

# How Much Extra Will Households Pay for Environmental Improvement? Impacts of Water and Sewerage Legislation in Preparation on Incomes of the Poorest Households in the South Bohemian Region

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## Abstract

Growing demand for water quality improvement has led to stricter legislation at the European Union level. The Czech legislation is beginning to significantly reflect the effort to meet the commitments. Environmental impacts along with guarantee of sustainability and reliability of drinking water supplies are the key point of regulation in the water and sewerage sector. The amendment to the Waters Act in preparation, along with other amendments, will lead to increased prices of water and sewerage charges, thereby being reflected in household expenditures. The effect of the changes in preparation is examined in the article among the lowest-income households in the South Bohemian Region. Based on micro models, it turns out that the lowest decile of households in the South Bohemian Region would expend an additional 0.5-1% of its incomes on water after all the changes are adopted. The impacts on different cities in this region differ the most due to existing infrastructure and wastewater treatment technologies. The presented results thus bring a more accurate estimate of the impacts than those presented by the study of the Ministry of Labour and Social Affairs, based on average data for the entire country. They clearly indicate the necessity to analyse socially sensitive issues at the local level with respect to considerable regional differences across the Czech Republic, which may cause significant distortions.

*Keywords: price of water; proportionality of regulation; Regulatory Impact Assessment; water and sewerage charges; local impacts; Waters Act*

JEL Classification: D14, G18, Q53

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## 1 Introduction

Water is considered a fundamental and necessary good for human well-being, and is tightly connected to development of societies. Sustainability development studies pay considerable attention to it [5]. There is a global pressure on environmental and water quality improvement. In this connection, the EU has adopted the Water Framework Directive, setting clear goals and directions in the area of water management and environmental protection. As part of the efforts to meet the requirements of the Directive, overall regulation of the water utility sector has been in preparation in the recent months, and there has been a considerable increase in legislative requirements on water and sewerage utilities, primarily in the area of water quality improvement and assurance of reliable and sustainable water supplies. Achievement of the environmental goals is associated with significant economic and social impacts.

The legislative process includes an assessment of proportionality of the regulation using a regulatory impact assessment process. The legislative changes in preparation involve both an assessment of impacts of each amendment separately and an aggregate assessment of the conceptual design for regulation in the water utility sector; the Government has commissioned the Ministry of Labour and Social Affairs to assess the social acceptability of changes to water prices. According to the study and forecast, the expenditures should increase the most in low-income families with children, namely up to 2.76% of the total family expenditures in 2020 [6]. However, no comprehensive assessment of the legislative changes in progress; only separate changes in preparation are assessed.

The paper analyses the impacts on expenditures of the lowest-income households associated with increased fees for surface/groundwater consumption, restricted utilisation of WWTP sludge on farmland [9], and definition of emission limits in wastewater. The paper is based on a complete study [4], where the impacts were analysed using a regional principle built on micro models, compiled for selected municipalities of different regions in which the water and sewerage charges are the highest. For these municipalities, we then calculated additional costs associated with the meeting of legislative changes newly approved and currently in preparation. The social acceptability of water prices is mostly perceived from the perspective of a whole country, but this approach does not correctly document the actual impacts on household expenditures due to considerable regional and local disparities. This paper therefore applies the “bottom-up” approach, i.e., one that is based on a reflection of situations in different regions. The South Bohemian Region was selected as the case for the purposes of this paper, as the local impacts differ the most in it. The situation in four cities of this region was used to model the impact. The analysis is based primarily on existing and approved RIAs [7], [8], [9], which contain expected impacts on businesses and expected partial cost increases.

The following chapter deals with the issue of socially acceptable price, which is often recognised as one of the rules of proportionality. Moreover, it briefly introduces the legislative changes in preparation, including the data used in the models described in the final part of the chapter. The third chapter presents the model results and their discussion. A discussion of the significance of impact modelling at the local level is part of the conclusion.

## **2 Material and Methods**

### *2.1 Social Acceptability of Water Price as a Proportionality Indicator*

The proportionality of regulation is often discussed in the area of water policy and the water and sewerage sector. The concept of social acceptability of the water price is often used as one of the primary indicators [2]. Thus, social acceptability of the water price influences the water and sewerage charges calculations in many countries [1]. The indicator is also used in the study by the Ministry of Labour and Social Affairs, the first one to assess the impacts of the legislation in preparation. It concerns the share of water expenditures (water and sewerage charges) in the total household expenditures. However, the rate of this share is not uniform according to different sources. The World Bank defines the acceptable share of water expenditures in proportion to the household income as 3-5%; the UN assumes a 3% threshold, and the OECD uses 4% [5]. For OP ENV projects in the Czech Republic, the social acceptability threshold is defined as 2%, but it is respected generally. The proportion is most commonly bound to the average household incomes in the country. Absolute quantification can be done across instead of relative figures. According to the State Environmental Fund [11], the socially acceptable water and sewerage fee price for 2016 is set at CZK 144.40/m<sup>3</sup> (valid for Prague as the maximum in the CR); the minimum is valid for the Moravian-Silesian Region, being CZK 93.93/m<sup>3</sup>.

The social acceptability of the water price involves comparison of calculations from many countries (e.g., Chile [10]), but the different quality of water supplied is not taken into account. In the CR, water is regarded as very good quality, often achieving parameters of baby water, but the quality in some other countries matches that of utility water and is not intended for drinking purposes. Therefore, the social acceptability of the water price should not be compared only from a purely economic point of view; correct comparison should take into account additional parameters such as chemical composition of water, its origin, need for purification, etc.

Generally speaking, the terms proportionality/acceptability are used increasingly often in recent years, not only when determining water prices. The notion of acceptability occurs in many other areas too, such as photovoltaics [12], power industry and housing.

## *2.2 Data Sources - Legislation in Preparation*

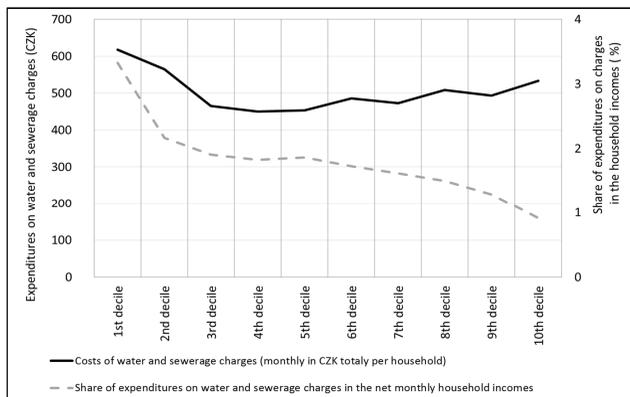
Nearly all newly emerging legislation is based on the Directive of the European Parliament and of the Council No. 2000/60/EC of 23 October 2000 establishing a framework for Community action in the field of water policy. However, regulation in the water utility sector is connected with numerous other areas, such as the impact of changes in waste management and a number of other regulations indirectly associated with the issue. In accordance with the EU law, the CR has adopted a Government Regulation on indicators and values of permissible surface water and wastewater pollution, requirements of permits for wastewater discharge into surface water and sewerage, and on sensitive areas [7]. The Ministry of the Environment (MoE) has developed regulatory impact assessments (RIA) for the individual changes to the Water Act, on which this paper is based.

The proportion of household expenditures on water and sewerage charges is published by the Czech Statistical Office; water and sewerage charges are published by respective utilities on their websites, and the other data are collected by the Ministry of Agriculture as part of Selected Data on Property and Operating Records of Water and Sewerage Networks (VUME, VUPE). We made the micro models described below based on these publicly available data and own designs.

## *2.3 Model Structure and Creation*

As part of the determination of the current burden on the lowest-income households, we first made an analysis of the current situation based on data on household incomes and expenditures in 2015 [3]. For the purpose of processing of impacts with respect to the lowest decile in the distribution of household incomes, we calculated with incomes up to CZK 6000 and up to CZK 8000 (net income per person in the household); these are amounts falling within the first decile; the income up to CZK 8000 is often in the second decile, resulting in an assessment of impacts on the first and second deciles with incomes of CZK 6000 and CZK 8000. Chart 1 shows the absolute costs of water and sewerage charges per different household income deciles at the CR level, and the share of expenditures on water and sewerage charges in the net monthly household incomes. It is clear from the data that the poorest households have the absolutely highest expenditures on water per person. The absolutely lowest expenditures on water and sewerage charges are in the 4<sup>th</sup> decile. The amount of expenditures continues growing in the other deciles. The costs of water and sewerage charges represent the heaviest burden for the poorest households. In the first decile, the costs of water and sewerage charges in 2015 were more than 3% of the net monthly household incomes; these expenditures were more than 2% in the second decile and less than 2% in the other deciles. However, data at the local level are not available in the same classification as the national data. Notably, they lack a division of costs by more detailed characteristics such as income deciles. The expenditures on water in the lowest household decile in each region could be determined using expert estimates and an array of data at the regional level (e.g., average expenditures and water consumption in the selected region).

**Figure 1. Household costs of water and sewerage charges by income decile in the CR in 2015**



Source: Authors based on [3]

The analysis of impacts of new legislation is based on micro models, made by selecting 4-5 municipalities in each of the 13 regions in the Czech Republic with the highest water and sewerage charges and including Prague as a whole. The impacts are thus calculated based on reflection of local disparities. In the South Bohemian Region, the impacts were modelled for the cities of Český Krumlov, Prachatice, Strakonice and Tábor. In total, more than 206 thousand equivalent inhabitants of the South Bohemian Region are covered with regard to wastewater treatment. The comparison uses data on household expenditures and incomes in 2015 in the South Bohemian Region and water and sewerage charges in 2015. The household expenditures were derived from average expenditures in the region and from the distribution of the expenditures by the income decile in the Czech Republic due to the lack of detailed data, The forecast calculations only include the impact of the legislative changes, and exclude any other impacts (e.g., energy price trends), and disregard the population income trend due to highly uncertain forecasts, potential oscillations of the economic cycle, primarily with respect to the lowest household decile as per income, on which these oscillations do not have a marked effect in the long run.

The impacts are reflected in the 2015 prices as an increase in each year, depending on the expected year coming into effect. We assume a reflection of 10% margin in the costs of investment and increased charges and 15% VAT for water and sewerage charges. The impact models are made so that the municipality either uses groundwater sources or surface water sources. In this connection, we assume a loss in networks and process consumption in water purification of 25.8%, meaning that 1 m<sup>3</sup> of water invoiced requires a consumption of 1.35 m<sup>3</sup> of raw water. According to the current legislation plans, the increase in groundwater consumption charges can be expected gradually from 2017. Besides, the impact assessment assumes implementation of charges for wastewater discharge from 2017. The restricted use of WWTP sludge on farmland can be expected from 2019. The stricter emission limits for wastewater discharges is expected from 2021.

The impacts were analysed using micro models separately for each city. First of all, the impact of legislation on current water and sewerage charges was calculated. Stricter emission limits were reflected through the growth in operating and/or investment costs for individual WWTP according to the current state and emission. This increase in costs connected with WWTP together with other newly established or increased charges (e.g. charges for wastewater discharge) forms the overall increase in costs and thus in water and sewerage charges. In the next step, the total increase of water and sewerage charges was reflected in the expenditure of poorest households (first decile).

Due to the increasing charges for groundwater consumption, increased charges for surface water consumption have to be considered as well. Each River Basin organisation raises its prices on an annual basis. The study also has to consider increasing prices of surface water consumption. Based on the price growth so far, we made a forecast of price trends until 2023 using a sliding average of the amounts for four previous years. The estimated amounts of charges for Povodí Vltavy excluding VAT are shown in Table 1. Including losses in networks, process consumption, profit margin and VAT, the end price will increase by CZK 0.12-1.1/m<sup>3</sup> in the different years compared to the 2015 prices, assuming 100% use of surface water.

**Table 1. Forecast of surface water consumption price increase in 2017-2023 (CZK/m<sup>3</sup> excl. VAT)**

| Year  | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|-------|------|------|------|------|------|------|------|
| Value | 3.77 | 3.85 | 3.93 | 4.01 | 4.09 | 4.18 | 4.27 |

Source: Authors

As concerns groundwater, the consumption charge should increase from CZK 2/m<sup>3</sup> up to the final CZK 6/m<sup>3</sup>, as of from 1 January 2022. This increase will be reflected in the end price of water as an increase by CZK 1.70 in 2017, CZK 3.41 in 2019, CZK 5.11 as of 2021, and CZK 6.82 as of 2022. In municipalities with predominant groundwater consumption, there will thus be a significantly greater price increase compared to those using primarily surface water.

The impacts of the increased charges for wastewater discharge to surface water and stricter emission limits on permissible pollution have been determined based on data on current emissions, technologies and extra costs distributed as depreciation of any investment associated with attainment of required concentrations. In the South Bohemian Region, the adoption of the emission limits proposed by the MoE [8] would require investment in reduction of total phosphorus emissions (Ptot) in all the four cities. Tábor would require the biggest investment; according to current concentrations, it would not meet emissions of total nitrogen (Ntot) and ammonia nitrogen (N-NH<sub>4</sub><sup>+</sup>) either. The calculation included depreciation of long-term tangible assets in depreciation class 5, i.e., depreciation over 30 years, the operator/owner's profit margin, and the VAT on sewerage charges. The increase in sewerage charges with average investment in light of various emission concentration proposals is shown in Table 2.

**Table 2. Impacts on sewerage charges from year of effect of decree (CZK/m<sup>3</sup>) compared to 2015**

| City          | Total expected average capital costs (CZK) | Cost in depreciation (CZK) | Cost of sewerage charge (CZK/m <sup>3</sup> ), incl. margin and VAT |
|---------------|--|----------------------------|---|
| Český Krumlov | 33,000,750                                 | 1,100,025                  | 1.02  |
| Prachatice    | 14,152,050                                 | 471,735                    | 2.08  |
| Strakonice    | 15,220,350                                 | 507,345                    | 0.42  |
| Tábor         | 404,942,750                                | 13,498,092                 | 12.51   |

Source: Authors

### 3 Results and Discussion

The individual increases to charges should take place gradually and the changes, or impacts on prices, are therefore assumed in 2017, 2019, 2021 and 2023. These increases are compared against 2015, which is considered the initial year before the change. The four cities studied in the South Bohemian Region will see increases in the water and sewerage charges of CZK 3.63-5.82 in 2017, and CZK 10.06-22.15 in 2023. Table 3 shows the total increase in the water and sewerage charges in each city and year.

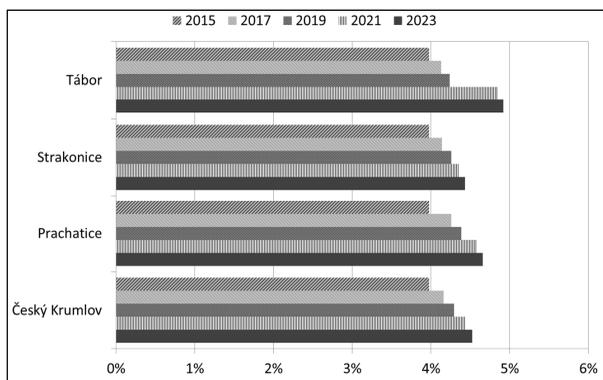
**Table 3. Water and sewerage charge increase (CZK/m<sup>3</sup>) in each year compared to 2015**

| City/year     | 2017 | 2019 | 2021  | 2023  |
|---------------|------|------|-------|-------|
| Český Krumlov | 3.63 | 6.23 | 8.96  | 10.66 |
| Prachatice    | 5.82 | 8.42 | 12.21 | 13.91 |
| Strakonice    | 3.63 | 6.23 | 8.35  | 10.06 |
| Tábor         | 3.63 | 6.23 | 20.45 | 22.15 |

Source: Authors

The increase in the water and sewerage charges due to the legislation changes can be further expressed as an increase in the share of expenditures on water in total household expenditures. The chart below shows the gradual increase in the share of costs of water and sewerage charges per household with incomes of CZK 6000 per person, i.e., households included in the first decile. Starting from 2017, we expect the implementation of a charge for groundwater consumption, a charge for surface water consumption, and a charge for wastewater discharge. Starting from 2019, we can expect an increase in the price associated with the restriction on use of wastewater treatment plant sludge on farmland. The stricter emission limits for wastewater discharges can be expected from 2021. Chart 2 shows the cost increases in the four cities of the South Bohemian Region – Tábor, Strakonice, Prachatice and Český Krumlov, selected as the cities with highest water prices in the Region. The most striking increase in the share in expenditures is seen in Tábor between 2019 and 2021; this area will thus be the most affected by the stricter emission limits, requiring an extensive adjustment to the wastewater treatment plant connected with massive capital investment costs. The impacts of the necessary adjustments will be perceptible for the following 30 years due to the depreciation period, i.e., at least for the depreciation duration. According to the analysis, the share of expenditures among the lowest-income households will not exceed 5% in any of the cities. Tábor is the closest to that threshold, with the expenditures being 4.92% of the incomes of households in the first decile. The share of expenditures on water is almost 0.5% lower in Český Krumlov and Strakonice.

**Figure 2. Share of costs per household with incomes of CZK 6000 per person (%) for selected cities**

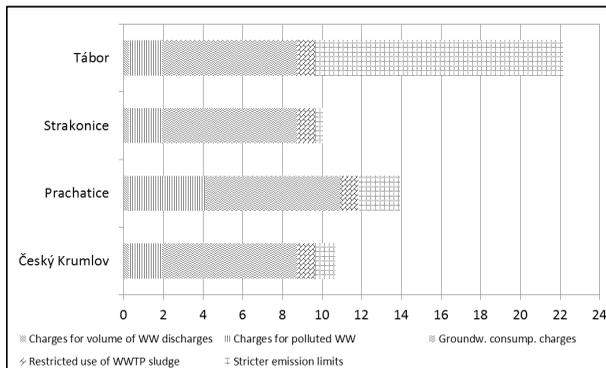


Source: Authors

The total increase in the water and sewerage charges should therefore be perceptible in 2023, after all the charges and legislative changes are implemented. Chart 3 below shows the individual items (charges) that will be reflected in the total water and sewerage charges in the four selected cities of the South Bohemian Region. In most of the cities, the increase in the water and sewerage charges will be associated mostly with the increase charge for groundwater consumption (from CZK 6.82/m<sup>3</sup>); in the case of Tábor, it will be the investment associated with meeting emission limits for the WWTP, amounting to CZK 12.51/m<sup>3</sup>. The component changes are

recorded in CZK per m<sup>3</sup>, including 15% VAT. On the whole, households in Tábor will pay CZK 22/m<sup>3</sup> more in 2023 compared to 2015. The other cities in the South Bohemian Region will not be affected much by the stricter limits on discharges, and the increase in the water and sewerage charges will not be as noticeable there.

**Figure 3. Expected increase in water and sewerage charges in 2023 (CZK per m<sup>3</sup>, incl. VAT)**



Source: Authors

The results presented above assume the maximum impact. Due to data availability, it was impossible to determine the exact amount of impact of the increase in the charges for surface/groundwater consumption. Municipalities using surface water as their source will not face such a high impact of the price increase. The decision on setting the emission limits will play a major role in the overall impact. If the stricter limits proposed by the Ministry of the Environment are implemented, the impact on the water and sewerage charges would be much more significant due to the failure to comply with the planned technical parameters in the majority of cases. The study assumed the average of the current proposals; the compliance is thus a question mark with a big influence on the final impacts.

#### 4 Conclusion

The objective of the paper was to assess the impacts of legislative changes in preparation on water and sewerage charges, or on the expenditures of the lowest household decile at the local level. The analysis of the local impacts showed that the poorest households have a noticeably higher relative share of household expenditures on water than maintained by the study of the Ministry of Labour and Social Affairs. Compared to the average expenditures of 2.8% of the total expenditures in 2020 among low-income families quoted by the Ministry, the above expenditures exceed in 4% of the total expenditures of the lowest-income households in the various cities of the South Bohemian Region in 2019. The difference is partly due to including different impacts on the water prices. Besides the increase in the charge for surface/groundwater consumption, the paper also assumes other impacts, including the need for investment in wastewater treatment plants due to stricter limits on quality of water discharged.

With respect to the decision-making process, the assessment of proportionality and acceptability has to evaluate all the impacts in aggregate, with an emphasis on the lowest-income households. Due to the significant differences, it is advisable in the event of significant legislative changes to carry out an assessment of impacts at not only the national level but also the local level on at least a sample of municipalities depending on data availability. Significant differences in the water management area can be observed even within the same Region due to the different infrastructures and technical equipment of treatment plants. On the example of the South

Bohemian Region, the impact on the expenditures on water differs by 0.5% of the total expenditures. Compared to the results from other municipalities, the impacts can be regarded as average with the exception of the city of Tábor. In the event of implementation of all the legislative changes, the study identified the highest increase in the water and sewerage charges in Prague, where the expenditures on water and sewerage charges would be up to 8% of the total expenditures in the lowest-income households in 2023. On the other hand, the comprehensive model identified the lowest share of expenditures on water in 2023 (3.5%) for Hradec Králové.

Based on the above results, it offers itself for discussion whether it is economically justifiable to increase the water and sewerage charges with respect to environmental impacts. Besides the direct financial effects, the assessment of the social benefits would require inclusion of additional non-financial and indirect utilities that the legislation in preparation and implementation of measures will entail. From a purely economic point of view, the price should always reflect the rarity of the good; only thus can responsible behaviour of consumers be achieved.

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