), and the supporting sewage network requiring minimal specifications.	5
	R14 Operation and maintenance costs	Primary and tertiary wastewater treatment technologies at an average cost more than \$0.0279/t (including \$0.0279/t) of wastewater, or secondary wastewater treatment technologies at an average cost more than \$0.1397/t (including \$0.1397/t) of wastewater, or manure treatment technologies at an average cost more than \$0.0210/ m ³ (including \$0.0210/m ³) of dirt	1
		Primary and tertiary wastewater treatment technologies at an average cost between \$0.0210/t and \$0.0279/t (including \$0.0210/t) of wastewater, or secondary wastewater treatment technologies at an average cost between \$0.1118/t and \$0.1397/t (including \$0.1118/t) of wastewater, or manure treatment technologies at an average cost between \$0.0140/m ³ and \$0.0210/m ³ (including \$0.0140/m ³) of dirt	2
		Primary and tertiary wastewater treatment technologies at an average cost between \$0.0140/t and \$0.0210/t (including \$0.0140/t) of wastewater, or secondary wastewater treatment technologies at an average cost between \$0.0838/t and \$0.1118/t (including \$0.0838/t) of wastewater, or manure treatment technologies at an average cost between \$0.0070/m ³ and \$0.0140/m ³ (including \$0.0070/m ³) of dirt	3
		Primary and tertiary wastewater treatment technologies at an average cost between \$0.0070/t and \$0.0140/t (including \$0.0070/t) of wastewater, or secondary wastewater treatment technologies at an average cost between \$0.0699/t and \$0.0838/t (including \$0.0699/t) of wastewater, or manure treatment technologies at an average cost less than \$0.0070 /m ³ of dirt	4
		Primary and tertiary wastewater treatment technologies at an average cost less than \$0.0070/t of wastewater, or secondary wastewater treatment technologies at an average cost more less \$0.0699/t (including \$0.0699/t) of wastewater, or toilet technology operation and maintenance costs are handled at no cost to the user	5

Criteria	Indicators	Description	Value
Economic affordability	R15 Availability of financial subsidies	The acquisition of financial subsidies for the technology poses challenges.	1
		The technology falls under the government's endorsed catalog of green, low-carbon, and environmentally friendly technologies, making it eligible for a subsidy that covers less than 10% of the total cost.	2
		The technology falls under the government's endorsed catalog of green, low-carbon, and environmentally friendly technologies, making it eligible for a subsidy that covers 10%-20% (including 10%) of the total cost.	3
		The technology falls under the government's endorsed catalog of green, low-carbon, and environmentally friendly technologies, making it eligible for a subsidy that covers 20%-30% (including 20%) of the total cost.	4
		The technology falls under the government's endorsed catalog of green, low-carbon, and environmentally friendly technologies, making it eligible for a subsidy that covers over 30% (inclusive) of the total cost.	5
Environmentally friendly	R21 Low contamination of the air	A large number of odors are generated in the technical processing, and the feeling of use is poor, or the maximum concentration of waste gas generated and emitted can meet the requirements of the GB3095 ClassIII standard.	1
		Odors are generated in the technical processing, and the feeling of use is relatively poor, or the maximum concentration of waste gas generated and emitted can meet the requirements of the GB3095 Class II standard.	2
		Little or no odor is generated in the technical processing, and the feeling of use is good, or the maximum concentration of waste gas generated and emitted can meet the requirements of the GB3095 Class I standard.	3
	R22 Low noise pollution	The technology produces noise levels exceeding 50dB (inclusive) while it cannot be used far from residential areas	1
		The technology produces noise levels exceeding 50dB (inclusive) while it can be used far from residential areas	2
		The noise generated by the technology's operation is controlled within the range of 45 to 50 dB (inclusive of 45 dB).	3
		The noise generated by the technology's operation is controlled within the range of 40 to 45 dB (inclusive of 40 dB).	4
		The noise generated by the technology's operation is controlled to be less than 40dB	5
	R23 Energy conservation and low carbon materials	The technology exhibits a comprehensive energy consumption exceeding 0.0657 kgce/m ³ (inclusive of 0.0657 kgce/m ³), while the utilization of low-carbon materials during its construction and maintenance remains below 10%.	1
		The technology exhibits a comprehensive energy consumption between 0.0615-0.0657kgce/m ³ (inclusive of 0.0615 kgce/m ³), while the utilization of low-carbon materials during its construction and maintenance remains between 10%-15% (including 10%) .	2
		The technology exhibits a comprehensive energy consumption between 0.0584-0.0615kgce/m ³ (inclusive of 0.0584 kgce/m ³), while the utilization of low-carbon materials during its construction and maintenance remains between 15%-20% (including 15%) .	3
		The technology exhibits a comprehensive energy consumption between 0.0549-0.0584kgce/m ³ (inclusive of 0.0549 kgce/m ³), while the utilization of low-carbon materials during its construction and maintenance remains between 20%-25% (including 25%) .	4
		The technology exhibits a comprehensive energy consumption less than 0.0549 (kgce/m ³), while the utilization of low-carbon materials during its construction and maintenance over 30%.	5

Criteria	Indicators	Description	Value
Environmentally friendly	R24 Water conservation and recycling	The water quality of technically treated effluent can satisfy the requirements specified in the GB5084 standard for irrigating dry cereal crops.	1
		The water quality of technically treated effluent can satisfy the requirements specified in the GB5084 standard for irrigating waterborne cereals.	2
		The effluent, following technical treatment, can satisfy the water quality requirements outlined in GB5084 for irrigating processed cooking and peeled fruits and vegetables.	3
		The effluent, following technical treatment, can fulfill the water quality requirements specified in GB5084 for irrigating raw vegetables and fruits.	4
		The technically treated effluent can fulfill the requirements specified in GB5084 for agricultural irrigation and landscape use.	5
	R25 Potential for nutrient recycling	The technology exhibits poor recovery of nitrogen (N) and phosphorus (P) from wastewater, resulting in low nutrient reuse	1
		The technology exhibits suboptimal recovery of nitrogen (N) and phosphorus (P) from wastewater, resulting in limited nutrient reuse	2
		The technology demonstrates moderate recovery of nitrogen (N) and phosphorus (P) from wastewater, resulting in moderate nutrient reuse	3
		The technology exhibits robust recovery of nitrogen (N) and phosphorus (P) from wastewater, resulting in significant nutrient reuse	4
		The technology demonstrates excellent recovery of nitrogen (N) and phosphorus (P) from wastewater, resulting in substantial nutrient reuse	5
	R26 Beneficial landscape integration	The technology may result in adverse landscaping effects.	1
		The technology may result in relatively adverse landscaping effects.	2
		The technology can lead to no landscaping effects.	3
		The technology can lead to relatively positive landscaping effects.	4
		The technology can lead to positive landscaping effects.	5
Technological adaptability	R31 Adaptability to changing temperature conditions	The technology's performance is affected by climate change, and it can only operate well within environments that range from 10°C to 30°C.	1
		The technology can operate normally at temperatures of 0°C to 40°C, but their operation has an additional negative impact on the environment and reduces the comfort level of users	2
		The technology can operate normally at temperatures of 0°C to 40°C and do not have additional negative impacts	3
		The technology exhibits the capability to operate in extreme temperatures, ranging from sub-zero temperatures below 0°C to high temperatures exceeding 40°C. But their operation has an additional negative impact on the environment and reduces the comfort level of users	4
		The technology exhibits the capability to operate in extreme temperatures, ranging from sub-zero temperatures below 0°C to high temperatures exceeding 40°C. And do not have additional negative impacts	5

Criteria	Indicators	Description	Value
Technological adaptability	R32 Available treatment capacity	Wastewater treatment technology and toilet technology with a minimum daily wastewater treatment capacity more than 1000 m ³ (including 1000 m ³)	1
		Wastewater treatment technology and toilet technology with a minimum daily wastewater treatment capacity between 500 m ³ and 1000 m ³ (including 500 m ³)	2
		Wastewater treatment technology and toilet technology with a minimum daily wastewater treatment capacity between 100 m ³ and 500 m ³ (including 100 m ³)	3
		Wastewater treatment technology and toilet technology with a minimum daily wastewater treatment capacity between 5 m ³ and 100 m ³ (including 5 m ³)	4
		Wastewater treatment technology and toilet technology with a minimum daily wastewater treatment capacity less than 5 m ³	5
	R33 Discharge limits	The processing capacity of wastewater treatment technology complies with the requirements of GB 18918 for the third level of wastewater; the processing capacity of toilet technology meets the standards outlined in GB/T 25246 for manure return to the field. Additionally, the fecal coliform bacteria value is $\geq 10^{-1}/L$.	1
		The processing capacity of wastewater treatment technology complies with the requirements of GB 18918 and GB 8978 for the second level of wastewater; the processing capacity of toilet technology meets the standards outlined in GB/T 7959. Additionally, the fecal coliform bacteria value is $\geq 10^{-2}/L$.	2
		The processing capacity of wastewater treatment technology complies with the requirements of GB 18918 and GB 8978 for the first level of wastewater; the processing capacity of toilet technology meets the standards outlined in GB/T 7959. Additionally, the fecal coliform bacteria value is $\geq 10^{-3}/L$.	3
		The processing capacity of wastewater treatment technology complies with the requirements of GB 18918 and GB 8978 for the first level of wastewater; the processing capacity of toilet technology meets the standards outlined in GB/T 7959. Additionally, the fecal coliform bacteria value is $\geq 10^{-4}/L$.	4
	R34 Complexity of operation and management	The use of technology requires①Strict adherence to time requirements;②Regular commissioning based on treatment testing ;③Regular pumping (emptying);④Periodic replacement of materials or fillers;⑤Additional treatment of post-treatment residues;⑥Complex equipment requiring regular maintenance;⑦Complexity of procedures used	
		Technology is required for 7 of the 7 items above	1
		Technology is required for 6 of the 7 items above	2
		Technology is required for 5 of the 7 items above	3
		Technology is required for 4 of the 7 items above	4
		Technology is required for 3 or less than 3 of the 7 items above	5

Note: The quantitative criteria for the indicators in the table are based on the relevant studies and standards(Firmansyah et al., 2021; Hashemi, 2020; Hu et al., 2021; MEP of China & AQSIQ of China, 2008; MOHURD of China, 2006, 2011, 2012, 2019a, 2019b; MOHURD of China & SAMR of China, 2019; SEPA of China & AQSIQ of China, 2002; Sutherland, 2023; Vidal et al., 2019).

Table S3 Rural sanitation and toilet technology combination

Type	Code	Combination composition	Type	Code	Combination composition
Primary wastewater treatment technology combination	EST101	Grating+ Sedimentation tank +Filter		EST232	Aeration Biological filter
	EST102	Grating+ Septic tank		EST233	Constructed wetland
	EST103	Grating+ Sedimentation tank		EST234	Constructed wetland+ Oxidation pond
	EST104	Grating+ Regulating tank + Sedimentation tank		EST235	Biological filter+ Constructed wetland
	EST105	Grating+ Sedimentation tank		EST236	Biological filter+ Land infiltration
	EST106	Grating+ Primary sedimentation tank + Coagulate sedimentation		EST237	Rotating biological Contactors+ Filter
Secondary wastewater treatment technology combination	EST201	A2/O		EST238	Anaerobic tank+ Contact oxidation+ Constructed wetland
	EST202	A2/O+ MBR		EST239	Anaerobic tank+ Contact oxidation+ Ecological pond +Constructed wetland
	EST203	A2/O+ Constructed wetland		EST240	Anaerobic tank+ Constructed wetland
	EST204	A2/O+ Biological filter		EST241	Anaerobic tank+ Ecological ditch
	EST205	Cass	Secondary wastewater treatment technology combination	EST242	Anaerobic tank+ Ecological pond
	EST206	Land infiltration		EST243	Anaerobic tank+ Ecological pond+ Purification canal + Eco ditch
	EST207	Wastewater purification biogas tank		EST244	Anaerobic tank+ Biological filter+ Constructed wetland
	EST208	Anaerobic tank+ A2/O		EST245	Anaerobic tank+ Land infiltration
	EST209	Anaerobic tank+ A2/O+ Constructed wetland		EST246	Anaerobic tank+ Micro-power aerobic tank+ Constructed wetland
	EST210	Anaerobic tank+ Aerobic tank+ Secondary sedimentation tank		EST247	Anaerobic tank+ Oxidation ditch+ Sedimentation tank
	EST211	Anaerobic tank+ Contact oxidation+ Sedimentation tank		EST248	Anaerobic filter+A2O+ Secondary sedimentation tank
	EST212	Anaerobic tank+ Contact oxidation+ Aeration Biological filter		EST249	Anaerobic filter+ Membrane bioreactor
	EST213	Anaerobic filter+ Land infiltration		EST250	Anaerobic filter+ Constructed wetland
	EST214	Anaerobic filter+ Oxidation pond+ Secondary sedimentation tank		EST251	Anaerobic filter+ Biological filter
	EST215	Anaerobic filter+ Oxidation pond+ Constructed wetland		EST252	Anaerobic filter+ Biological filter + Land infiltration

Type	Code	Combination composition	Type	Code	Combination composition
Secondary wastewater treatment technology combination	EST216	Anaerobic filter+ Oxidation pond+ Eco ditch	Tertiary wastewater treatment technology combination	EST253	Biogas digester+ Contact oxidation+ Constructed wetland
	EST217	Anaerobic tank+ Aerobic pond+ Constructed wetland		EST254	Biogas digester+ Constructed wetland
	EST218	Anaerobic pond+ Facultative pond+ Aerobic pond		EST255	Biogas digester+ Ecological pond+ Eco ditch
	EST219	Anaerobic baffled reactor+ Land infiltration		EST256	Biogas digester+ Biofiltration +Constructed wetland
	EST220	Oxidation ditch+ Sedimentation tank		EST257	Biogas digester+ Land infiltration
	EST221	Integrated purification tank		EST258	Biogas digester+ Micro-power aeration
	EST222	Biogas digester+ Facultative biofiltration		EST301	Activated carbon filtration
	EST223	MBR		EST302	Activated carbon filtration+ Liquid chlorine disinfection
	EST224	SBR		EST303	Activated carbon filtration+ Chlorine-containing disinfectant tablets
	EST225	SBR+ Filter		EST304	Activated carbon filtration+ Ultraviolet disinfection
	EST226	Hybrid anaerobic+ Contact oxidation		EST305	Do not use tertiary processing technology
	EST227	Hybrid anaerobic+ Constructed wetland		EST401	Double pit alternating toilet
	EST228	Contact oxidation+ Sedimentation tank		EST402	Fecal and urine separate sanitary toilet
	EST229	Contact oxidation+ Sedimentation tank +Constructed wetland	Toilet technology	EST403	Three-compartment septic tank toilet
	EST230	Contact oxidation+ Constructed wetland		EST404	Double urn funnel type sanitary toilet
	EST231	MBR+ Land treatment		EST405	Flush toilets (connected to sewerage)

Table S4 Rural sanitation and toilet technology combination score

Code	R 11	R 12	R 13	R 14	R 15	R 21	R 22	R 23	R 24	R 25	R 26	R 31	R 32	R 33	R 34
EST101	3.0	3.5	2.8	2.9	4.1	1.3	3.5	3.6	4.6	3.4	1.0	3.6	1.8	4.2	3.2
EST102	4.7	4.5	4.9	4.8	4.7	1.4	4.8	4.0	4.7	4.1	1.0	3.8	4.8	3.5	4.7
EST103	4.6	4.1	4.7	4.6	4.7	1.1	4.6	4.0	4.6	4.0	1.0	3.7	4.7	3.3	4.3
EST104	4.6	4.3	4.5	4.7	4.7	2.5	4.8	3.8	4.8	3.7	1.0	3.8	4.7	3.8	4.2
EST105	4.7	4.6	4.8	4.8	4.8	1.8	4.8	4.1	4.6	4.0	1.0	3.8	4.8	3.4	4.6
EST106	3.0	3.7	4.0	3.7	4.2	2.1	3.4	3.9	4.5	3.8	1.0	3.7	4.4	3.7	3.4
EST201	2.0	2.1	3.5	3.6	1.0	2.3	3.5	1.5	4.5	1.4	1.0	3.8	4.6	3.7	2.4
EST202	1.5	1.6	1.8	1.6	1.0	2.2	2.2	1.4	4.9	1.3	1.1	3.7	1.7	4.0	2.1
EST203	1.9	2.1	3.6	3.4	1.0	2.5	3.5	1.4	4.7	1.8	3.8	3.6	1.7	3.8	2.5
EST204	1.6	1.4	1.8	1.6	1.0	2.3	2.2	1.4	4.8	1.3	1.0	3.7	1.2	4.0	2.0
EST205	2.2	2.1	1.9	1.6	1.0	2.2	2.1	1.5	4.5	1.5	1.2	3.5	1.9	3.8	2.5
EST206	3.0	3.2	3.8	3.6	3.0	1.6	4.5	4.8	1.9	4.0	4.0	2.5	3.8	1.4	3.9
EST207	3.9	4.2	4.2	4.1	3.7	1.4	4.3	4.5	1.6	4.0	1.0	1.8	4.2	1.6	4.1
EST208	1.9	2.0	3.5	3.5	1.0	2.3	3.4	1.3	4.6	1.5	1.0	3.7	3.7	3.7	2.6
EST209	1.8	1.8	3.5	3.3	1.0	2.5	3.4	1.2	4.8	2.0	4.1	3.8	3.5	4.0	1.9
EST210	3.9	3.6	3.4	3.4	1.0	2.0	3.6	1.8	4.1	1.7	1.0	3.9	3.7	3.4	3.3
EST211	3.2	3.4	4.4	3.7	2.3	2.5	4.0	2.5	4.8	3.0	1.0	4.9	3.9	3.6	3.9
EST212	2.5	2.3	1.8	1.6	2.9	1.9	2.4	3.8	3.0	4.1	4.3	3.6	1.8	2.2	3.2
EST213	2.6	2.5	1.5	1.6	2.9	2.0	2.2	3.8	3.0	3.6	1.0	3.7	1.6	2.2	2.9
EST214	2.4	2.4	1.8	1.6	2.8	2.2	2.3	3.8	3.6	3.5	3.8	3.8	1.7	3.0	2.8
EST215	2.3	2.2	1.7	1.5	2.6	2.3	2.3	3.8	3.3	4.2	4.5	3.7	1.7	2.8	2.6
EST216	2.4	2.3	1.5	1.5	2.8	2.1	2.1	3.8	3.1	4.2	4.5	3.7	1.7	2.5	2.5
EST217	2.5	2.8	2.3	1.6	1.9	2.3	2.6	1.8	3.3	2.1	4.6	2.8	2.5	2.8	3.1
EST218	3.3	3.5	2.2	1.8	3.5	2.5	2.7	1.8	2.0	1.9	4.6	2.9	2.4	1.5	3.7
EST219	2.5	2.3	2.4	2.2	2.8	1.7	2.9	3.8	3.2	4.0	4.3	3.6	2.8	2.7	2.7
EST220	2.0	2.1	1.1	1.2	1.0	2.2	2.1	1.4	4.7	1.2	1.2	3.8	1.0	4.0	2.6
EST221	4.9	3.9	4.5	4.3	2.4	3.6	4.0	4.9	4.2	4.8	2.3	4.3	4.9	3.6	4.6
EST222	2.6	2.3	1.9	1.6	2.9	1.9	2.3	3.9	3.5	3.7	1.0	2.0	1.8	3.0	2.6
EST223	2.0	1.7	1.9	1.6	1.0	2.2	2.4	1.5	4.5	1.4	1.0	3.5	1.9	3.8	2.1
EST224	2.2	2.1	1.9	1.6	1.3	2.0	2.3	1.5	4.0	1.4	1.0	3.5	1.9	3.4	2.7
EST225	1.9	1.8	1.2	1.0	1.4	2.0	2.1	1.5	4.3	1.3	1.0	3.7	1.0	3.6	1.9
EST226	1.9	1.7	1.8	1.6	1.9	2.2	2.4	3.8	3.5	3.5	1.0	3.6	1.8	3.0	2.0
EST227	2.8	3.0	1.8	1.6	1.9	2.6	2.3	3.9	3.2	4.1	4.2	3.6	1.8	2.8	3.4
EST228	2.9	2.8	3.4	3.4	1.9	1.9	3.9	3.8	3.5	3.4	1.0	3.8	3.8	3.0	3.3
EST229	4.2	3.7	4.5	4.6	2.6	3.3	4.4	3.9	4.5	4.7	3.9	4.3	4.6	3.8	4.4
EST230	2.8	2.8	3.6	3.4	1.9	2.5	3.5	3.9	3.5	4.2	4.3	3.6	3.8	3.0	3.2

Table S4 Rural sanitation and toilet technology combination score

Code	R 11	R 12	R 13	R 14	R 15	R 21	R 22	R 23	R 24	R 25	R 26	R 31	R 32	R 33	R 34
EST231	2.0	2.2	1.8	1.6	1.0	1.3	2.1	1.4	4.4	1.3	4.2	3.6	1.8	3.8	2.7
EST232	2.1	1.9	1.9	2.1	1.8	1.9	2.5	3.5	3.7	3.2	1.0	3.5	1.9	3.2	2.5
EST233	2.6	3.2	3.8	3.6	1.9	2.5	4.5	4.0	3.1	4.6	4.5	2.6	4.1	2.6	3.7
EST234	4.3	3.8	4.6	4.5	2.3	2.9	3.8	4.0	4.8	4.8	4.1	4.8	4.7	3.6	4.7
EST235	2.7	2.8	2.5	3.4	1.9	2.1	3.0	3.9	4.0	4.1	4.6	3.7	1.8	3.4	3.2
EST236	2.8	2.9	2.5	3.4	2.8	2.0	3.1	3.9	3.8	4.1	4.6	3.7	1.8	3.2	3.6
EST237	2.6	2.4	1.1	1.0	2.4	2.1	1.9	2.4	4.2	2.6	1.3	3.8	1.2	3.6	3.1
EST238	2.3	1.7	3.5	3.3	1.8	2.1	3.6	3.1	3.6	3.5	4.1	3.8	3.7	3.1	2.1
EST239	2.2	2.4	3.4	3.1	1.8	2.3	3.7	3.0	3.7	3.8	4.7	3.9	3.5	3.1	2.8
EST240	2.5	3.5	3.7	3.5	1.9	2.2	4.0	3.4	3.5	3.8	4.3	3.7	3.9	3.0	3.7
EST241	2.9	3.3	3.7	3.5	3.4	1.6	3.9	3.4	1.8	3.8	4.2	3.7	3.8	1.4	3.7
EST242	3.4	3.2	3.7	3.5	3.4	1.7	4.2	3.4	1.7	3.8	4.2	3.7	3.9	1.1	3.7
EST243	3.0	3.1	3.7	3.1	3.2	2.2	3.8	3.2	2.1	4.0	4.6	3.8	3.5	1.5	3.4
EST244	2.6	2.7	1.8	1.6	1.8	2.0	2.2	3.3	4.1	3.6	4.6	3.8	1.7	3.5	3.2
EST245	2.8	3.1	3.7	3.5	2.9	1.5	3.9	3.4	2.4	3.8	4.3	3.7	3.9	1.6	3.6
EST246	3.3	3.5	2.3	2.1	1.8	2.2	2.5	3.3	3.3	3.6	4.6	3.8	2.7	2.5	3.4
EST247	1.8	1.9	1.2	1.1	1.0	2.0	2.1	1.4	4.3	1.3	1.2	3.8	1.0	3.6	2.4
EST248	1.7	1.6	1.8	1.6	1.0	2.2	2.3	1.2	4.9	1.3	1.1	3.9	1.6	4.0	2.2
EST249	2.3	2.1	1.2	1.4	1.0	2.3	2.2	1.4	4.5	1.2	1.0	3.8	1.4	3.8	2.5
EST250	4.7	3.7	4.4	4.3	2.4	3.2	4.3	4.2	4.2	4.7	4.0	4.9	4.6	3.5	4.6
EST251	2.4	2.2	1.8	1.4	2.8	2.0	2.3	3.4	3.9	3.6	1.0	3.8	1.5	3.4	2.7
EST252	2.3	2.7	1.7	1.4	2.6	1.9	2.2	3.3	4.0	3.7	4.3	3.9	1.3	3.4	3.1
EST253	2.3	2.4	3.6	3.3	2.7	2.1	3.9	3.2	3.6	3.6	4.2	3.7	3.7	3.0	3.0
EST254	3.2	3.5	4.4	4.1	2.8	2.6	4.5	4.5	3.5	4.1	3.7	3.9	3.6	2.8	3.4
EST255	3.3	3.2	3.6	3.3	3.5	2.6	3.8	3.3	2.8	4.0	4.7	2.4	3.7	1.6	3.1
EST256	2.6	2.4	3.2	3.4	1.9	2.0	3.5	3.3	3.3	3.9	4.6	3.3	3.7	2.5	2.9
EST257	3.0	3.6	3.6	3.5	2.9	1.3	4.3	3.4	2.5	3.7	4.3	2.3	3.8	1.6	4.2
EST258	2.3	2.3	1.9	1.6	2.6	2.1	2.6	3.4	3.6	3.3	1.0	3.4	1.9	3.0	2.7
EST301	4.5	4.6	3.9	4.4	4.1	2.8	4.3	4.1	3.2	4.3	1.0	4.5	4.2	2.0	4.6
EST302	4.4	4.3	3.7	4.2	3.7	2.0	4.2	3.8	4.1	4.1	1.0	4.4	3.3	3.4	4.1
EST303	4.5	4.8	4.2	4.6	3.9	2.3	4.3	4.0	4.2	4.2	1.0	4.3	4.2	3.3	4.5
EST304	4.5	4.5	3.9	4.4	3.6	2.5	4.4	3.5	3.7	3.9	1.0	4.5	4.2	3.0	3.8
EST401	4.8	4.5	4.8	4.5	4.8	2.2	4.8	4.8	4.9	4.9	1.0	4.5	4.6	3.8	4.8
EST402	4.7	4.3	4.8	4.5	4.9	3.3	4.8	4.9	4.8	4.9	1.0	3.8	4.2	3.8	4.5
EST403	4.9	4.5	4.8	4.5	4.7	3.3	4.8	4.9	4.8	4.8	1.0	3.9	4.5	4.0	4.7
EST404	4.8	4.3	4.9	4.4	4.9	3.8	4.9	4.8	4.6	4.7	1.0	3.3	4.2	3.9	4.6
EST405	4.6	4.7	4.7	4.9	4.9	3.5	4.8	4.9	4.7	4.7	1.0	3.7	4.3	4.1	4.6

Table S5 Descriptive statistics of participants

Factor	Options	Case 1	Case 2	Case 3	Case 4
		N(%)	N(%)	N(%)	N(%)
Age	18-30	1(14.29%)	0(0.00%)	1(14.29%)	2(28.57%)
	30-50	3(42.86%)	5(71.43%)	5(71.43%)	3(42.86%)
	Above50	3(42.86%)	2(28.57%)	1(14.29%)	2(28.57%)
Gender	Male	6(85.71%)	6(85.71%)	6(85.71%)	5(71.43%)
	Famale	1(14.29%)	1(14.29%)	1(14.29%)	2(28.57%)
Education level	High school and below	3(42.86%)	2(28.57%)	2(28.57%)	1(14.29%)
	University	3(42.86%)	3(42.86%)	4(57.14%)	3(42.86%)
	Master degree and above	1(14.29%)	2(28.57%)	1(14.29%)	3(42.86%)

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