CROSS-SECTORAL

Decentralisation of wastewater infrastructure in Eastern-Germany

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Federal regulation in Germany made decentralised wastewater treatment solutions viable alternatives to large sewer network systems. The implementation, however, is weakened due to path dependence.

Network infrastructures create high path dependencies due to the long life cycles of their technical components. Besides this, established knowledge and routines of decision makers, regulations, administrations and a well-rehearsed daily operation contribute to their persistence. Since high investments are bound to the sewers with a service life of approximately eighty years, wastewater infrastructures are a typical example of path dependent infrastructures. As a result, a dominating engineering logic has been established, which is taught at universities and technical schools. Moreover, the flexibility of large technical systems to adapt to changing framework conditions is limited due to technical reasons.

This article focuses on developments in a particular region of Germany, where demographic change, accompanied by social, economic, legal and technical transitions challenge the hitherto dominant central wastewater infrastructures. A relatively new generation of decentralised onsite wastewater treatment plants has been developed and technically optimized throughout the last few years and is becoming increasingly competitive with the dominant network system. We want to show the constraints of a system change by looking at a conflictive case of a particular wastewater association in Saxony (Eastern Germany). Referring to a constraint analysis, we give suggestions to overcome the path dependency for a more adaptive infrastructure setup.

Challenges in the wastewater sector

During the economic and demographic boom in the 1960s up until the 1980s, the dominating system logic of centralised wastewater management was successfully implemented in Western Germany. At the time of reunification in 1990, the state of the wastewater sector in Eastern Germany was very poor. Urban areas had old and run down sewer systems, while the rural regions were predominantly relying on cesspools. The cesspools were only considered as transitional technology to the central sewerage connection. Environmental policy fostered a catchup process to reach coherent infrastructure conditions with Western Germany. High subsidies were provided in order to adjust the Eastern German system to national standards, starting in larger cities and continuing to smaller villages. The sewers and wastewater treatment plants were dimensioned for regional growth.

By the end of the 1990s, it became obvious that the expected regional development did not occur: a large part of the new infrastructure was already superfluous due to a decrease in population in Eastern Germany. Water use has halved since 1990 in wake of demographic change and decrease of personal water consumption. In the federal state of Saxony, the population is projected to shrink from five million in 1990 to three million in 2050. Problems with technical functionality, increased blockages and corrosion of drains, water contamination and foul smells are consequences of the low and still decreasing flows (BGW 2005).

Public funds and subsidies have been constantly declining and today, particularly small communities are struggling to meet the standards set for infrastructure optimization by the national state and the European Union. The European Union Water Framework Directive mandates that all wastewater facilities are upgraded to a high standard by 2015. This directly affects the rural settlements, where the catch up process of sewerage construction has not taken place so far.

Experiences with overdimensioned infrastructures, population resistance against the expensive central sewer connection and exorbitant investments led to fading political support for the dominant central system. At the same time, onsite wastewater treatment technology was further improved and reached comparable environmental standards with the central plants.

In order to meet the EU wastewater standards in a more adaptive and cost effective way, Saxony changed its wastewater strategy in 2007: the Saxon Ministry for Environment and Agriculture (SMUL) subsidizes the building

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as well as upgrading (with a biological cleaning stage) of onsite water treatment technologies as alternatives to large wastewater infrastructures (SMUL 2007). This represents a radical shift in the paradigm from sewerage as a public service with central network system to an individual private responsibility under public control. Aspects constraining this shift between two socio-technical systems are empirically analysed by referring to a case study in a rural area, where the two alternatives (centralised versus decentralised) have led to a conflict (Wolf 2009).

The decentralised versus decentralised conflict

The case study covers a long conflict between two communities in the northern part of Saxony as a result of the question whether the households in village *A* (In order to preserve anonymity and privacy of interview partners, the name of the communities are not stated in this text) should be connected to the already established central wastewater treatment plant for village *B*. The region is severely affected by population loss and shortages of public funds. At the end of the 1990s, village *B*—having a more urban structure and a higher population density than *A*—made high investments in a centralised sewer wastewater system and a new treatment plant benefiting from high public subsidies. Practically all households in village B are connected to the system. In order to "close the gaps to the centralised system" and meet the legal requirements, the wastewater association considers it the best option to connect village A to the established treatment plant through a sewer system. The wastewater management of village A has been relying on private cesspools for decades. These are no longer meeting the required environmental standards—at least from 2015 on. While village *A* was a flourishing agricultural cooperative before the German reunification, today, young people have migrated to the cities and the few residents that are left live on large properties; with 48 per cent of the inhabitants are older than 50 years.

In 2002, the plans of the wastewater organization to install a sewer system in *A* were presented to the public. This led to a major debate: village *A* claimed this option to be unsustainable, as distances for the sewer systems are long and wastewater charges for them are expected to rise significantly. Its residents were not willing to invest in sewer systems that they expect to lie fallow in the near future.

As an alternative to the sewer connection to village *B*, *A's* residents favoured an upgrade of their cesspools to modern and regulation-abiding onsite treatment plants. They claim this option to be less cost intensive and more adaptive to the ongoing demographic transition. Nevertheless, the wastewater association insists on the centralised option, arguing that it is the more cost efficient and environmentally safer choice.

While the federal policy landscape has always been favouring central wastewater systems—and therefore the option favoured by the wastewater association—,in 2007 the federal "small sewage treatment plant regulation" (Kleinkläranlagenverordnung) gave municipalities the possibility to choose between centralised and decentralised options, in order to find an economically sound solution (SMUL 2006). Moreover, the upgrade of onsite treatment technologies may obtain subsidies if the comparative economic advantage can be indicated.

For this reason, each party commissioned cost comparison studies according to federal standards. The studies resulted in contrary results, each representing the view of its respective party. The second key point of conflict is the reliability of the water protection: the central plant is easy to control by the water authority and operated by professionals while the high number of onsitetreatment plants, which are run by individual households, are maintained and controlled by private firms only twice a year.

The discussion between the two municipalities has been ongoing for almost eight years without results. While the citizens of village A are fighting for a decentralised system, the wastewater association and the lower water authority insist on the centralised option. This very conflictive case is not representative of communities in Eastern Germany or Saxony in particular. Nevertheless, it explores typical constraints in decision making between a dominant technology and a competing technology in network industries. Beyond that, the case uncovers reasons for incoherence between the federal paradigm shift and the local persistence of old concepts.

Institutional constraints on a paradigm shift

Three types of constraints on decision making were identified: regulative (rules, policies, contracts, agreements), normative (knowledge, skills, competencies) and cognitive (values, goals, roles) (Scott 2001).

Regulative constraints appear due to unclear, ambiguous and incoherent provisions, which challenge their practical implementation. The major constraint hindering clear decision priorities is the cost-efficiency criterion based on the cost-comparison method. Although a federal standard is approved, the freedom to vary input factors leads to variable results. As the case study showed, every party is able to present a correct cost-comparison favouring its preferences. Further regulative constraints are caused by the lack of clarity in dealing with the decentralised system: rules for maintenance companies are ambiguous, liabilities in case of water pollution are—or at least seem to be—poorly applicable and a sanctioning system for individual plant operators is not fully developed. This is the case because such provisions were not essential for a successful performance

of the centralised system; they are not yet implemented in the authority's routines.

While the higher environmental authorities transfer the implementation of the regulation to the subordinate authorities, the latter lack experience and support in terms of how to employ them in practice. Lower water authorities and wastewater organizations have the obligation to guarantee water protection and thus fear that regulations for maintenance and operation of onsite-treatment plants are not strict enough. In order to avoid trouble they rather oppose the decentralised option. Legislative provisions may seem to be hard facts at first sight, but they are highly dependent on cognitive connotations. If there is no trust in them, they do not come into practise.

The central and decentralised systems follow diametric normative systems: while the roles in the central system are clearly defined in a hierarchical system from the EU down to the local public organization, the decentralised system has a more diverse role composition. New private actors and individuals have to be involved and responsibilities have to be divided between them and the public actors. This is not an easy task as the hierarchical system is highly consolidated. In our specific case, the lower water authority and the wastewater association declared to be overburdened with the new tasks and do not trust the fragmented management and control scheme.

The cognitive constraints are rooted in different strands of argumentation employed by the opponents. The proponents of the decentralised option—the federal environmental ministry, the upper water authority, the citizens of village *A*—use arguments based on supposed decreased costs and adaptation capacities to demographic change. However, the proponents of the central system—lower water authority and wastewater association—make arguments based on supposed the controllability of water protection, environmental and public health safety. Communication and trust between the groups on the 'decentralisation / adaptation' side and the 'security / control' side are poor and thus negotiation processes bypass each other. Different value systems and priorities lead to failure of agreements.

Analysis of regulative, normative and cognitive institutional aspects showed that the decentralised system does not yet have stable and fixed structures like the centralised system does. It reverts largely to structures it had to take over from the traditional system, which do not necessarily fit. If the readiness to experiment with new modes of collaboration and operation, maintenance and control is missing at the executive level, it is hard to implement new rules and procedures which are not coherently fitting with the old system.

Different interest coalition types

The advocates of the centralised and the decentralised system function in different ways: the established proponents of the traditional central system collaborate in well organized and trustful supply chains, which are closed to radical system changes. The wastewater association has its small number of partners to cooperate with. Besides obligatory cooperation with the water authority, those partners include consulting engineers and construction firms that are specialized in sewer system supply. Due to the long term collaboration, the coalition is well stabilized and based on trust relations. The partners have little interest in fostering a system change in which they do not have competitive experience. Public authorities—like the municipality or the lower water agency—who have to deal with financial shortages and decreasing human resources tend to employ low-risk procedures. They rather avoid innovations. Throughout the last decades, the centralised system has been validated by law and missing competition. Thus, there was no need to establish strong negotiation, communication and public relation structures in order to legitimate its persistence.

The proponents of the decentralised system form young, weakly organized open networks. The citizens of village *A* founded a citizen's action group without established cooperation structures. They put their emphasis on communication with high political bodies, scientists, private companies and local press. Through this, they established their own network outside the influence sphere of the traditional system, trying to legitimize the decentralised option. Through active communication they got more influence in the decision making process than legally defined and managed to block the decision making process. As the actors of the centralised system have fixed and stable procedures, they are not prone to react and adapt quickly to this situation. The decentralised system, not stabilized yet, has considerable flexibility to adjust to the reactions of the traditional system. Thus, it may take advantage of the inflexibility of customary structures.

Conclusions

Decentralised sewerage systems have lower entry costs and are more flexible to adapt to demographic changes. Demographic shrinkage and financial shortages may pave the way for them to become more eligible. However, the established institutional structures in the wastewater sector are specialized on centralised technologies and less suitable for decentralised solutions.

The step from the formal recognition of prospects of the new technology to its implementation may only be taken successfully if lower level actors (for example, wastewater associations) open up and are willing to leave their

established path. Higher level actors (for example, federal environmental ministry) have to assist the adaptation of regulative, normative and cognitive structures to make the alternative system competitive and practicable.

So what are the lessons learnt to encourage institutionalization of decentralised systems? Rules and regulations have to be clear and related to practise; if the application of the cost comparison method delivers ambiguous results, then uncertainties are too high to make it a real basis for prioritization of options.

Concerning the division of power and expertise in new actor networks, the change from the supervision of one professionally operated treatment plant to a high number of them requires the involvement of trustworthy actors who are able take over parts of the water protection tasks. In order to make this possible, a close cooperation and division of liabilities between wastewater associations, lower water authorities and private firms has to be promoted. Maintenance companies have to be empowered to reliably accomplish their tasks.

Capacity building, fortification of communication and information channels, education and strengthening of social infrastructures are indispensable prerequisites for decentralisation. Spreading responsibilities among diverse actors may only be met successfully if actors work closely together and establish strong trust relations. Individual operators of small sewage plants have to be made aware of their responsibilities. They need to be prepared and supported sufficiently in order to become capable of meeting their duties. Additionally, a control and sanctioning scheme for the maintenance and operation actors is needed. As with decentralised consulting, communication and education services for diverse actors become more important, water authorities and wastewater associations may need additional support to fulfil this task. Thus, human and financial resources for fulfilment of new requirements need to be provided.

Decision makers have to be aware of the fact that the existence of a promising technology alone does not necessarily lead to its fruitful implementation. Consideration of social and institutional factors contributes to the implementation of a paradigm shift towards decentralised technologies beyond the wastewater infrastructure and makes them valuable for network industries in transition.★

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