Lucrările Seminarului Geografic Dimitrie Cantemir
Vol. 52, Issue 2, December 2024, pp. 1-17 (Online First)
http://dx.doi.org/10.47743/lsgdc.v52i2.01

Article

The Domestic Water Footprint of the Inhabitants of Iași Municipality. Preliminary results

Oana-Letiția CIUBOTARIU[1]✉ , Vasile JITARIU[1], Andrei-Cosmin OLARIU[1]

[1] *Department of Geography, Faculty of Geography and Geology, Alexandru Ioan Cuza University, Iași, Romania*

Abstract. The water footprint is an essential indicator reflecting water usage across human activities, encompassing blue, green, and grey footprints. It raises awareness of direct and indirect water consumption and its environmental impacts.

In our research, we developed a methodology based on bibliographic analysis, focusing specifically on the residential component of water usage. The results are based on average values of evaluated parameters, which provide suggestive insights. To gather data, we distributed a quantitative questionnaire to residents of the Iași metropolitan area. The preliminary findings, based on 175 anonymous responses, reveal an average water footprint of 7,999.277 liters per day per person. By comparison, the average daily water footprint is 3,397 liters globally, 3,287 liters in Europe and 4,627 liters in Romania. The highest footprint (11,536.22 liters per day) was found in Moara de Vânt-Țicău, while the lowest (6,293.57 liters per day) was in Centru. Statistical analyses were conducted to examine the relationship between water consumption and various demographic, educational and social factors (for instance, higher water usage among more educated individuals could be attributed to their habits or social influences). The study faced limitations, including poor questionnaire response rates, age restrictions, partial water footprint analysis, and uneven neighborhood distribution.

This study emphasizes the importance of the water footprint as an indicator for assessing sustainable water consumption.

Keywords: water footprint, sustainability, residential water usage, quantitative analysis, environmental awareness.

Résume. L'empreinte hydrique est un indicateur essentiel reflétant l'utilisation de l'eau dans les activités humaines, englobant les empreintes bleue, verte et grise. Elle sensibilise à la consommation directe et indirecte d'eau ainsi qu'à ses impacts environnementaux.

Dans notre recherche, nous avons développé une méthodologie basée sur une analyse bibliographique, en nous concentrant spécifiquement sur la composante résidentielle de l'utilisation de l'eau. Les résultats sont basés sur des valeurs moyennes des paramètres évalués, fournissant ainsi des indications suggestives. Pour recueillir des données, nous avons distribué un questionnaire quantitatif aux résidents de la zone métropolitaine de Iași. Les résultats préliminaires, obtenus à partir de 175 réponses anonymes, révèlent une empreinte hydrique moyenne de 7 999,277 litres par jour et par personne. En comparaison, l'empreinte hydrique

CORRESPONDENCE:
✉Bd-ul Carol I nr. 20A, Iaşi, Romania
@ oanaletitia99@gmail.com (O.C.)

ARTICLE HISTORY:
Received: 20.11.2024
Received in final form: 21.12.2024
Accepted: 23.12.2024

quotidienne moyenne est de 3 397 litres à l'échelle mondiale, 3 287 litres en Europe et 4 627 litres en Roumanie. La plus grande empreinte (11 536,22 litres par jour) a été trouvée à Moara de Vânt-Țicău, tandis que la plus faible (6 293,57 litres par jour) a été enregistrée à Centru. Des analyses statistiques ont été réalisées pour examiner la relation entre la consommation d'eau et divers facteurs démographiques, éducatifs et sociaux (par exemple, une consommation d'eau plus élevée chez les individus plus éduqués pourrait être attribuée à leurs habitudes ou à des influences sociales). L'étude a rencontré des limites, notamment de faibles taux de réponse aux questionnaires, des restrictions d'âge, une analyse partielle de l'empreinte hydrique et une distribution inégale des quartiers.

Cette étude souligne l'importance de l'empreinte hydrique en tant qu'indicateur pour évaluer la durabilité de la consommation d'eau.

Mots-clés : empreinte hydrique, durabilité, consommation résidentielle d'eau, analyse quantitative, sensibilisation environnementale

Introduction

Water is a fundamental and strategic resource for social development. Economic growth, poverty reduction, human health, and environmental conservation are closely linked to the use of water resources. Influenced by both human activity and climate change, the pressure on global water resources is increasing (Makki et al., 2013; Chen et al., 2017; Muthu, 2021). Urbanization, as being part of globalization and economic prosperity, is believed to contribute to the expansion of impermeable surfaces, which in turn reduces the infiltration of rainwater (Ursu et al., 2020); this means that the water resource can no longer be replenished through precipitation. Water is involved in all production processes of goods or services (Lee et al., 2016); many countries seriously waste this resource and, if the trend continues, by 2025, two-thirds of the global population will live in water-scarce countries and by 2030, the availability of freshwater resources worldwide will be 40% less than it is today (Lee et al., 2016).

Discussions and studies on water resources should address global management, limited freshwater renewal rates, sustainable water use for companies and consumers, and include green water alongside blue water consumption and pollution analysis (Hoekstra & Mekonnen, 2012; Hoekstra, 2017).

Although there are many studies on this topic conducted globally and in Europe, there are relatively few conducted in Romania. Given that the concept of the water footprint is relatively new in Romania, it is absolutely necessary to address the subject, particularly in light of the country's high per capita water consumption, which is a major issue (Ene & Teodosiu, 2009). Nationally, the most pressing issues include the low level of investments and the slow implementation of reforms in the national economy, including those related to investments in water infrastructure (Ene & Teodosiu, 2009).

Research on water footprints and virtual water trade has evolved significantly since 2009, emphasizing sustainability, equity and efficiency. Van Oel et al. (2009) pioneered the analysis of external water footprints in the Netherlands by linking them to local water scarcity, identifying critical hotspots for resource management.

Subsequent studies, such as those by Ercin et al. (2013) and Hoekstra and Mekonnen (2016), refined these approaches for France and the UK, respectively, highlighting water-use efficiency across different regions. Notably, Lenzen et al. (2013) illustrated how virtual water flows often originate from water-scarce areas, underscoring the global implications of these studies.

The global nature of water footprint assessments is evident in early works by Hoekstra and Hung (2002), which estimated water footprints for most countries, followed by more detailed assessments incorporating a wider range of products and higher spatial resolution. The integration of water footprint assessments into broader environmental and economic research reflects a growing recognition of the interconnectedness of water management and trade dynamics. As the field matures, it increasingly informs strategies aimed at achieving sustainable water use globally, particularly in the context of transitioning to a biobased economy and addressing the challenges posed by climate change (Hoekstra, 2017).

The water footprint is an indicator of direct water consumption (domestic water footprint, which includes water used for hygiene, cooking, car washing etc.) and indirect water consumption (virtual water footprint, which refers to the total volume of water used for producing a good; a significant portion of virtual water is of external origin); this tool also draws attention to the degradation of water resources (Ercin et al., 2012; Pahlow et al., 2015; Hoekstra, 2017; Lee, 2019; Maeseele et al., 2021; Cazcarro et al., 2022).

The concept of the water footprint, which Arjen Y. Hoekstra first proposed in 2002, is primarily intended to illustrate the hidden connections between human consumption and water use, as well as between global trade and water resource management (Vanham & Bidoglio, 2013). The main objective of the water footprint is to quantify the pressure imposed by the population's water demand on the environment (Lee et al., 2016; Konar & Marston, 2020; Maeseele et al., 2021).

Since it is important to know the source of water when calculating the water footprint, Hoekstra segmented it into three categories: green water footprint (originating from precipitation), blue water footprint (represented by the total volume of surface and groundwater) and gray water footprint (wastewater and the water required to dilute pollutants) (Ercin et. al., 2012; Pahlow et al., 2015; Lee et al., 2016; Hoekstra, 2017; Konar & Marston, 2020).

A country's water footprint is determined by the following factors: the volume of consumption (relative to gross national income), consumption patterns (e.g. type of diet), the water footprint per ton of products consumed, climate, and agricultural practices (Chapagain & Hoekstra, 2004; Hoekstra & Mekonnen, 2012).

The water footprint is the first indicator in evaluating the sustainability of water consumption (Ercin et al., 2012). In the context of globalization, sustainable development has become a challenge for the entire planet; the balance between

economic growth and environmental protection is quite delicate (Hoekstra & Chapagain, 2007). The rate of increase in water consumption has doubled in comparison to the rate of population growth, due to urbanization and worldwide population expansion (Lee et al., 2016).

Populations residing in regions abundant in natural resource reserves often perceive water as an entitled, reliable, and abundant resource. However, few are fully aware that external factors, such as climate change, significantly threaten its availability (Attari, 2014). In Eastern Europe, including Romania, projected climate scenarios indicate notable changes, including rising average annual air temperatures, reduced atmospheric water input, and an increased frequency of extreme pluvio-thermal events (Minea et al., 2022). These changes are expected to exacerbate drought periods, directly affecting water availability. Such fluctuations in water resources not only influence aquatic biodiversity but also disrupt the ecosystems surrounding aquatic areas. Consequently, declines in aquatic flora and fauna reduce the availability of food resources (Jitariu et al., 2022). All these issues support the need for implementing studies on water consumption among the population.

The increasing complexity and interconnectedness of disaster risk governance issues require much more flexible and innovative solutions, sensitive to local characteristics. Therefore, analytical capacity along with the recognition of the local context, as well as transdisciplinary thinking and public-private partnerships is necessary (Lee et al., 2016; Minea et al., 2022).

Specialized literature also offers a series of measures to improve the water footprint; Hoekstra highlighted that an association of technological, behavioral, and political tools is necessary for efficient water resource management. Among the proposed methods are: setting upper limits for the water footprint per watershed, establishing benchmarks for the water footprint per product and fair quotas for the water footprint per community, changing diets to food products with low water requirements (e.g. reducing the amount of animal products consumed, as they have a higher water footprint than plant products) and reducing food waste (about 21% of freshwater resources are involved in the production of food that ends up being disposed of) (Lee et al., 2016; Hoekstra, 2017; Mekonnen & Gerbens-Leenes, 2020). Only 4% of humanity's water footprint is linked to domestic water use. This means that if people consider reducing their water footprint, they should look more at their diet than at water use in the kitchen, bathroom, and garden (Hoekstra, 2012).

This paper aims to partially evaluate the water footprint of the inhabitants of the city of Iași, from the perspective of direct consumption (domestic water footprint) and diet (a component of indirect consumption). As Vanham & Bidoglio (2013) also state, conducting a water footprint assessment in practice can be challenging due to data availability and reliability. This study's data came from a questionnaire, which may have affected the results in an arbitrary way. According to Chen et al. (2017), the

water footprint calculated from the consumer's perspective is more useful than water consumption from the producer's perspective; this statement validates the choice of this study to apply the questionnaire from the perspective of the consumer population. By analyzing water consumption from the consumer's perspective, we can better identify how personal choices and behaviors impact overall water resources. This approach is particularly beneficial for developing targeted strategies aimed at promoting responsible water use among individuals. Understanding consumer behavior allows policymakers, educators, and environmental advocates to create effective awareness campaigns and interventions that resonate with the public, ultimately fostering a culture of sustainability in water consumption.

1. Materials and methods

Between May 14, 2024 and June 3, 202, and between November 5, 2024 and November 8, 2024, 175 respondents, citizens of Iași municipality, completed the questionnaire created on the Google Forms platform, which contained 6 sections. Of these, only 168 respondents chose to fill in the entire questionnaire. The participants in this study were aged between 18 and 59 years. The questionnaire was based on various online water footprint calculators and numerous studies in the field. The extremely limited number of such studies applied in Romania pushed the working team towards creating their own methodology inspired by recent previous research conducted in Europe, America and Asia. The primary inspirational research was conducted by Mekonnen and Hoekstra in 2011. Many of the food water footprints were also taken from the website healabel.com (Adriane, 2022), specifically from the "Water Footprint Of Food List" page and with small additions from: Aldaya & Hoekstra (2010), Bartocci et al. (2017), David (2013) etc. The spatial component of this study was based on mapping the respondents within 14 neighborhoods of Iași municipality: Copou, Păcurari, Moara de Vânt - Țicău, Dacia, Alexandru cel Bun, Centru, Cantemir - Podu Roș, Mircea cel Bătrân, Tătărași, Zona Industrială, Nicolina, CUG, Bucium and Galata. The responses were processed in the spreadsheet software Microsoft Excel 2021, using in most cases, the cross-multiplication rule. Water footprints were initially calculated in milliliters/week/capita and later converted to liters/week/capita.

Various statistics and graphs were created to better analyze the behavior of Iași citizens in terms of water consumption and classify them into a typology: wasteful or economical, depending on various socio-economic factors: age, average net income, level of education etc. The data collection tool provided respondents the opportunity in the third section to check the weight consumed per week for each food category (fruits and vegetables, legumes, animal products, beverages, berries, meat, nuts and seeds, oils, processed and ultra-processed products, other products, chocolate, sugar, cigarettes etc.). In the fourth section, the subject was asked about domestic water

consumption (bathroom and kitchen sink tap, shower, toilet, dishwasher, washing machine etc.), type of faucet and pets. In the fifth section, those who participated in the study were asked about the lawn area, how often they water it, how often they wash the car and by what method. In the final section, participants shared their views on current and potential measures to reduce or improve the water footprint.

The final water footprint was calculated by summing all the footprints from each response checked or written in the questionnaire from all its sections. Maps were also created in QGIS 3.36 software representing the average age of respondents by neighbourhood, the average net salary of respondents by neighbourhood and the average household water footprint of respondents by neighbourhood.

2. Results and discussions

In the context where globalization increasingly influences society and its behavior, consumerism is strongly influenced by the pressure and opinion of the community, especially friends and family. The evolution and development of consumerism have a direct impact on the water footprint, as water is involved in all existing processes, goods and services.

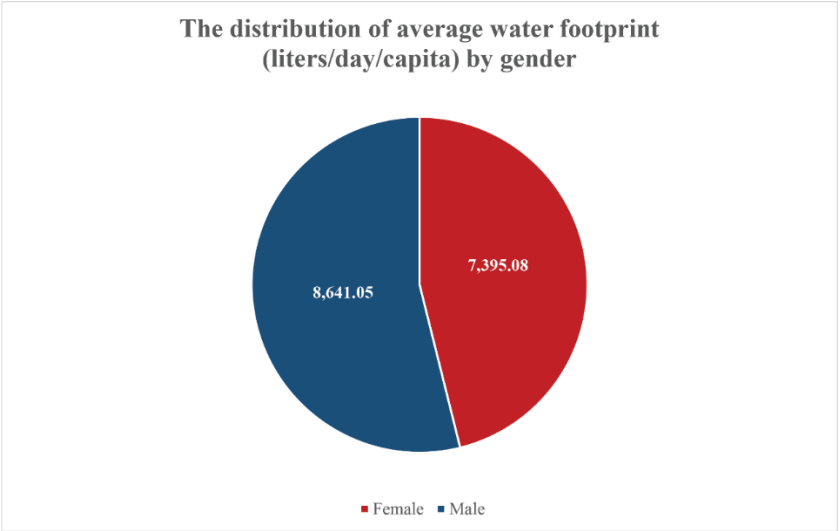

Figure 1. The distribution of average water footprint (liters/day/capita) by gender
Source: authors

The results of the survey conducted in Iași municipality were quite unexpected and surprising in some aspects. Figure 1 shows that individuals identifying as male seem to have a larger water footprint compared to those identifying as female, with this fact attributed to higher salaries among men than women, indicating a more profligate behavior. The difference between these two categories is approximately 1,246 liters per day per capita, which seems worthy of consideration by men for a

subsequent review of their behavior, diet and expenses. Since the present analysis also considered the virtual water footprint, this situation can also be explained by the fact that, in general, male respondents own more cars than female respondents, and therefore their final consumption is higher.

There is a positive correlation observed regarding the water footprint and the educational cycles of the respondents, in the sense that studies seem not to inspire more economical behavior; the more educated a person is, the more they consume (see Figure 2). The regression coefficient is positive (0.1869), but the expectations were that it would be negative, due to the fact that higher education fosters an environmentally friendly mindset.

One possible explanation is financial progress; as the level of education increases, so do incomes, allowing people to afford more modern and more expensive goods, including from the perspective of the water footprint. Social pressure is another factor that leads individuals to make more eccentric choices as they climb the social ladder. The water footprint is a quantitative indicator that qualitatively illustrates society's behavior. The modernization of the concept of social normality has led to an increase in individuals' behavioral and social expectations, resulting in accelerated resource consumption. Daily activities and habits must meet a certain social standard, thereby influencing individual water footprints (Jack, 2017). The high footprint of respondents with secondary school education can be explained by the fact that they still live with their parents and benefit financially from them.

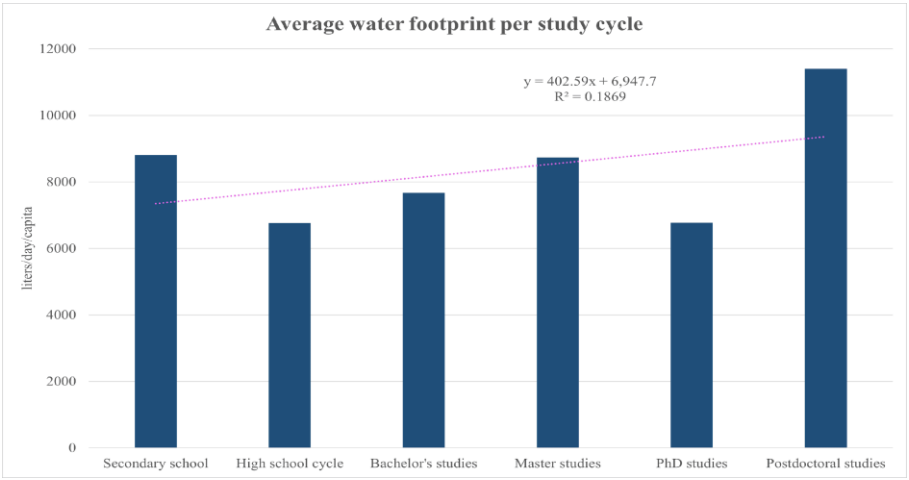

Figure 2. Average water footprint per study cycle
Source: authors

Iași is a relatively young city, as the map in Figure 3 also shows, mostly because it is a university center. The neighborhoods with the youngest respondents are Copou,

C.U.G., Zona Industrială and Tătărași, whereas the neighborhoods with the oldest respondents are Dacia, Mircea cel Bătrân, Galata, Bucium and Moara de Vânt - Țicău. This situation may be the result of these neighborhoods being preferred by students, either due to their proximity to the University (Copou) or due to the lower prices in more peripheral neighborhoods such as C.U.G. and Tătărași. On the opposite end, neighborhoods such as Mircea cel Bătrân, Galata, or Bucium attract a more mature, financially independent population that seeks to live for longer periods (or even permanently) in the same place.

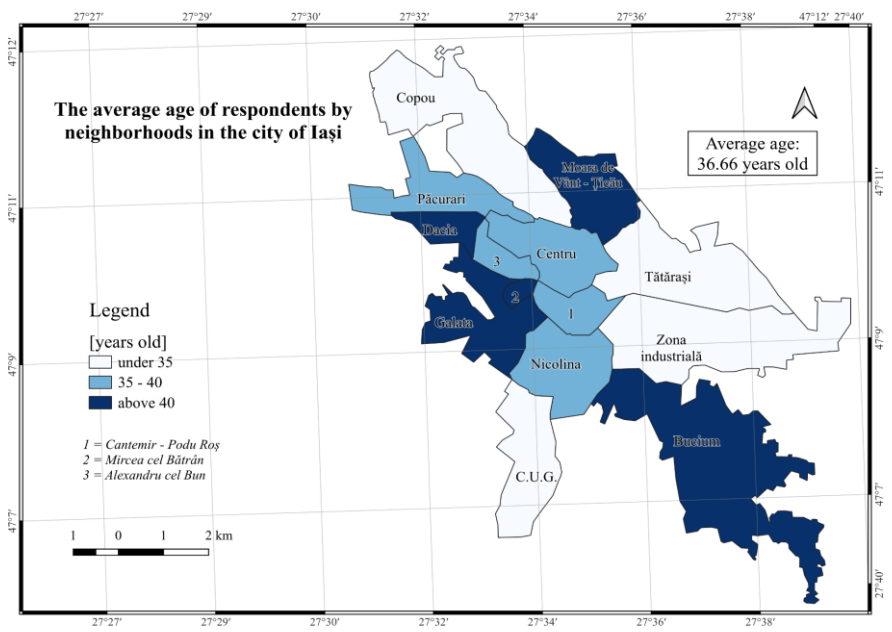

Figure 3. The average age of respondents by neighborhoods in the city of Iași
Source: authors

In general, it is observed that the average age of the respondents is quite low (36.66 years), but despite this, there are significant differences in terms of average net salary, water footprint and other indicators. The young age can be explained by the method of administering the questionnaire: online.

The correlation coefficient has values 0.03, indicating that there is no true correlation between water footprint and age (see Figure 4). However, it can be observed that the lowest values appear in mature adults (41-55 years old), likely as a consequence of rationing during the communist period (they are focused on an economical lifestyle). The highest values are recorded in the elderly (over 55 years old), where other needs (illness, raising grandchildren etc.) probably lead to higher consumption. The small number of responses limited the creation of larger age groups,

currently using the categories of young adults (18-24 years), mature adults (25-40 years), older adults (41-55 years) and seniors (55 years and over).

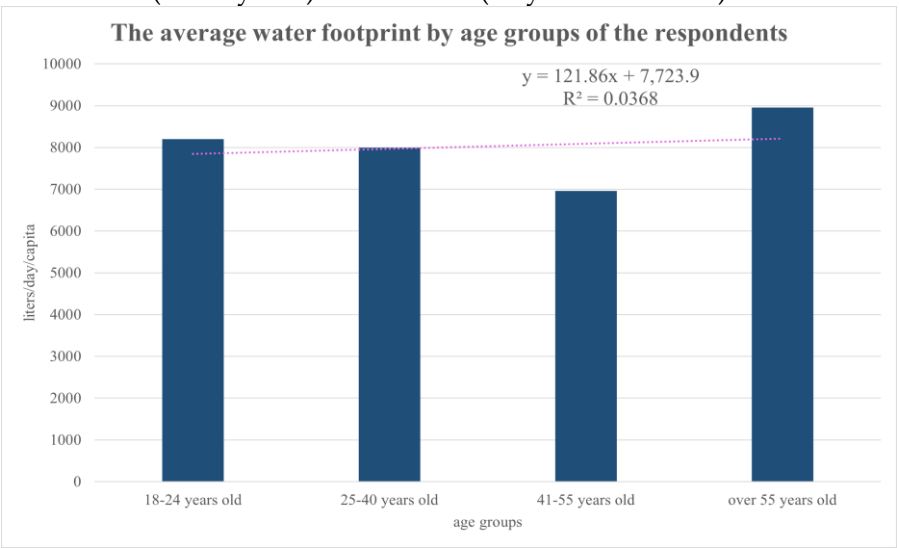

Figure 4. The average water footprint by age groups of the respondents
Source: authors

Between water footprint and average net income, because the correlation factor is very near to the 0 value (see Figure 5), does not exist a correlation. Therefore, the water footprint is not directly proportional to the average net income. However, the highest water footprint values belong to the group of people earning under 2,000 lei per month and those who earn over 8,000 lei per month. At the same time, the lowest value belongs to the group earning 2,000-4,000 lei per month, making it difficult to draw a conclusion in this regard.

People with the highest incomes (over 8,000 lei) can afford to consume more expensive goods and services, which generally have a higher water footprint (people in this category may also have an affinity for technology, as their high level of education allows them to access specialized information and equipment, which can also lead to a higher water footprint). Those who earn less than 2,000 lei but still have a very high footprint are very likely to live with their parents, which influences their lifestyle and choices. The category of those with an income between 4,000 and 6,000 lei per month also has a high footprint, as financial comfort allows them to fulfill their desires and maintain a decent standard of living. The income category of 2,000-4,000 lei per month includes those who are at the beginning of their careers and see resource-saving as a way to ensure a decent living. The salary category of 6,000-8,000 lei per month includes people who, although they can afford more luxurious conditions, choose to maintain a decent lifestyle because they understand how difficult it is to make money in the current economic context of Romania.

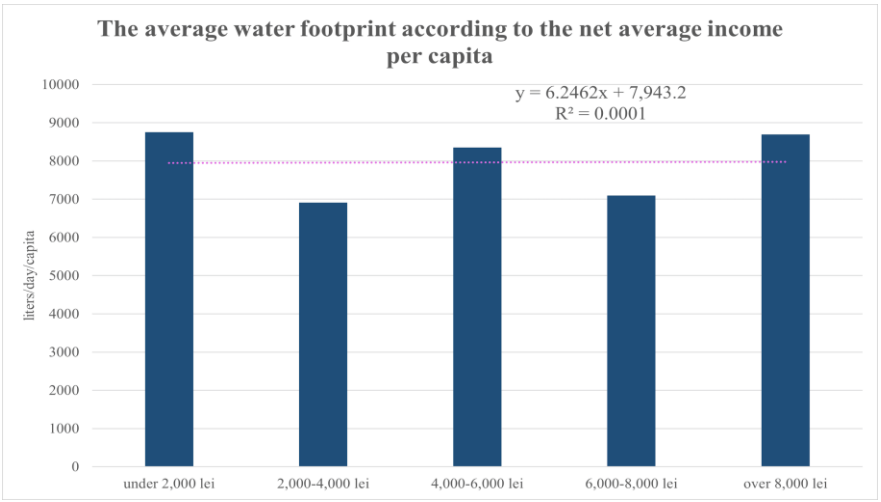

Figure 5. The average water fooprint according to the net average income per capita
Source: authors

There is a very slight positive correlation observed between actual water consumption expressed in cubic meters and water footprint, in the sense that the two quantities are inversely proportional: as more cubic meters of water are reported, the water footprint tends to be increasingly reduced, although it does not seem to be a strict rule (see Figure 6).

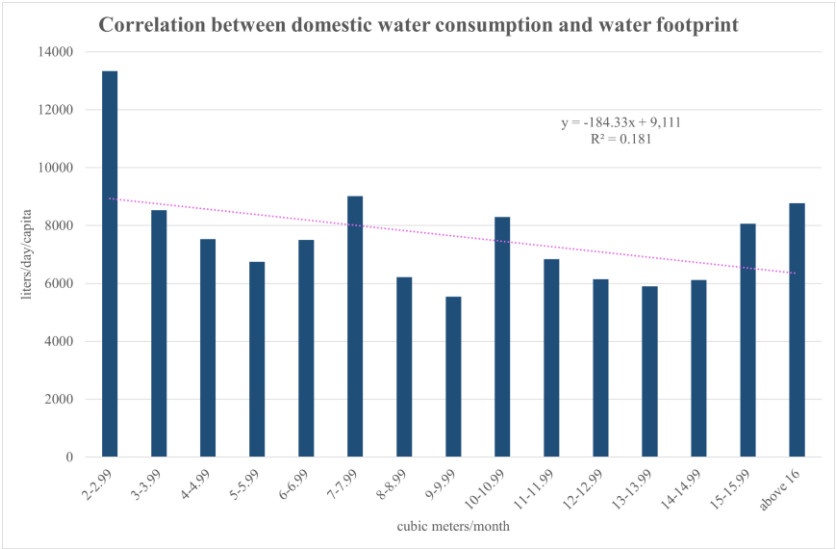

Figure 6. Correlation between domestic water consumption and water footprint
Source: authors

The expectations for this statistic were that the results would indicate a decrease in water footprint as the number of cohabitants increases, since a more restrictive behavior in terms of expenses and implicitly the water footprint would emerge (see Figure 7). However, no correlation is observed between the two variables

considered, suggesting that, based on this graph alone, a chaotic behavior can be noted. However, it is observed that the highest water footprint belongs to individuals living with at least 7 other people in the same household, which can be explained either by an exaggeration of their own water consumption or by an increase in their own needs. The level of education has a significant impact on the consumption of water as reported and taxed by the state, being more controlled as the level of education increases. However, when it comes to the water footprint, it increases with education (see Figure 8). Education encourages conscious water consumption, but formal education alone is insufficient for fostering a realistic understanding of water use and its environmental effects. Therefore, declared consumption and education levels are inversely proportional, while the water footprint and education levels are, surprisingly, directly proportional. This is because a more economical behavior is expected from the educated ones, theoretically, as they are more attentive to environmental needs than those with an average or low level of education. However, more educated individuals tend to be attracted to technological modernization, and thus end up having high water footprints, as they purchase products and services that are significant consumers of water resources.

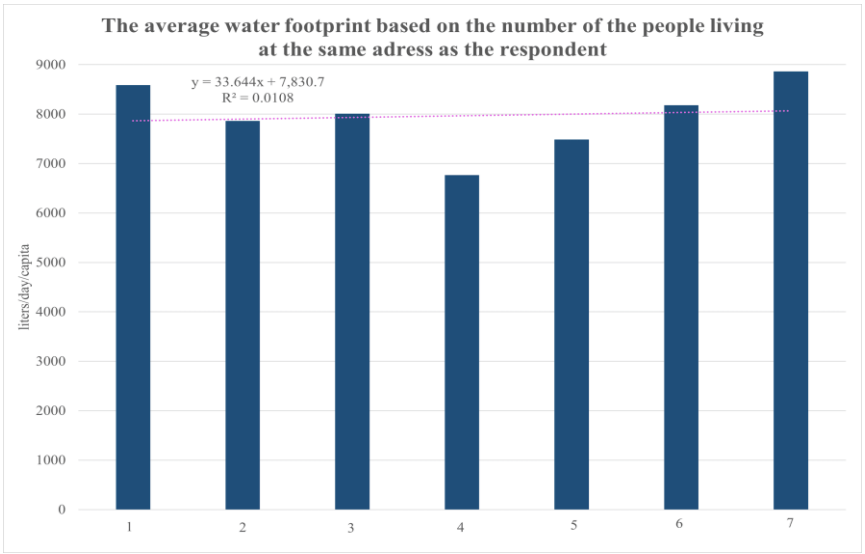

Figure 7. The average water footprint based on the number of people living at the same address as the respondent

Source: authors

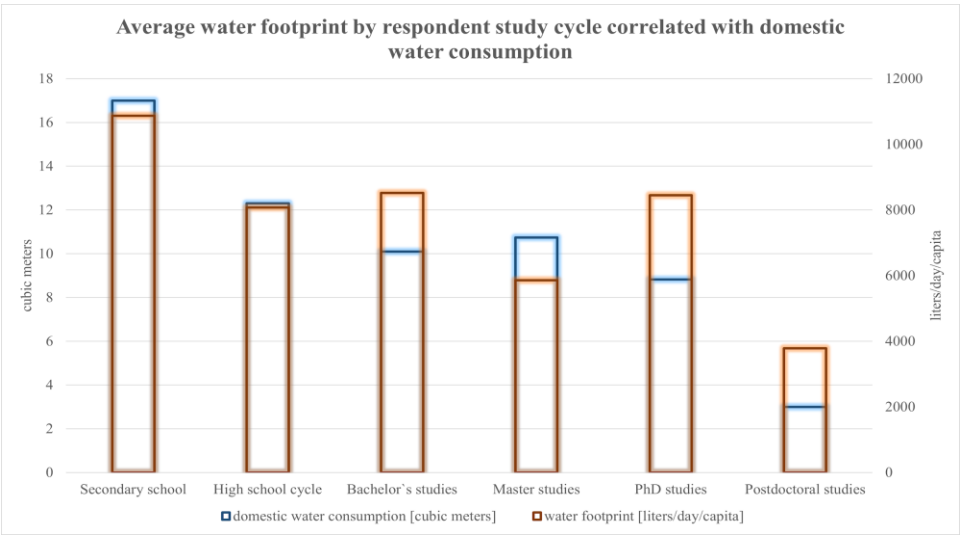

Figure 8. Average water footprint by respondent study cycle correlated with domestic water consumption
Source: authors

The water footprint map (see Figure 9) shows that the lowest footprint is found in Centru, while the highest footprints are recorded in neighborhoods such as C.U.G., Tătărași and Moara de Vânt-Țicău. In the neighborhood with the lowest footprint, survey respondents are typically aged between 35 and 45, an age where responsibility increases. This is compounded by the fact that most respondents here have incomes in the 2,000-4,000 lei per month range, which has the lowest water footprint. These factors contribute to more frugal behavior, as these respondents are at a life stage marked by significant expenses and modest income. In contrast, the neighborhoods with the highest footprints are located on the outskirts of the city, where numerous residential developments are being constructed. These areas also have the youngest average age among respondents, a demographic with a relatively high water footprint due to social pressures that encourage spending over saving. Moreover, this group often still relies on parental support, leading to less responsible financial behavior.

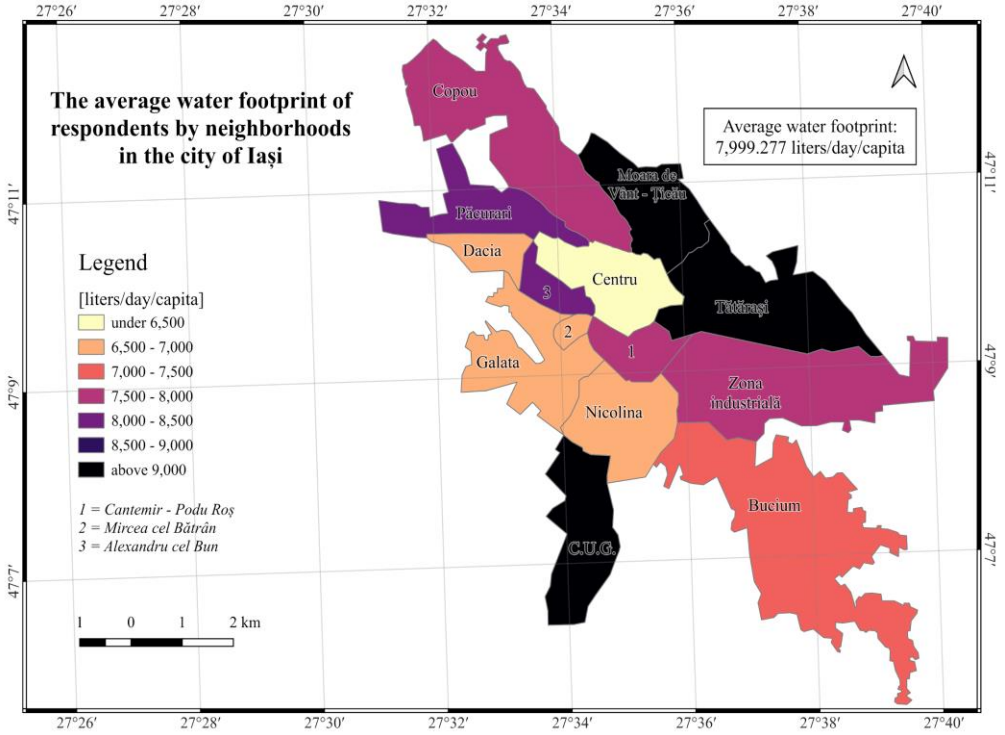

Figure 9. The average water footprint of respondents by neighborhoods in the city of Iași
Source: authors

Globally, the average water footprint is approximately 3,397 liters per day per capita (Chapagain & Hoekstra, 2004). At the European level, it averages around 3,287 (±557) liters per day per capita (Gibin et al., 2022), while in Romania, the average water footprint is about 4,627 liters per day per capita (Knoema, 2005). In the city of Iași, the average water footprint of respondents is around 8,000 liters per day per capita, which is relatively high. This can, however, be explained by the fact that it includes virtual water, a component that significantly influences the total consumption. The national water footprint reflects consumption in both rural and urban areas while also encompassing individuals with high incomes as well as those with low and very low incomes. These parameters may explain the high values observed among respondents from Iași Municipality, an urban environment where goods and services are significantly more diverse, accessible, and abundant, and where people have relatively higher salaries compared to other regions in Romania. The total value of the water footprint can vary considerably depending on the type of respondents.

From a few aspects, the present study had limitations. The response rate to the questionnaire was poor, combined with an uneven distribution of questionnaires over the neighborhoods, and this challenges the representativeness of our study. The

methodology we used was based on a mix of approaches reported in the literature. Another drawback is the age restriction, since people older than 60 were not surveyed, because distributing the questionnaire was conducted online, a format which is difficult to access for the elderly. Second, the water footprint reflected only part of the virtual water consumed, since we excluded virtual water consumed for transportation, clothes, book and medicine in order to reduce the width of the questionnaire. Neighborhood boundaries posed another challenge, as respondents living near borders might have selected a neighboring area. Moreover, we had extremely low response rates in both the middle school and postdoctoral education categories. This study was also time-intensive, requiring extensive data processing. Despite these limitations, the findings offer valuable insights into water footprint patterns and suggest further research directions.

This study is intended to be repeated in the future with a much higher number of respondents (at least 300 per neighborhood) to yield realistic results, thereby increasing the feasibility of implementing the proposed measures and solutions. Additionally, a similar questionnaire should be conducted in other county capitals within the North-East region, initially focusing on Bacău and Botoșani. Another goal is to cluster the results and subsequently redefine neighborhood boundaries based on population water footprint patterns.

Conclusions

The study of the water footprint is a topic of great interest in today's global context; climate change, along with economic and demographic developments, are key factors that significantly impact water resources. Therefore, understanding water consumption patterns is essential for the effective management of water resources.

In a nutshell, the preliminary results suggest that water consumption in Iași municipality correlates best with the level of education and less with age, actual water consumption or average net income.

The average water footprint identified in our research is approximately 7,999.277 liters per day per person, indicating a substantial level of water use that raises concerns about sustainability. The highest recorded consumption was found in Moara de Vânt-Țicău, while Centru reported the lowest at 6,293.57 liters per day.

The distribution of the water footprint highlights clear socio-economic and demographic differences across the city. Lower footprints in neighborhoods like Centru are associated with older, more financially prudent individuals, whose consumption habits are shaped by life stages involving greater responsibilities and modest incomes. In contrast, higher footprints in peripheral neighborhoods reflect the influence of younger populations, social pressures, and the rapid expansion of

residential developments. These findings emphasize the need for targeted water conservation strategies that address the unique characteristics of each community.

Notably, younger individuals tend to have a higher water footprint, averaging 11,536.22 liters per day in some areas, compared to older demographics. This trend indicates that higher disposable income among youth leads to more extravagant consumption habits, making them more wasteful than older individuals. This can also be explained by referencing the social behavior of individuals; most of the time, the group to which a person belongs will influence them to a greater or lesser extent. Social pressure is an important factor in the behavioral analysis of consumerism.

The findings of this study highlight the critical need for increased awareness regarding water consumption patterns among residents of Iași. Rather than simply advocating for an awareness-raising initiative to save water, it is essential to understand the specific factors influencing individual water footprints. This understanding can lead to more effective strategies for promoting sustainable water use, tailored to the demographic and socio-economic characteristics of the population. By addressing these underlying factors, we can foster a more informed and proactive approach to water conservation.

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID

Vasile JITARIU 0000-0002-7972-7995

References

Adriane, M. (2022). *Water Footprint Of Food List* [Science]. HEALabel. Available at: https://www.healabel.com/water-footprint-of-food-list/?fbclid=IwZXh0bgNhZW0CMTAAAR0x9b2S-cX1HlznqNDHmdm3u8gAHtPwlFCu4jr4zOOyZ2Ekrpu2J9a6SWs_aem_ASseHPktmIneRew2bCD5LuSbXbXh12aq1w91TRT6VMmefW_T4-Kix3gsFdM8IGcQo9mfRv-YzVH6Oa5LrZG_jpzc [Accessed 21 May 2024].

Aldaya, M.M. & Hoekstra, A.Y. (2010). The water needed for Italians to eat pasta and pizza. *Agricultural Systems*, 103 (6), 351-360. https://doi.org/10.1016/j.agsy.2010.03.004

Attari, S. Z., (2014). Perceptions of water use. *Proceedings of the National Academy of Sciences* 111 (14), 5129–5134. https://doi.org/10.1073/pnas.1316402111

Bartocci, P., Fantozzi, P. & Fantozzi, F. (2017). Environmental impact of Sagrantino and Grechetto grapes cultivation for wine and vinegar production in central Italy. *Journal of Cleaner Production* 140, 569-580. https://doi.org/10.1016/j.jclepro.2016.04.090

Cazcarro, I., Schyns, J.F., Arto, I. & Sanz, M.J. (2022). Nations' water footprints and virtual water trade of wood products. *Advances in Water Resources*, 164, 104188. https://doi.org/10.1016/j.advwatres.2022.104188

Chapagain, A.K. & Hoekstra, A.Y. (2004). *Water footprints of nations*. UNESCO-IHE Institute for Water Education

Chen, W., Wu, S., Lei, Y. & Li, S. (2017). China's water footprint by province, and inter-provincial transfer of virtual water. *Ecological Indicators* 74, 321-333. https://doi.org/10.1016/j.ecolind.2016.11.037

David, L. (2013). *Car Washing and the Environment* [News]. FSCW. Available at: https://www.fscw.us/Info/CarWashingEnvironment [Accessed 15 May 2024].

Ene, S.A. & Teodosiu, C. (2009). Water Footprint and Challenges for its Application to integrated Water Resources Management in Romania. *Environmental Engineering and Management Journal* 8 (6), 1461-1469. https://doi.org/10.30638/eemj.2009.213

Ercin, A.E., Mekonnen, M.M. & Hoekstra, A.Y. (2012). *The water footprint of France*. UNESCO-IHE Institute for Water Education.

Ercin, A.E., Mekonnen, M.M. & Hoekstra, A.Y. (2013). Sustainability of national consumption from a water resources perspective: The case study for France. *Ecological Economics*, 88, 133–147. https://doi.org/10.1016/j.ecolecon.2013.01.015

Gibin, D., Simonetto, A., Zanini, B. & Gilioli, G. (2022). A framework assessing the footprints of food consumption. An application on water footprint in Europe. *Environmental Impact Assessment Review* 93. https://doi.org/10.1016/j.eiar.2022.106735

Hoekstra, A.Y. (2012). The hidden water resource use behind meat and dairy. *Animal Frontiers* 2 (2), 3-8. https://doi.org/10.2527/af.2012-0038

Hoekstra, A.Y. (2017). Water Footprint Assessment: Evolvement of a New Research Field. *Water Resources Management*, 31 (10), 3061-3081. https://doi.org/10.1007/s11269-017-1618-5

Hoekstra, A.Y. & Chapagain, A.K. (2007). *Globalization of Water: Sharing the Planet's Freshwater Resources*. John Wiley & Sons. https://doi.org/10.1002/9780470696224

Hoekstra, A.Y. & Hung, P.Q. (2002). Virtual water trade: A quantification of virtual water flows between nations in relation to international crop trade. *Water Science and Technology* 49, 203–209.

Hoekstra, A.Y. & Mekonnen, M.M. (2012). The water footprint of humanity. *Proceedings of the National Academy of Sciences* 109 (9), 3232-3237. https://doi.org/10.1073/pnas.1109936109

Hoekstra, A.Y. & Mekonnen, M.M. (2016) Imported water risk: the case of the UK. *Environmental Research Letters*, 11 (5). https://doi.org/10.1088/1748-9326/11/5/055002

Jack, T. (2017). Cleanliness and consumption: Exploring material and social structuring of domestic cleaning practices. *International Journal of Consumer Studies*, 41 (1), 70-78. https://doi.org/10.1111/ijcs.12315

Jitariu, V., Dorosencu, A., Ichim, P. & Ion, C. (2022). Severe Drought Monitoring by Remote Sensing Methods and Its Impact on Wetlands Birds Assemblages in Nuntași and Tuzla Lakes (Danube Delta Biosphere Reserve). *Land*, 11 (5), 672. https://doi.org/10.3390/land11050672

Knoema. (2005). National Water Footprint statistics. Available at: https://public.knoema.com/syzodwc/national-water-footprint-statistics?location=1001580-romania [Accessed 2 June 2024].

Konar, M. & Marston, L. (2020). The Water Footprint of the United States. *Water* 12 (11), 3286. https://doi.org/10.3390/w12113286

Lee, Y.-J. (2019). Ecological Footprint and Water Footprint of Taipei. *Sustainability* 11(20), 5714. https://doi.org/10.3390/su11205714

Lee, Y.-J., Tung, C.-M., Lee, P.-R. & Lin, S.-C. (2016). Personal Water Footprint in Taiwan: A Case Study of Yunlin County. *Sustainability* 8 (11), 1112. https://doi.org/10.3390/su8111112

Lenzen, M., Moran, D., Bhaduri, A., Kanemoto, K., Bekchanov M., Geschke, A. & Foran, B. (2013). International trade of scarce water. *Ecological Economics* 94, 78–85. https://doi.org/10.1016/j.ecolecon.2013.06.018

Maeseele, C., Pradinaud, C., Payen, S. & Roux, P. (2021). L'empreinte eau—Memento graphique. https://doi.org/10.15454/RX5E-Q558

Makki, A.A., Stewart, R.A., Panuwatwanich, K. & Beal, C. (2013). Revealing the determinants of shower water end use consumption: Enabling better targeted urban water conservation strategies. *Journal of Cleaner Production*, 60, 129-146. https://doi.org/10.1016/j.jclepro.2011.08.007

Mekonnen, M.M. & Gerbens-Leenes, W. (2020). The Water Footprint of Global Food Production. *Water* 12 (10), 2696. https://doi.org/10.3390/w12102696

Mekonnen, M.M. & Hoekstra, A.Y. (2011). The green, blue and grey water footprint of crops and derived crop products. *Hydrology and Earth System Sciences* 15 (5), 1577-1600. https://doi.org/10.5194/hess-15-1577-2011

Minea, I., Iosub, M. & Boicu, D. (2022). Multi-scale approach for different type of drought in temperate climatic conditions. *Natural Hazards*, 110 (2), 1153-1177. https://doi.org/10.1007/s11069-021-04985-2

Muthu, S.S. (ed.) (2021). *Water Footprint: Assessment and Case Studies*. Springer Singapore. https://doi.org/10.1007/978-981-33-4377-1

Pahlow, M., Snowball, J. & Fraser, G. (2015). Water footprint assessment to inform water management and policy making in South Africa. *Water SA* 41 (3), 300. https://doi.org/10.4314/wsa.v41i3.02

Ursu, A., Stoleriu, C.C., Ion, C., Jitariu, V. & Enea, A. (2020). Romanian Natura 2000 Network: Evaluation of the Threats and Pressures through the Corine Land Cover Dataset. *Remote Sensing*, 12 (13), 2075. https://doi.org/10.3390/rs12132075

Van Oel, P.R., Mekonnen, M.M. & Hoekstra, A.Y. (2009). The external water footprint of the Netherlands: Geographically-explicit quantification and impact assessment. *Ecological Economics* 69 (1), 82–92. https://doi.org/10.1016/j.ecolecon.2009.07.014

Vanham, D. & Bidoglio, G. (2013). A review on the indicator water footprint for the EU28. *Ecological Indicators* 26, 61-75. https://doi.org/10.1016/j.ecolind.2012.10.021