A tool for comparing economic costs of different sanitation options

This paper presents a standardised tool for comparing different sanitation options based on their economic costs. In Lower Austria the application of this tool is mandatory for receiving subsidies from the government for the construction of sanitation infrastructure.

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Abstract

A number of projects in developing countries have been or are developing planning tools based on the assumption that an appropriate planning process is vital for successful implementation of sanitation solutions. However, it should be taken into consideration that planning tools do not necessarily have to be developed from scratch. One could make use of successfully applied tools from other countries. Therefore the aim of this paper is to present a planning tool which is used by planners in Austria for the comparison of different sanitation options. The use of this tool, which is provided by the government, is mandatory to receive subsidies from the government for the construction of sanitation infrastructure. Different variants are compared based on their economic costs within a fixed set of framework conditions. Based on the principle that the solution having the lowest economic costs is the most favourable, this solution is eligible for receiving subsidies. To guarantee a standardised procedure a number of input variables, e.g. unit costs for investment and operation and maintenance, are fixed and can not be chosen freely by the planner. Strength and weaknesses of the tool towards its wider application are discussed.

Introduction

Appropriate planning is considered as crucial to improve sanitation in developing countries. Therefore different projects have been or are developing planning methodologies and tools. However, a wide range of tools exists already and is in use. Most existing tools focus on water borne sanitation and consider technical and economic aspects only. Despite it is believed that making use of existing tools as much as possible and only adapt them for different circumstances is possible, faster and more efficient.

This paper presents one tool which is used in Austria to compare different variants of solutions based on their economic costs. By adapting the cost base and extending or adapting the range of possible technical solutions this tool could be easily used within other framework conditions, i.e. in other countries. Moreover, using other criteria than costs would result in different tools, providing decision makers with additional data of different variants. Additional criteria could be e.g. energy consumption, resources-efficiency, greenhouse gas emissions, etc.

It is important to note that within specific framework conditions such tools only provide a comparison of different variants but do not anticipate a decision. Application of tools using different criteria will always require an additional multi-criteria decision support approach based during which social values for different criteria (weighting factors of the criteria) are applied. Up to a point, as will be shown later, such weighting factors can be incorporated into the tool already. While this can be done it is still not recommended as it adds to in-transparency of the entire planning process. Social values are therefore best introduced by the legal framework conditions or during the multi-criteria decision.

Key Points:

- To receive subsidies for investments in sanitation infrastructure in Austria it is mandatory to use a tool for calculating economic costs of different sanitation options.
- Technological solutions not in line with the legal requirements and the state-of-the-art can not be chosen
- A fixed cost base shall guarantee a standardised procedure and prevent misuse of the tool
- Other criteria than economic costs could be easily added to such a tool
- A comparison of options shall be objective and therefore not include „social values“ as criteria

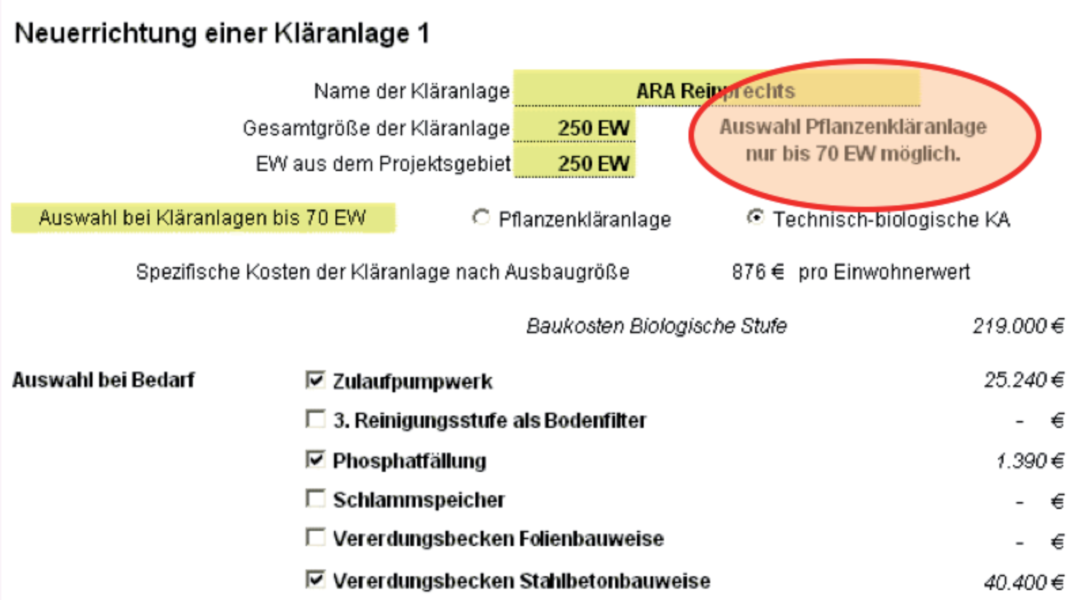

Figure 1: Screenshot – Built-in limitation of choice (in the red circle: "Choice of constructed wetlands possible only up to 70 person equivalents")

Methodology

The paper describes a tool provided by the Government of Lower Austria (Amt der NÖ Landesregierung, 2005). Using this tool is mandatory for planners for receiving subsidies for the construction of sanitation infrastructure. The tool comprises a number of MSExcel® spread sheets and the related documentation. Screenshots shown and information provided are based on the information provided in the tool.

Legal standards and state-of-the-art

The principles of the tool, the Austrian legal requirements and the state-of-the-art (which is defined by the local governments in Austria), are reflected e.g. by a limited choice of possible technological solutions. As an example, Figure 1 shows that the selection a of constructed wetland system for wastewater treatment is possible for up to 70 person equivalents only. This is based on the fact that larger constructed wetland systems are still not considered state-of-the-art by the relevant authority.

Legal Standards and even more the state-of-the-art are also reflected in the cost base of this tool. Costs of different technical units can not be chosen freely but are pre-defined. Necessarily these costs are based on average market prices, which adhere to laws and standards valid in Austria. Adherence to the standards is guaranteed by the fact that only variants can be considered for which a valid construction permit is issued by the relevant authorities.
In this way this tool incorporates legal and technical standards of the sanitation sector, eliminating the necessity to compare technological solutions from a technical point of view. Solutions which do not fulfil legal standards in a country or solutions which do not adhere to technical standards in place are not possible.
Deviations from this pre-defined framework conditions are possible but only in duly justified cases and require prior approval from the authorities.
As mentioned earlier the definition of these framework conditions in number, type and value theoretically allows the introduction of social values. This might be needed because the tool e.g. does not allow differentiation of operation cost for different types of technical wastewater treatment plants, thus neglecting the fact that some types may consume less energy thus requiring less recurring costs, thus being possibly cheaper from an economic point of view. Indirectly this fact poses disadvantages for treatment plants with actual low operational cost.

Cost Base

As mentioned before, the tool does not allow the planner to choose unit cost freely. The reason is to prevent misuse of the tool by "trimming" one variant which is socially/politically wanted to a point where it becomes the solution with the lowest economic costs. This has been possible in the past by using prices at the upper or lower end of a realistic price range for different units. Therefore the software accepts only entries of quantities for units and uses built in and non-modifiable unit prices.
In the tool costs for construction have been derived from tenders from projects implemented recently. As far as technical standards are concerned the costs introduced assume minimum requirements, additional requirements e.g. regarding the purification efficiency in sensitive areas can be added as additional treatment steps. Figure 2 shows as an example the cost base for investment (reinvestment) costs and operation and maintenance costs, respectively, for wastewater treatment plants.

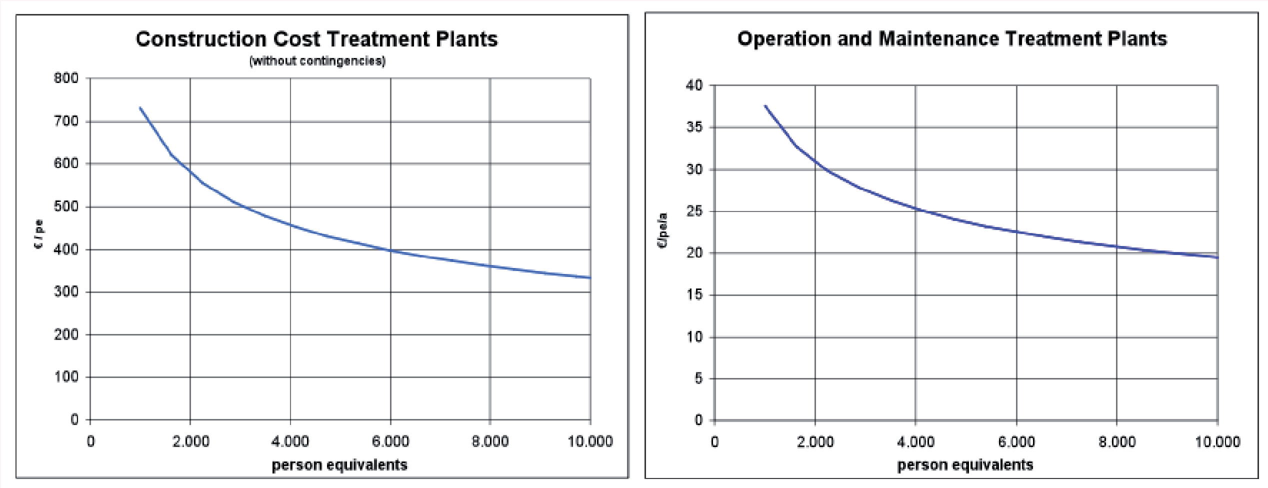

Figure 2: Construction costs (left) and operation and maintenance costs (right) in relation to the relative to design As**capacity of the wastewater treatment plant in person equivalent (Amt der NÖ Landesregierung, 2005, modified)**

already mentioned there is no differentiation between costs for different wastewater treatment technologies. It is clear that the disadvantage of this method is that actually justifiable deviations can not be considered. However, at least the basis for a certain result of the calculation is transparent and the results become comparable.

It is also clear that the introduction of political/social preferences is possible. In the case of the presented tool it has to be understood that it was developed for rural areas at a time where small, decentralised solutions were politically preferred. Therefore the cost base leans towards favouring decentralised systems by assuming relatively low costs for operation and maintenance of small treatment plants and relatively high cost for connecting to an existing sewer. This results in a tendency that smaller systems with short sewers are the preferred solutions from an economic point of view and therefore considered for subsidies.

Life span of inve stments

The lifespan of the various investments is considered with fixed values:

sewer lines	- 50 years
pumping stations	- 17 years
treatment plants	- 25 years

After these periods the tool assumes full reinvestment cost in the same costs (depreciated) as the original investments.

Cost Comparison

Cost comparison in the tool is based on the actual cash value methodology. For each variant the actual cash value (of one unit) is calculated using the following formula:

$$\sum_{n=0}^{pa-1} I(1+i)^{(a\cdot n)} + \sum_{n=0}^{p-1} OM(1+i)^{n}$$

where I = investment costs; OM = annual costs for operation and maintenance; I = interest rate (minus inflation); p = timeframe for cost comparison; and a = lifespan of unit.

The standard timeframe used for cost comparisons in Austria is 50 years. The presented method allows comparing the entire costs of investments, reinvestments and operation and maintenance for any number of solutions for this period.

Example

The following example of a small rural village in Austria shall highlight the use of the tool. As mentioned in the introduction the tool was developed for water borne sanitation only. Therefore in this particular case the only two variants compared were (i) the construction of a decentralised small wastewater treatment plant of 250 person equivalents and (ii) the connection to an existing sewer system of a nearby town (via 2 km pressure sewer) and treatment of the wastewater in the existing treatment plant.

In this particular case it is not necessary to compare the entire solutions but only those parts where the two variants differ. Therefore the entire sewer system in the small village has been neglected, being the same for both options. Consequently the comparison starts at the point where wastewater is either discharged to a decentralised treatment plant or pumped to an existing facility. Figure 3 shows the proposed location of a decentralised treatment plant („Option A“) and the required sewer for connection to the existing system („Option B“).

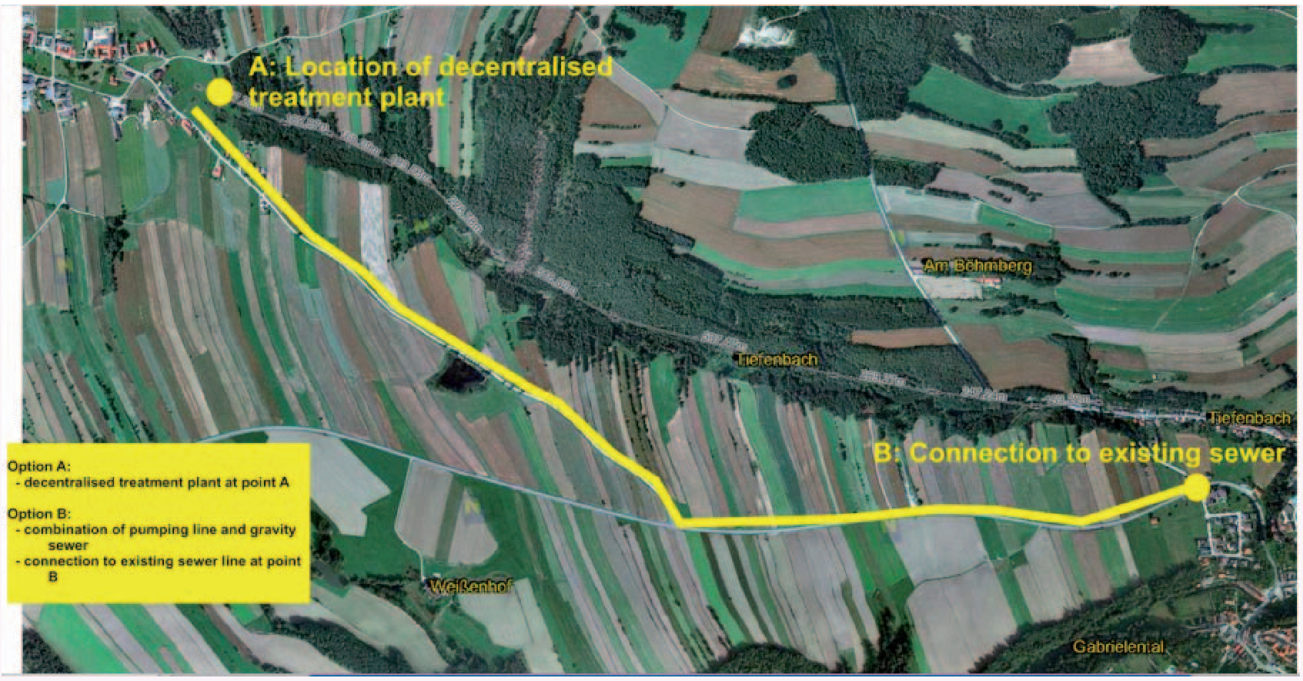

Figure 3: Aerial photograph showing the different option

For „Option A" additional costs for enhanced phosphorous removal had to be considered due to stringent requirements from the authorities. For this purpose the tool offers the selection of additional pre-determined cost for a phosphate precipitation unit.

For „Option B" additional cost for a pumping station with pressurised air were considered. The pumping line ends at the beginning of a combined sewer system of the town. To avoid odour problems during dry periods the authorities would not approve an ordinary pumping station. Here is one of the few options in the tool where own cost estimates can be introduced. However, such estimation requires prior approval of the authorities.

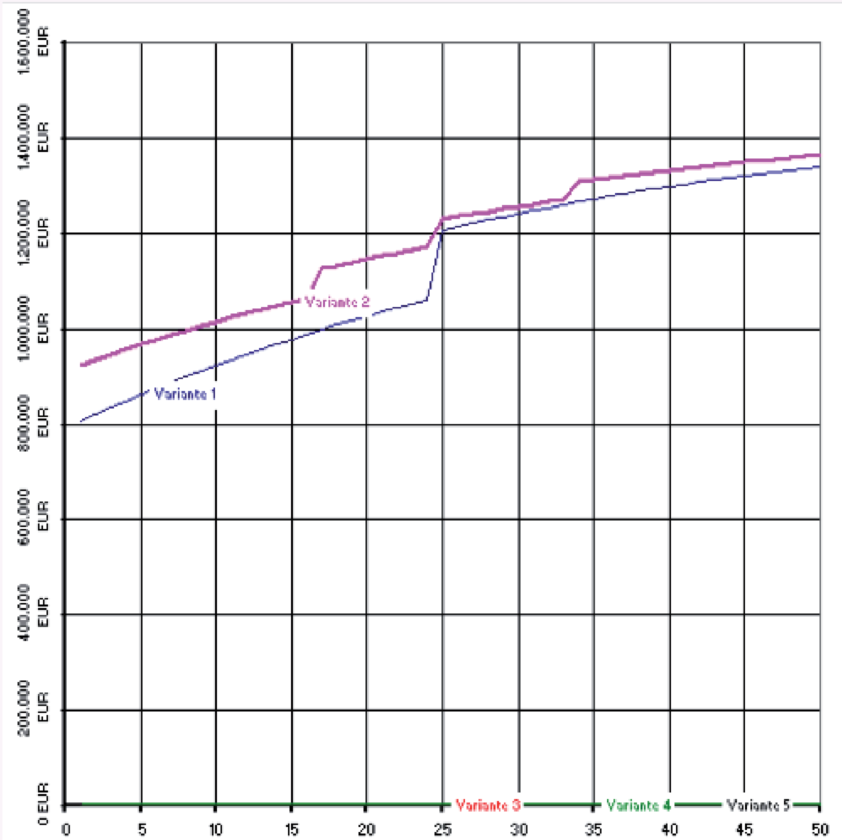

Figure 4: Result of the cost comparison of variant solutions („Option A" = Variante 1 = decentralised treatment plant; „Option B" = Variante 2 = centralised solution)

Figure 4 shows the results of the cost comparison. The decreasing effects of the consideration of operation and maintenance costs as well as reinvestments at the end of the lifespan of various different units can clearly be seen. In the case of „Option A" (= Variante 1 in Figure 4), the decentralised treatment system, shows slightly less costs over a period of 50 years and would be the solution which is eligible for receiving subsidies from the government. The client could still choose to implement „Option B" (= Variante 2 in Figure 4), however, full cost would have to be covered by the client without receiving subsidies.

The example also shows limitations of the presented tool. There is quite a high degree of uncertainty of the following assumptions on which this calculation is based:

- fixed interest rate of 3 % over the entire 50 years,
- fixed reinvestment periods and
- pre-determined costs for investment, reinvestment and operation and maintenance.

Considering these uncertainties it must be questioned whether a comparatively small cost difference (e.g. less than 2 % in the example) already justifies a decision for one or the other solution.

Conclusion

The tool presented, which is mandatory to receive subsidies, compares different variants based on their economic costs. While it has been specially developed for Austria and water borne sanitation solutions only by

- changing the cost base and
- adapting the possible technology choices

adaptation of the tool to other circumstances should easily be possible.

The main advantage of using such a tool is that it produces a transparent result with the main input parameters being fairly indisputable (mainly physical parameters).

Another main advantage is the a-priori consideration of technical and legal standards. This prevents the comparison of variant solution with different performances regarding certain parameters like for example purification efficiency, related health risk, building standards, etc. On the contrary it eliminates the need to consider all these criteria separately as solutions which do not fulfil the defined legal and technical minimum standards will not be allowed.

On the other hand, such standardisation has also disadvantages such as that the introduction of new, alternative technologies is difficult or even impossible if the tool is not updated regularly and new technological solutions are included.

Another major disadvantage is the uncertainty of the data base. However, the fact that all projects in a defined area and all variant solutions make use of the same data base clearly outweighs this inherent flaw.

There is also a number of parameters which is not considered in the tool. For future applications the development of similar tools in which economics being only one of the criteria when comparing variants is required. In cases where either the costs of two variants are close of where costs are not the (only) major issue, other criteria, e.g. energy consumption, resources-efficiency, greenhouse gas emissions, etc., may be introduced

References

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