IN PLAIN LANGUAGE

Do we need New Alternative Sanitation Systems in Germany?

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German Association for Water, Wastewater and Waste
Deutsche Vereinigung für Wasserwirtschaft,
Abwasser und Abfall e. V.

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Do we need New Alternative Sanitation Systems?

Whether climate or demographic change, rising commodity prices, water shortages or hunger in many parts of the world; all these topics are of importance to urban water management in Germany. When considering these issues, questions have to be raised as to whether our current sanitation system is able to cope with the above mentioned developments and their impacts. The current approach to sanitation in Germany usually relies on water-borne sewer systems and the centralised treatment of domestic wastewater, commercial and industrial effluent and rainwater together.

This centralised system increasingly shows its limitations. Its original functions, which are the establishment of high hygiene standards and the prevention of flooding, have been broadly achieved in Germany. Yet the system remains inflexible and has low resource efficiency with relative high investment and operational costs. More and more, these centralised systems have to deal with new challenges and the required adaptations result in substantial additional expenditures. An example is the advanced treatment of wastewater for the removal of pharmaceutical residues and micro-pollutants.

Rapid urbanisation and increased population growth is occurring globally. More and more people want to partake in a "Western standard of living" and are, as one element of change, increasing their meat consumption, which results in an increased demand for agricultural fertiliser. Sanitation systems and wastewater management in urban areas are therefore subject to significant changes. It is neither possible nor desirable to focus on a worldwide implementation of water-borne sewer systems with centralised wastewater treatment. Usually these systems do not use resources economically and have relatively high costs.

On the other hand, several regions in Germany and other industrialised nations are experiencing shrinking population numbers ("demographic change"). As a result, sewers and treatment plants in these regions have become oversized, leading to higher maintenance costs, increased operational problems and rising wastewater fees.

In both examples, **N**ew **A**lternative **S**anitation **S**ystems (abbreviated as "NASS") can play an important role (see Table 1).

"Waterhouse" in Knittlingen, near Pforzheim – site of the pilot project for the DEUS 21 concept; it houses installations for the treatment of rainwater and wastewater as well as for nutrient recovery

Should we separate our wastewater like we separate our rubbish?

New alternative sanitation systems (NASS) are based on the separate collection, conveyance, discharge, treatment and reuse of source separated flows (see Table 2). The aim of implementing NASS is the reuse of water and the utilisation of useful substances extracted from wastewater (especially nutrients and organic matter).

Table 1: Goals of NASS

Goals
1. Sustainable use or reuse of material and water flows in a recycling system. 2. Creation of cost efficient alternatives to current systems. 3. Broadening the range of treatment options for countries with inadequate sanitation. 4. Further development of the German water industry's competitiveness in the global market.

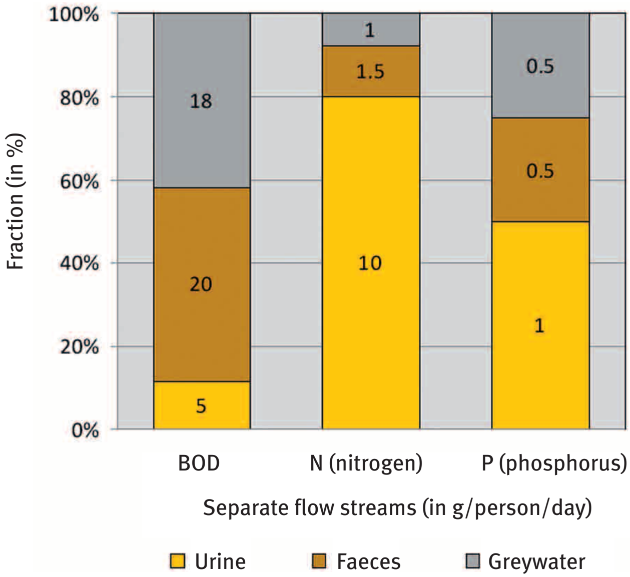
Table 2: Definitions of the most important wastewater streams

Term	Explanation
Excreta	Urine and faeces
Yellowwater	Urine and flush water
Brownwater	Faeces and flush water (and toilet paper)
Greywater	Wastewater without excreta (water from kitchens, showers, sinks, washing machines, etc.)
Blackwater	Excreta and flush water (and toilet paper)

Image left: View of a soil filter for rainwater evaporation and a visitor centre (with green roof), housing a multistage greywater recycling facility (close to Potsdamer Platz, Berlin)

Similar concepts are also known as: "ecological sanitation (ecosan)", "productive sanitation", "resources orientated sanitation", "sustainable sanitation", "decentralised sanitation and reuse".

Six different system types can be identified, which can be distinguished by the specific material flows and the technology used during their collection (see Table 3).



Top chart:
Content of the different domestic wastewater streams (urine, faeces, greywater) in percentages and absolute values (BOD is biological oxygen demand).

Image left:
Constructed wetland for greywater treatment at the Lübeck-Flintenbreite settlement

*Table 3: According to a classification based on the "Collected flow streams", six system types of wastewater infrastructure can be defined**

No.	Name of the system type	Flow separation	Source separated flows	Treatment objective
1	**Single material flow system (flush toilet, vacuum toilet)**	Mixed collection and discharge	Sewage	Discharge and removal Recovery and reuse
2	**Blackwater dual material flow system (flush toilet, vacuum toilet)**	Greywater separation Remaining wastewater with reduced load and volume	Greywater Blackwater	Recovery and reuse
3	**Urine diversion dual material flow system (urine diversion flush toilet)**	Yellowwater separation Remaining wastewater with reduced load	Yellowwater Brownwater/ greywater	Recovery and reuse
4	**Urine diversion triple material flow system (urine diversion flush toilet)**	Yellow- and greywater separation Remaining wastewater with reduced load and volume	Yellowwater/ greywater Brownwater	Recovery and reuse
5	**Faecal matter dual material flow system (composting toilet)**	Greywater separation Undiluted excreta No remaining wastewater	Greywater Excreta	Recovery and reuse
6	**Urine diversion triple material flow system (urine diversion dehydration toilet or UDDT)**	Yellow- and greywater separation Undiluted faeces No remaining wastewater	Urine/greywater Faeces	Recovery and reuse

* A separation of material flows is not strictly necessary for NASS: greatest possible resource utilisation is the priority (therefore, under certain conditions, System 1 can be regarded as NASS).

Did you know that there are NASS concepts that work without water?

By using the various technologies designed to collect, discharge and treat wastewater, it is possible to separate and utilise all the individual flows of wastewater. Human excreta can be collected, for example by using a vacuum toilet, and be transported separately from greywater. Urine diversion flush toilets enable the separation of yellow- and brownwater. Urine diversion dehydration toilets (UDDTs) and waterless urinals enable separation of urine and faeces and an odourless operation without the use of flushing water.

The system type **triple material flow system with UD** (see Table 4) is an example of one of the six groups. In this system, urine/yellowwater, brownwater and greywater are collected and treated separately. After urine treatment, liquid or solid mineral-organic fertiliser is created. Treating brownwater can create organic fertiliser or biogas as a renewable energy source. Greywater is treated separately and can be reused for various purposes.

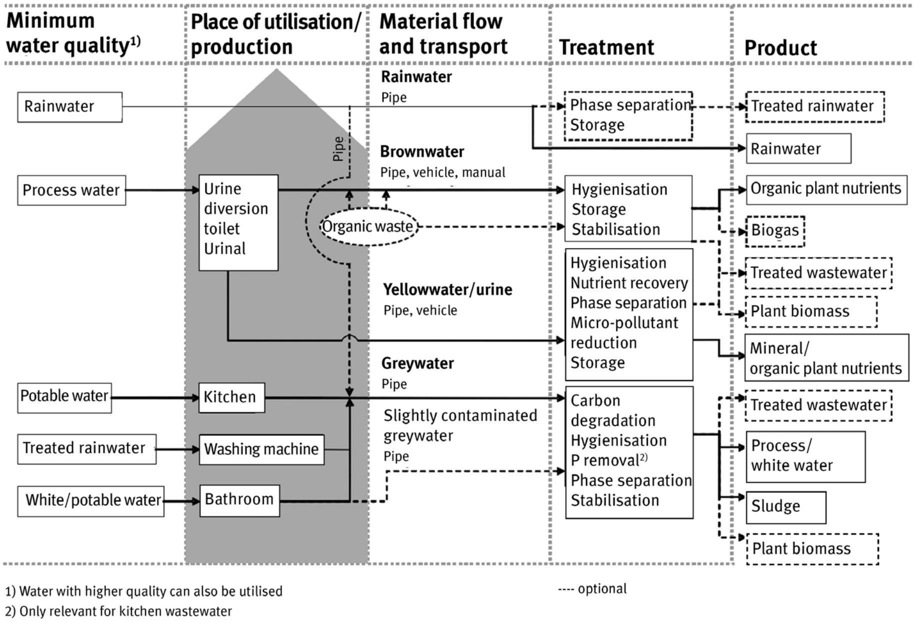


Table 4: Example of NASS: Triple material flow system with urine separation and brownwater treatment (see System No. 4 in Table 3)

Animal manure is used as fertiliser in the agricultural sector.

Why not also use human waste?

Nowadays we know that phosphorus resources are limited and dwindling, leading to fertiliser scarcity and price increases. Due to the growing shortage of high quality mineable phosphate ore, combined with rising energy prices, the cost of mineral fertiliser will continue to rise in the future. For many farmers in developing and emerging countries, mineral fertiliser is already unaffordable which inevitably leads to lower crop yields, hunger and poverty.

Domestic wastewater contains significant amounts of plant nutrients (nitrogen, phosphorus, potassium). In Germany these resources remain to date largely untapped and are instead removed from wastewater with great effort and expense (nitrogen and phosphorus elimination). NASS, however, produce substrates which can be used as fertiliser. Potentially 17 – 25% of the mineral fertiliser currently used in Germany, depending on the specific nutrient, can be substituted by NASS products.

NASS products are fertilisers whose fertilising effects have been fairly well assessed already.

Agricultural work in the fields in Germany

Human urine, in particular, can be used as a fertiliser with little or no treatment. However, a distinction has to be made between private and commercial use since pharmaceutical residues and pathogens can be found in urine (pathogens can be present in urine if it has been contaminated with faeces). The use of urine in one's own garden is possible without any health risks. Stored urine is suitable as fertiliser for commercial use in agriculture; struvite (ammonium magnesium phosphate) or ammonium sulphate – products which can be extracted from urine – are further options.

Should urine be approved as a fertiliser?

Currently, there are no clear legal guidelines for the use of products generated from NASS in Germany. Obtaining legal approval for fertilisers from NASS is desirable in order for these products to comply with fertiliser regulations so that they can be utilised legally. To date, the use of these products is only possible via an exception in the fertiliser legislation (for research purposes) or as a secondary resource and waste in accordance with recycling legislation.

Image left: Fertilising with stored urine in a field trial near Bonn, as part of the SANIRESCH research project

Image right: Harvesting urine-fertilised wheat near Bonn


365 Orte im
Land der Ideen.

How could existing sewer systems be converted to NASS?

Conventional wastewater treatment systems have resulted in a high degree of user satisfaction in Germany through past decades of large scale investment. However, the maintenance and refurbishment of the existing infrastructure now requires substantial new investment. Current estimates for the complete refurbishment of Germany's public sewer system lie at 50 to 55 billion Euro (DWA survey of 2004, see DWA Themenband NASS, p. 264) – a cost which will have to be met in the coming years and decades in order to address the current investment deficit.

The uncertainty as to whether these investments are sustainable in a rapidly changing world, is one of the main driving forces behind the development of NASS. Due to the necessary investments and the changing environment there are now opportunities for the implementation of the new technical possibilities offered by NASS.

Image left: A greywater recycling plant in the visitor centre of "Block 6", an apartment building near Potsdamer Platz in Berlin

Image right: Urine diversion dry toilet, as one example of a diversion toilet

Every change creates an opportunity

NASS technologies promise more flexibility to adapt to the rapidly changing conditions such as demographic change, rising demands on water resource protection and the effects of climate change. In addition, an opportunity to conserve water resources, to utilise energy contained in wastewater and to reclaim increasingly scarce phosphorus resources exists.

The gradual conversion of existing systems to NASS presents a challenge. Implementing NASS can have a positive or a negative effect on existing infrastructure. For example, the diversion of some source separated flows (or a reduction in drinking water consumption) could affect the transport of the remaining sewage flows and lead to a less efficient utilisation of existing sewer systems and wastewater treatment plants. These consequences need to be addressed in advance and require an increased planning effort for the implementation of NASS. Carrying out further NASS pilot projects is an essential prerequisite for long term implementation. Such pilot projects can increase the acceptance of this technology among policy makers and

the population at large. Furthermore, these projects can lead to the establishment of technical regulations and legally binding guidelines.

The high adaptability and the potential for cost efficiency of NASS lead to long-term benefits. In order for decision makers to consider NASS, incentive mechanisms should be created for the transition period.

Incentives for the introduction of NASS are also sensible when considering the potential of NASS for the international market (for example, 2.6 billion people worldwide live without adequate sanitation, often under conditions of water, energy and fertiliser scarcity). The propagation and implementation of NASS in Germany can be beneficial for entering new emerging markets abroad. This is particularly relevant in relationship to those countries that see Germany as a model for technical and sustainable development.

Greywater recycling plant at the "Am Kurpark Späth" Hotel in Bad Windsheim close to Erlangen

Table 5: Settings which suit NASS

When is NASS particularly suitable?

1. Shrinking or growing cities
2. Rural settlements and villages
3. New housing developments without connection to a sewer system
4. New housing developments where wastewater treatment plants are reaching their design capacity in terms of eliminating nitrogen
5. Mountains and holiday regions, nature reserves
6. Apartment blocks requiring renovation

For further reading:

DWA-Themen
Neuartige Sanitärsysteme
(Themenband KA 1), DWA 2008
available via the DWA shop
www.dwa.de/shop € 85.00

Website of the Sustainable Sanitation Alliance: www.susana.org

*Table 6: Examples of NASS projects**

The concept of NASS is not a future fantasy. It is state of the art technology with many ongoing projects worldwide. In German speaking countries there are project examples at the following locations:

1. "Block 6", apartment block in Berlin, near Potsdamer Platz (apartment block with a decentralised greywater recycling plant)
2. Berliner Wasserbetriebe office building, Berlin-Stahnsdorf (urine diversion flush toilet)
3. Lübeck-Flintenbreite (settlement with vacuum sewer system, constructed wetland)
4. Allermöhe, Hamburg (settlement with compost toilets, constructed wetland)
5. The hotel "Am Kurpark Späth" in Bad Windsheim, near Erlangen (greywater recycling plant)
6. Knittlingen, near Pforzheim, DEUS 21 project (settlement with vacuum sewer system, biogas production)
7. Huber SE company office building in Berching, near Nuremberg (membrane bioreactor for brown- and blackwater)
8. Emschergenossenschaft/Lippeverband office building in Emscherquellhof (urine diversion flush toilets, waterless urinals, urine storage, planted soil filter)
9. GIZ office building in Eschborn, near Frankfurt (SANIRESCH project: urine diversion flush toilets, waterless urinals, urine storage, struvite reactor, membrane bioreactors)
10. EAWAG office building in Dübendorf, near Zurich (urine diversion flush toilets, waterless urinals, urine storage)
11. Solarcity Linz, Austria (settlement with urine diversion flush toilets, constructed wetland)

* More information on these projects is available via the Sustainable Sanitation Alliance (www.susana.org/library).

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