HOW TO MEASURE AND USE NATURE-BASED RECREATION EFFECTS: EXAMPLE OF RESULTS FOR THE VLTAVA RIVER CASCADE

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Abstract

Despite the long-term needs for research on benefits associated with recreation in nature-based areas that would be localized and methodologically sound, the evidence of such results is still very scarce at Czech and even at international level of tourism and recreation research, as well as in project evaluation practice. We strived for such results in a four-year interdisciplinary project "Recreational purposes of Vltava river cascade and its economic potential under the climate change". This contribution briefly presents the highlights of our results, the full set of results being publicly available at a web application https://shiny.fzp.czu.cz/kaskada-rekreace/ (in Czech language).

Based on the results of the project, we demonstrate and discuss the particular uses of various socio-economic indicators that have been estimated for the pilot site of the Vltava river cascade for communication with local stakeholders and regional to national decision-makers, for project/subsidy evaluation etc. This demonstration is relevant across disciplines such as water management, tourism, land management, nature protection etc.

Key words: water-based recreation; tourism impacts; recreation ecosystem service; climate change scenarios; interdisciplinary modelling

Introduction

Despite the long-term needs for research on benefits associated with recreation in nature-based areas that would be localized and methodologically sound, the evidence of such results is still very scarce at Czech and even at international level of tourism and recreation research, as well as in project evaluation practice. Practitioners will most likely fail if they try to find examples of research results that would be on top of that also comprehensive, simply commented even for non-economists, and directly utilizable in various levels and types of decision-making (national to local, strategic to operational etc.) eg. in tourism evaluation for destination management, regional development or spatial planning.

We strived for such results in a four-year interdisciplinary project "Recreational purposes of Vltava river cascade and its economic potential under the climate change" and aim to present them to the practitioners and researchers at the RAOP conference. Following a thorough procedure of linking climatic scenarios, hydrological model, water balance and water management model and several types of socio-economic models, we will show and discuss:

a) how the present visitation loads driven by water-based activities at the Vltava river cascade translate into the total societal value of recreation ecosystem service (relevant for cost-benefit analyses) and into total economic effects on the local and regional economy (incl. GDP and employment);

b) how climate change is expected to affect both the potential for recreation and these economic measures associated with water-based recreation; and

c) how the particular results (measures) are valid, robust and explicitly linked with their uses in decision-making (eg. cost-benefit analyses or communication with economic subjects in the area) in an intuitive and methodologically sound way.

Despite being mentioned as important for most multi-purpose water reservoirs, the quantification of social benefits of recreation is usually not covered in the applied research on prioritization of the allocation of water resources among different uses (including cost-benefit analyses and optimization models).

Materials and methods

The pilot area for this study is the stretch of the Vltava river from České Budějovice to the Vrané dam. The study benefits from an interdisciplinary modeling approach - we link climatic scenarios, hydrological/water balance and water management models and several types of socio-economic models.

Climate change scenarios for precipitation and temperature were developed using advanced delta change method, on the basis of three sets of climatic model simulations (CMIP5, CMIP6, LENS). After calibration of the estimates with observed data on precipitation and temperature and runoff series adjusted for water use in the Vltava Cascade pilot area, the scenario data series of precipitation and temperature were used as input into two models of hydrological balance (GR4J and BILAN), to estimate runoff and other variables related to future hydrological balance. Calibrated model GR4J, better performing at estimation of minimal runoff, was employed for the final simulation of future hydrological balance.

In contrast to the conventional evaluation of climate change impacts at specific time slices (eg. years 2020-2050, 2050-2070), the results of the study are reported for a change in hydroclimatic variables in relation to temperature increase (+1, +2 and +3°C), i.e. an indicator of the intensity of climate change; and are grouped into three clusters that represent three possible variations of the pattern of changes in hydroclimatic variables on the catchment area.

Socio-economic models were developed based on an original data survey in the area (Kaprová, 2020; Mácová 2022) and characterize: i) the total nonmarket social benefits related to water-related recreation activities in the pilot area in monetary terms estimated through a microeconomic model of recreation demand; and ii) the total market effect of water-related recreationists´ spending on the income of regional businesses and service providers, on regional employment etc. derived from cross-sectoral input-output analysis (Kaprová, 2022). Changes in recreation demand as a response to water level manipulation were modeled using contingent behavior model (for decrease of water level by 1-2 m) and benefit transfer function (>2 m). The aggregation of economic effects is based on mobile positioning data from CE-Traffic and T-Mobile, in combination with visitation trends reported by the Czech Statistical Office.

Details of the methodology are available eg. in Mácová et al. (2022).

Results

In terms of climate change impacts, three main trends are identified for the pilot area, all of which assume a decline in summer runoffs and an increase or stagnation in winter runoffs. Average annual runoffs increase for the most favorable cluster of scenarios even with up to +2°C warming; while for the two other scenario clusters, it always decreases compared to current temperature conditions, which holds for all temperature changes examined (+1 to +3 °C).

As climate change progresses, water management in the reservoirs becomes more intensive to ensure the main purposes of the storage function of the dams.

In terms of recreation, the analysis of water balance was used to quantify the probabilistic characteristics of water level fluctuations on three indicators of recreational use of the river and river banks – access to water from the river bank, possibility to use existing mooring spots by boats and navigability of the waterway.

In socio-economic analysis, we estimate that the intensity of water-related visitation at the pilot site reaches 5.7 to 8.9 million person-days annually. The presence of visitors at the pilot site translates into (i) annual social non-market benefits of 0.5-0.8 billion CZK (which represents an estimate of the social value of the recreation ecosystem service generated by water ecosystems at the pilot area). Further for market effects (ii), the total of 2.4-3.7 billion CZK of visitor spending related to visits to water areas at the pilot site translate into direct, indirect and induced effects on all sectors of economy, and yield 0.9 to 1.9 billion regional gross value added (a rough proxy for GDP), in total; and 900 to 1500 full-time equivalents as indicator of yearly generated jobs. Half of the market effects is generated in the area up to 10 km from water. All the socio-economic results reported in this paragraph were estimated and adjusted with the aim to represent an average year right before covid-19 pandemics.

The pressure on recreation use is expected to grow even in view of climatic scenarios. Less dramatic changes of water level (<2 m decrease) do not significantly affect the demand for water-based recreation at the pilot site and the predicted visitation intensities. For larger water level changes, there is a noticeable decrease in water-related recreational activities; however, for most scenarios these negative changes are offset by visitation growth in response to increased average air temperatures.

The average change in visitation loads and economic measures (i) and (ii) associated with water-based recreation at the pilot site are estimated for water dam Orlík and Slapy. The predicted effects of particular combinations of climate change scenarios and modeling clusters show a total decrease in

visitation (and subsequent economic effects) only for Orlík dam and the combination of scenario +3°C and the most unfavorable modeling cluster. For all the other scenario/cluster combinations at Orlík dam, the visitation intensity and economic effects are predicted to increase in future. For Slapy dam, all the scenario/cluster combinations up to +3°C suggest a total growth of social and market effects under climate change.

Discussion

The analysis is based on most up-to-date primary data and models. Robustness of the results was tested in all stages of modeling. Wherever applicable, the economic modeling and aggregation of the economic effects (i) and (ii) employ sensitivity analyses to parameter distribution, assumptions on distribution etc.

On the basis of the results presented above, we further demonstrate how to distinguish different economic indicators and their use in communication, and in project evaluation (not only in water management, but also in nature protection, project/subsidy evaluation in general etc). In some existing guidances that are available in CZ for use in decision-making (eg. SUDOP, 2017), various indicators are distinguished by their use. Other existing guidelines such as IP LIFE guidance on evaluation of effects of LIFE projects (and other subsidy evaluation guidelines) are less specific about which economic measure is relevant to achieve a potentially desired outcome. The explicit link of the monetary results with their uses in decision-making are described further below for the two types of economic measures analyzed in our project:

(i) Social value of the recreation ecosystem service generated by water ecosystems estimated through non-market valuation technique (recreation demand analysis) is a methodologically sound measure for the use in cost-benefit analyses of projects, for justifying the public expenses aimed at retaining/enhancing the recreation function of the area etc. This result is however not much comprehensive for eg. inhabitants of the area, owners and employees of businesses related to tourism. In this study, climate change will not most likely hinder the total social value of the pilot site for recreation - on the contrary, it is expected to increase.

(ii) Effects on regional economy are generally comprehensible for communication with economic subjects in the area and for discussions of projects/public support aimed at enhancing employment, regional GDP or regional income with national or regional policymakers. A bit thoughtful selection of particular economic indicators is needed as some (gross value added, employment in FTE) are more comprehensive than others (output, income) for presentation to non-macroeconomists and non-statisticians. For evaluation of projects, status quo needs to be correctly specified together with the boundaries of the analysis (national input output data are generally not sufficient for analysis of regional or local impacts of recreation on economy if most visitors to the place are of Czech origin; exemptions are one-off events). In this study, even under climate change the regional economy related to recreation use of the Cascade is most likely to grow.

In the trending ecosystem service accounting concept (EC, 2020), both concepts (i) and (ii) can be employed.

Tourist expenditure in a nature-based area is an indicator that remains (much) more easily measured than correctly clarified and used in policy-making. Perhaps interestingly for many decision-makers, the recreationist´s expenditure itself is not a correct measure of economic effect nor of recreation value.

Conclusion

The article focuses on social value and socio-economic impacts of water-related recreation associated with the largest system of dams in the Czech Republic that is characterized by multipurpose use. The results of this study are a vital prerequisite for more informed and therefore more sustainable analyses of climate change impacts on multipurpose use of water reservoirs.

We summarize the highlights of the results that are publicly available and concisely presented (in Czech) at a web application https://shiny.fzp.czu.cz/kaskada-rekreace/ (Strnad et al., 2023). The app also discusses the particular uses of various socio-economic indicators presented in this contribution.

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Souhrn
Přes dlouhodobou potřebu výzkumu socio-ekonomických přínosů spojených s rekreací v přírodních oblastech, který by poskytoval lokálně specifické a metodologicky dobře podložené výsledky, jsou takovéto výsledky výzkumu stále velmi vzácné jak na české, tak i mezinárodní úrovni výzkumu cestovního ruchu a rekreace, stejně jako v praxi hodnocení projektů. Ve čtyřletém interdisciplinárním projektu "Rekreační účely vltavské kaskády a její ekonomický potenciál v podmínkách klimatické změny" jsme se snažili takovýchto výsledků dosáhnout. V tomto příspěvku stručně představujeme jejich shrnutí, přičemž veškeré výsledky jsou dostupné ve webové aplikaci https://shiny.fzp.czu.cz/kaskada-rekreace/ .
Na základě výsledků projektu demonstrujeme a diskutujeme konkrétní využití různých socioekonomických ukazatelů, které byly odhadnuty pro pilotní lokalitu Vltavské kaskády, pro různé účely: komunikaci s místními aktéry, v rozhodování na regionální a celostátní úrovni, pro hodnocení projektů/dotací atd. Tato diskuse je relevantní napříč různými obory jako je vodní hospodářství, cestovní ruch, management krajiny, ochrana přírody atd.

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