

## Article

# Travelling Plastics: Exploring River Cruise Companies' Practices and Policies for the Environmental Protection of the Rhine

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**Abstract:** Since 2013, romantic Rhine cruises gained immense popularity in Europe. However, these tourism activities also involve the generation of large amounts of waste. As rivers contribute significantly to the plastic waste influx in the marine environment, it is essential that river cruise companies cope with plastics in an environmentally-safe way. In this contribution, we try to overcome knowledge gaps regarding both the plastic practices of river cruise companies and the policies on cruise tourism and environmental pollution. We adopt a multiple-case study approach and use the Social Practice Theory to analyse the companies' practices and challenges. Furthermore, we combine this with the analytical approaches of the Policy Arrangements and Synoptic Governance to explore the policies for environmental protection and tourism. The results show that, overall, river cruise companies have an eco-friendly approach to plastic waste management. However, dealing with plastics in the freshwater environment is not sufficiently rooted in the above policies: river cruise companies face important omissions in policies and facilities, resulting in plastic emissions in the river. Following the results, we formulate recommendations to support sustainable waste management routines onboard and to improve waste reception facilities onshore to protect the aquatic environment.

**Keywords:** river cruise tourism; Rhine River; social practice theory; policy arrangement approach; governance theory; macroplastics; microplastics; plastic pollution; wastewater treatment; waste infrastructure

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## 1. Introduction

Plastic pollution in freshwater and marine ecosystems is a major environmental issue of modern times since it causes a serious risk to human health and the ecology [1–3]. A substantial proportion of plastic waste from land-based sources flows through rivers into the marine environment [1,4,5]. One of the largest river basins of Europe, the Rhine, transposes approximately 20 to 30 tons of plastic waste to the North Sea each year [6]. With regard to this pollution in the Rhine, most scholarly attention is focused on microplastics [7–9] in comparison to macroplastics [6]. There is a lack of data about macroplastics in the freshwater environment, whilst these contribute significantly to the riverine plastic weight input to oceans [5]. Over time, macroplastics (>0.5 cm) present in the aquatic environment degrade into smaller particles of microplastics (<0.5 cm) [10]. To properly cope with plastic pollution in aquatic systems, our knowledge should be expanded concerning the origins, disposal, and degradation of macroplastics [11].

Research has shown that of the total amount of waste produced by the entire shipping fleet, about 25% is generated by cruise vessels [12]. In a study on the origins of plastic

waste in the freshwater environment in the Netherlands, Werner et al. [13] reported that inland shipping is a major source of plastic pollution. However, the different sub-sectors of inland shipping and their plastic emissions have not yet been investigated in detail. While research has been carried out on the impact of waste produced on board sea and ocean cruise ships [14], no single study exists on river cruise ship-generated waste. Hence, this study addresses this knowledge gap by investigating river cruising in relation to macroplastic pollution in the Rhine.

Europe's river cruise market represents about 41% (378 vessels) of the active river cruises worldwide and can be seen as the inland shipping sub-sector with the largest passenger capacity of up to 194 passengers per vessel. In 2019, over 1.79 million people opted for a journey on a river cruise in Europe, and the Rhine is considered one of the most popular destinations for cruise tourism [15]. Data show that this sector is rapidly expanding in Europe, which may increase its social, economic, and environmental impacts even more [16].

Research to date has not yet determined how river cruise companies deal with plastics, nor was the political arena (context) in which these vessels operate (i.e., policy domains of environmental protection of the Rhine and river cruise tourism) researched. The primary aim of this contribution is to gain a better understanding of Rhine River cruise companies' practices related to plastics and investigate how policies of tourism and environmental protection influence these plastic practices. A secondary purpose of this paper is to develop policy recommendations to improve Rhine River cruise companies' practices when dealing with plastics. Therefore, this paper's research question is: what are the dynamics of interaction between the policy domains of environmental protection of the Rhine and river cruise tourism and how can policies be enhanced to improve Rhine River cruise companies' practices related to plastics?

This paper is structured as follows: in Section 2 we operationalise the theoretical concepts used. Section 3 addresses the methods chosen. Subsequently, the findings that provide valuable insights into river cruise companies' practices, are addressed in Section 4. Lastly, policy recommendations are presented to promote sustainable solutions to river cruise companies' current plastic waste management practices.

## 2. Theoretical and Conceptual Framework

The theoretical angle of this investigation is a combination of (sociological) theories on both social practices and governance arrangements. It mainly uses the perspective on social practices of Shove, Pantzar, and Watson [17] and combines this with ideas on policy analysis, more specifically with the Policy Arrangement Approach [18,19], as well as a synoptic view on governance. These different angles are combined in the conceptual model that is guiding the research project (Figure 1).

There are many theories that focus on the social patterns and social practices in our societies and a group of theories have come to be known as 'practice theories'. Schatzki [20,21], inspired by Wittgenstein, emphasised intelligibility and understanding in the 'flow of praxis' and Bourdieu [22] developed his idea of 'habitus', wherein rules of conduct, norms, and forms of understanding influence social patterns. Shove et al. [17] developed one approach to social practices where, following Reckwitz [23] (p. 249), a practice is a 'block or pattern' of bodily and mental activities, things and their use, understanding, knowledge, and 'states of emotion and motivational knowledge', and applied it to tangible and practical levels of practice: showering, skateboarding, or using materials and plastics on river cruises. Shove et al. [17] emphasised that comprehension of the elements of practice and their interconnectedness should be at the core of policy initiatives on sustainable living. When more environmentally friendly patterns of consumption are desired, the practices should be altered to make them more sustainable instead of teaching people to make different choices [24]. The elements of a social practice are summarised with and condensed to a conjunction of *matter*, *competence*, and *meaning*. The *matter* element consists of things and items, the human body, apparatus, tools, and infrastructures [17].

*Competence* as a combination of having practical knowledge and several tiers of understanding. Finally, *meaning* is ‘collapsing’ mental activities, emotions, and motivational knowledge into one—referring to ways of thinking (and feeling) in certain ‘timespaces’ [17] (pp. 23–24). According to Shove et al. [17], there are three scenarios considering the integration of the three elements of practice, namely, proto-practices (elements are not yet linked), practices (elements are linked), and ex-practices (linkages between different elements are no longer sustained). When routinised, the same elements are continuously linked in a similar manner. When the effectiveness of particular configurations is desirable, connections between elements should be re-established regularly, otherwise, these connections dissolve [17]. Policymakers can influence elements, interrelatedness, and trajectories of practice and processes of reproduction. Practice theory offers a conceptual and intellectual foundation for developing action plans and policy interventions to deal with complex challenges such as giving rise to routines with higher sustainability [17].

The Policy Arrangement Approach (PAA), introduced by Van Tatenhove, Arts, and Leroy in 2000 [18], was used to understand the dynamics of interaction between different policy arrangements (PA). We identify two such arrangements in this study, namely the arrangement for environmental protection of the Rhine and the one for river cruise tourism and their influence on the cruise companies’ practices related to plastics. A PA is defined as “the temporary stabilisation of the organisation and substance of a policy domain at a specific level of policymaking” [18] (p. 54). Liefferink [25] visualised the PA as a tetrahedron that is shaped in terms of the *actors*, *resources*, *rules of the game* and *discourses* dimensions. The dimensions of the PA are interlinked, which means that a change in one dimension affects other dimension(s). Scholars could enter the tetrahedron via each of these dimensions. For this project, we chose to access the tetrahedron via the *rules of the game* and *discourses* dimensions. Firstly, the *rules of the game* dimension has the potential to characterise differences between institutional systems, specifically to delineate actors’ role divisions and responsibility rules in governance arrangements [26]. Secondly, the *discourses* dimension strongly relates to *meaning*-making in social practices. Therefore, the first dimension refers to the organisational part of a PA and the latter to the PA’s substance [26]; these complement each other in this paper.

### 2.1. Conceptualisation of the Policy Context

For this study, an extension to the PAA was needed for gaining a deeper understanding of different spheres within a governance arrangement or constellation, to emphasise the role of public and private actors in governance and to characterise and describe the detailed interactions between the state, market, and civil society -spheres in governance of a problem or issue. For this, the synoptic view on governance of Steurer was very helpful [27]. He describes the interaction between the three governance spheres and different types of regulations applicable within and between spheres [27]. Over the past two decades, the PAA, originally with a strong governmental and state authority focus, evolved to a governance approach with more room for the market and civil society. Some scholars characterise this transition to governing beyond state authority as a ‘shift from government to governance’ [28,29].

### 2.2. Operationalisation of Theoretical Concepts Used

The SPT and PAA are operationalised in a conceptual framework to explore the relationship between policy domains (i.e., the Rhine environmental protection [PA1] and river cruise tourism [PA2]) and river cruise companies’ practices related to plastics (see Figure 1). As policies are, in view of practice theory (with a so-called ‘flat ontology’; Schatzki [21]), also practices, policy arrangements—PA1 and PA2—are bundles of practices and broader constellations surrounding the practices of Rhine River cruise companies’ and their passengers. The passenger perspective, as experienced by river cruise companies, is included in the conceptual model (practice circle SP2) due to its influence on river cruise companies’ plastic practices and the PAs. In addition, the synoptic view on governance of

Steurer [27] is included in the conceptual model to put the policy domains PA1 and PA2 into perspective and it helps to extract more details from the *actors*, *resources*, *rules of the game*, and *discourses* dimensions. Accordingly, these four dimensions are depicted in the state, market, and civil society governance spheres. This extension also helps to identify the policy arrangement's position on the continuum from government to governance. Based on the above, a set of assessable indicators was developed for the SPT elements (i.e., *matter*, *competence*, and *meaning*) to research Rhine River cruise companies' practices related to plastics (see Section 3). Secondly, as described earlier in Section 2, we focus on the *rules of the game* and the *discourses* dimensions in PA1 and PA2 [25]. Considering the *rules of the game* dimension, arguments founded upon principles, laws, and regulations [30] are researched. Concerning the *discourses* dimension, actors' problem definition, values, norms, and viewpoints [19] are analysed in contemporary narratives used in PA1 and PA2. *Discourses* influence *meaning-making* by river cruise companies: "Discourse is defined here as an ensemble of ideas, concepts, and categories through which meaning is given to social and physical phenomena, and which is produced and reproduced through an identifiable set of practices." [31] (p. 300). By investigating the interactions between policy and practice, the possibilities for interventions will be unravelled to improve Rhine River cruise companies' practices related to plastics.

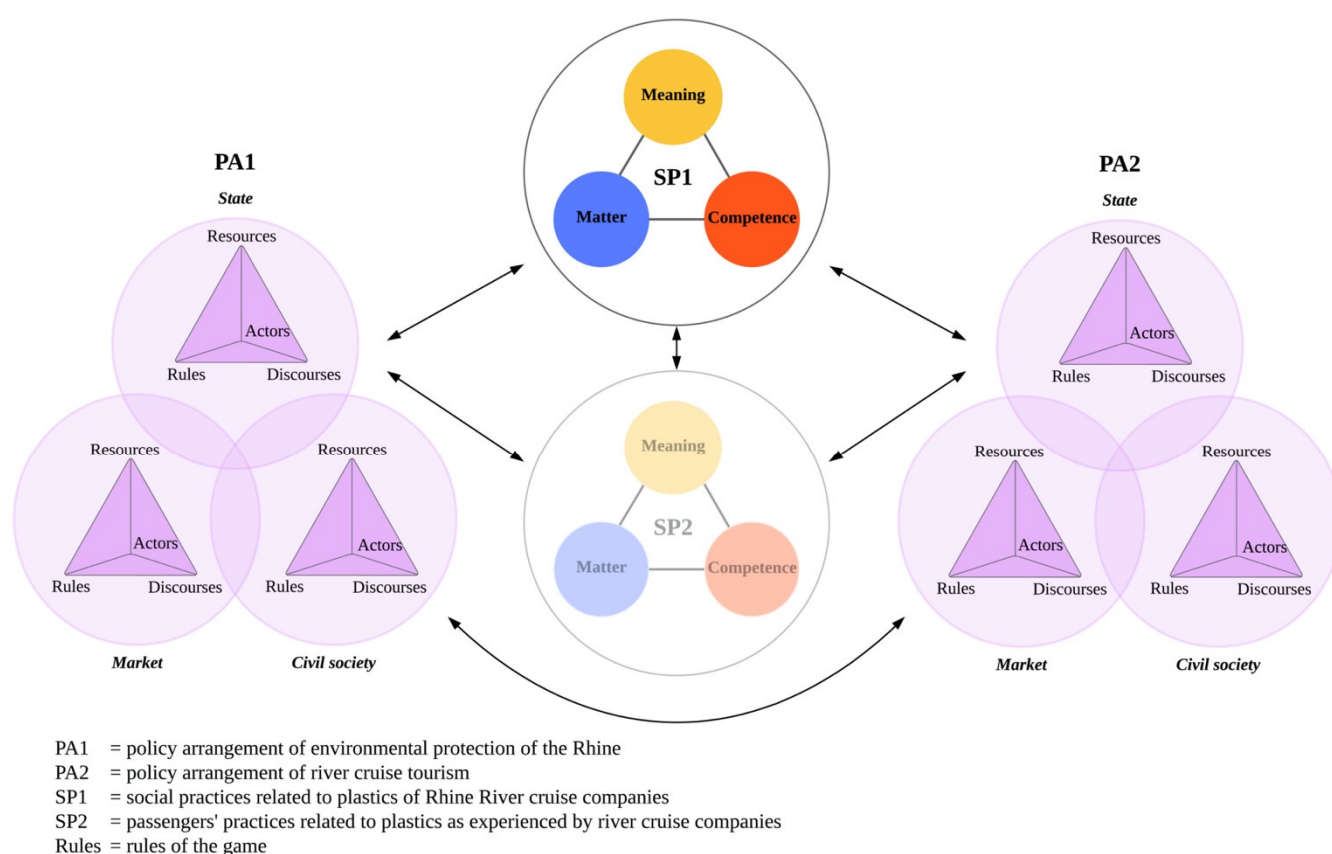


Figure 1. Conceptual framework.

### 3. Methodology

This study used a multiple-case study approach to explore the Rhine River cruise companies' practices related to plastics and their experiences of passenger behaviour. Due to extended river cruise operations caused by the corona pandemic, it was not possible to interview passengers, nor was it possible to observe them on board. Therefore, Rhine

River cruise companies are the core unit of analysis in this study; accordingly, seven member organisations of the European River Cruise Association were included as cases in this study, representing 25% of all European river cruise companies. Some of the studied ships also cruise other European rivers, and most of the companies are internationally oriented having their own policies for different rivers. We expect the studied cases to be exemplary for dealing with plastics on the river Rhine and we expect that our findings will not deviate greatly from river cruises in Europe as a whole. Table 1 shows an overview of the characteristics of these seven cases. Nautical experts were approached because they primarily handle information services, crew members management, clean shipping, and waste management. An exception to the rule is case 1, and its three sub-cases (1.1–1.3) that embody shipowners and captains providing services to the same river cruise company. The latter group is a valuable data source because they have extensive knowledge of the onboard practices of both passengers and crew.

To gather a comprehensive set of data for answering the research question and to ensure research validity and to a certain extent also generalisability, a triangulation of multiple qualitative research methods was used: namely document analysis, exploratory interviews consisting of both expert and case interviews, and fieldwork. All data used for this paper were derived while conducting the master thesis work of Van Klink [32]. First, document analysis was conducted to investigate the policy context of environmental protection of the Rhine and river cruise tourism. After an in-depth internet study, the relevant policy documents, reports, background papers, and strategies were selected based on their expected relevance, resulting in a comprehensive list of 13 documents (see Appendix A). After a close reading of these, the documents were analysed thoroughly based on the PAA's dimensions [25]. Second, both expert and case study interviews were conducted. For each of the selected cases (Justification case selection can be found at the start of section three. More detailed information on the cases is given in Table 1.) one or more interviews were conducted. In addition, by using a snowballing technique, we selected leading policy officials and scientific experts in the field of EU and/or Rhine plastic, environmental and water governance. Interviews were semi-structured, allowing respondents to introduce topics they consider essential as well [33]. In total, nine expert interviews and nine case interviews were conducted between April and July 2021 (see Appendix B for an overview of the expert interviewees). The exploratory interviews, each about 45 min duration, were audio-recorded, transcribed, and then coded with the help of Atlas.ti version 8.4.5 (ATLAS.ti Scientific Software Development GmbH, Berlin, Germany), enhancing the reliability of the research approach [34]. Third, most of the case interviews were combined with fieldwork onboard river cruise vessels berthed at the quay in Papendrecht, Dordrecht, Nijmegen, and Arnhem (see Table 1). The average length of the fieldwork was about 45 min each time. While conducting the fieldwork, focus was on the following *matter* elements [17]: plastic products provided, waste facilities, and, lastly, icons, pictograms, or text used explaining onboard waste management procedures. Moreover, the researcher investigated where and how plastics could potentially pollute the environment. Observations were captured via photographs and noted down in a booklet.

**Table 1.** Overview of the case studies.

Case	1.1	1.2	1.3	2	3	4	5	6	7
Fleet	Dutch	Dutch	Dutch	Dutch	Dutch	Swiss German	Swiss	Ameri- can	American English German
Number of stars	3–4	3–4	3–4	3–4	3–4	3–4	4–5	4–5	4–5
Number of active vessels	1 *	1 *	3 *	3 *	4 *	55 */66	19 */35	5 */19	28 *

Function respondent	Ship owner & captain	Ship owner & captain	Ship owner & captain	Nautical Technical Manager	Nautical Technical Manager	Nautical Manager	Nautical Director	Nautical Director	Nautical Manager
Guided tour on board	Fieldwork on board	Fieldwork on board		Fieldwork on board	Fieldwork on board		Fieldwork on board		Fieldwork on board
Date	3 May 2021	7 May 2021	7 June 2021	8 June 2021	11 May 2021	24 May 2021	20 May 2021	27 May 2021	11 June 2021

Note. Each case represents a river cruise company. Sub-case 1.1–1.3 illustrates shipowners who rent out the use of their vessels to a charterer (i.e., the same river cruise company—case 1). \* Active river cruise vessels in the Rhine area.

A combination of deductive and inductive approaches is applied in this study. Firstly, the deductive approach is concept-driven [35]; therefore, *matter*, *competence*, and *meaning* of the SPT are incorporated in a priority template of codes [36], guiding the exploratory case interviews, the fieldwork, and their analysis (see Table 2). Furthermore, the PAA dimensions were incorporated in the expert interview-guide. Secondly, this research used an inductive approach, forcing the researcher to engage with the empirical world that has been analysed [37]. Social phenomena were investigated by focusing on three elements: respondents' experiences, problems faced by respondents, and how respondents try to solve problems [38]. Adding this inductive approach is valuable because it enables the researcher to include new concepts in the findings of this study [39], and, eventually, take a more holistic view of the data.

**Table 2.** Elements of the Social Practice Theory of Shove et al. [17] linked to river cruise companies' practices related to plastics as incorporated in the interview guide.

Social Practice Theory	Subjects Incorporated in the Interview Guide
Matter	Products: single-use plastic products, water bottles, personal care products, tableware, cigarettes, sanitary waste Packaging: individual packaging, large-size packaging Waste infrastructure: waste bin, sanitary waste bin, waste sign, waste separation bin, open/closed waste bins at the deck, waste depot onboard vessel, onshore waste containers, wastewater storage tank, wastewater treatment system, wastewater reception facilities, sludge reception facilities Information provision: icons, pictograms and/or text used explaining waste management
Competence	Knowledge of waste separation Passenger instructions Crew members waste management skills River cruise companies' plastic waste reduction skills
Meaning	Conceptions of waste Idea of comfort and luxury Symbolic meaning of waste signs Plastic reduction objectives Importance of waste separation Value of sustainable waste management Awareness of the impact of plastics on the environment

#### 4. Results

The study's findings are structured as follows: first, in Section 4.1, policies are discussed, with emphasis on the *rules of the game* (Tables 3 and 4) and the *discourses*

dimensions of the two PAs that are described. Second, in Section 4.2 the river cruise companies' practices related to plastics are discussed structured by the *matter*, *competences*, and *meaning* dimensions of the SPT. Lastly, the influence of governance on practices (Section 4.3) is addressed.

#### 4.1. Policy Domains of Rhine Environmental Protection and River Cruise Tourism

Here, we focus on PA1 and PA2 and their interactions, and, more specifically, the *rules of the game* and *discourse* dimensions.

##### 4.1.1. Rules of the Game

Table 3 below provides an overview of the *rules of the game* for Rhine environmental protection (PA1). And Table 4 shows the *rules of the game* for river cruise tourism (PA2). Both represent a condensed summary of formally adopted EU and Rhine River basin policies (Appendix A). In this study, we do not focus on individual member states' rules, as cruises cross state boundaries regularly and, therefore, are expected to be affected especially by river basin and EU policies.

**Table 3.** Rules of the game dimension for environmental protection of the Rhine.

Rules of the Game for Rhine Environmental Protection	Focus
Water Framework Directive (2000/60/EC)	Inclusive water protection in Europe's river districts, coastal waters, and groundwater. Objective: reaching a 'good chemical and ecological status'. Diminishing 45 priority substances in the freshwater environment. Plastics is not included in the priority substances list.
Marine Strategy Framework Directive (2008/56/EC)	Safeguarding European marine environments. Recent focus on scrutinising data on plastics originating from inland water areas. Source-based approach: prevent plastics from entering the North Sea.
Single-Use Plastics Directive (2019/904/EU)	Focus on the effect of plastic items on people's health and the marine environment. 10 Most frequently encountered plastic items on beaches were categorised. Restricts single-use plastic items from entering the market (e.g., cotton swabs and straws).
ICPR Rhine 2040 programme	Focus on water quality, high and low water levels, and ecology. Goal six of the Rhine 2040: diminishing the (plastic) waste influx in the aquatic environment (source-based approach). Measurements: creating awareness through a waste collection campaign, collecting data on waste management, and improving waste management. The International Commission for the Protection of the Rhine (ICPR) has not yet decided whether they will set up an expert group plastic (expert interview 5).

The level of bindingness of the policies that are described in this table varies significantly, as ICPR policymaking has a lower degree of institutionalisation and political bindingness in comparison to policies agreed upon by all member states in the EU setting [40].



These characteristics give the ICPR more freedom to act and to develop innovative water management policies. Contrary to what would be expected, this did not (yet) result in ambitious ICPR policies with regard to plastic pollution in the freshwater environment.

**Table 4.** Rules of the game dimension for river cruise tourism.

<b>Rules of the Game for River Cruise Tourism</b>	<b>Focus</b>
Treaty of Lisbon (2009)	<p>The legal basis provided for the river cruise sector by the European Union.</p> <p>Enhance member state's collaboration (interchanging best practices).</p> <p>Promote competitiveness of the EU's undertakings in the river cruise sector.</p> <p>EU supported shaping of a favourable environment in which the tourism sector flourishes.</p>
Europe, the world's No 1 tourist destination—a new political framework for tourism in Europe (2010)	<p>Sustainable tourism, improvement of competing efforts, the perceptibility of tourist destination Europe, and the expansion of financial policies.</p> <p>The aim of the memorandum was to remain the world's number one tourist destination.</p>
Green Award	<p>Requirements for inland shipping sector to promote environmentally friendly navigation.</p> <p>Inland shipping certificate used for river cruise vessels since 2017.</p> <p>Award levels: bronze, silver and gold (accredited based on a point system).</p> <p>Green Award focuses on emission reductions.</p> <p>Green Award concentrates on waste separation [requirement 40a and 40b].</p> <p>There are no specific requirements concerning plastic use onboard.</p> <p>Operating a ship with a wastewater treatment plant is a prerequisite [requirement 50g].</p> <p>One requirement focuses on river cruises, specifically hotel facilities [requirement 70d].</p>
Convention on the collection, deposit and reception of waste generated during navigation on the Rhine and other inland waterways (CDNI)	<p>Objective: "reaching an ever more environmentally friendly inland navigation sector" [41].</p> <p>CDNI waste categories: greasy and oily waste (category a), cargo-related waste (category b), and other waste (category c).</p> <p>Category c includes household waste and wastewater from passenger ships [42].</p> <p>Contracting states are obliged to set up reception facilities for domestic waste and wastewater (Article 8.02).</p> <p>CDNI does not specify which actor is accountable for financing the construction of infrastructure for wastewater and sludge [43].</p> <p>Article 77 of the CDNI shows that wastewater discharge in rivers is allowed from vessels with a capacity of fewer than 50 passengers. Since 2011, vessels with a capacity of more than 50 passengers are only allowed to discharge wastewater when using a treatment plant onboard which follows ES-TRIN regulations.</p>



ES-TRIN 2021	<p>Provisions regarding shipbuilding and equipment by the EU committee for drawing up standards in the field of inland navigation (CESNI).</p> <p>Includes technical standards for onboard sewage treatment plants. Guidelines outlined by the European Commission (DG MOVE) and the Central Commission for the Navigation of the Rhine (CCNR).</p>
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It should be noticed that EU tourism policies are developed from an economic point of view by the Directorate-General for International Market, Industry Entrepreneurship, and Small- and Medium-sized Enterprises (DG GROW). Table 4 shows that the EU promotes sustainable high-quality tourism, however, these regulations do not include plastic waste generated during tourism activities. This could be attributed to less involvement in the development phase of such policies by the Directorate-General for the Environment (DG Environment).

#### Rules of the Game Dynamics of Interaction

The momentum for dealing with plastic pollution was present during the last decade in PA1, resulting in the creation of water-based and land-based policies to cope with this issue in the marine environment. Concerning the freshwater environment, however, such specific policies do not yet exist. EU tourism policies do not address the topic of plastics as well. Remarkably, after 2010, no novel EU tourism policies were introduced, although, in this period, tourism activities expanded rapidly in Europe. This study shows that the existing EU policies focusing on plastics are primarily developed by DG Environment, while DG GROW and DG MOVE appeared to play a significant role in the development of EU tourism policies. In conclusion, collaboration between these Directorate-Generals is needed to strengthen interlinkages between both PAs.

#### 4.1.2. Discourses

##### PA1 Environmental Protection of the Rhine

This study identified several *discourses* related to the Rhine's environmental protection. First, the European Union strives towards 'ecologically healthy and chemically clean water' (case interview 6). This is a central *discourse* in, for example, the Water Framework Directive (WFD), the ICPR's Rhine programme and in the EU member states' River Basin Management Plans. Following this *discourse*, policymakers stress that on short notice plastics should be labelled as a priority substance in the WFD (expert interview 5). This labelling would help policymakers meet policy objectives about keeping rivers healthy and clean (expert interview 5). The second *discourse* identified encompasses the 'Polluter Pays Principle', which plays a vital role in for instance the WFD, the Waste Framework Directive, and CDNI (expert interview 1). This principle indicates that people who generate (more) waste should pay (extra) for waste handling costs. Third, the *discourse* of 'the prevention of pollution at the source' takes a centre stage in plastic pollution-related policies and is widely considered more effective than aiming for end-of-pipe solutions (expert interview 5). An example is that the sixth goal of the Rhine 2040 programme focuses on diminishing the plastic waste influx in the Rhine River. One of the MSFD's goals is also the prevention of the entering of plastic litter into the marine environment. Lastly, the Single-Use Plastics Directive (SUP) aims to create awareness about the use of disposable plastics and their environmental impact. Specifically, the 'anti-plastic straws phenomenon' raises questions about the necessity of using straws when consuming beverages. Surprisingly, research data show that only a limited number of straws were found on Dutch riverbanks (expert interview 3). Therefore, a narrative shift to product packaging at large would be worthwhile because of its major environmental impact (expert interview 3).

## PA2 River Cruise Tourism

This study's results show a variety of river cruise tourism associated *discourses*. First, the tourism agenda 'Europe, the world's No 1 tourist destination' (goal-oriented *discourse*), developed in 2010 by the European Commission, plays a central role in PA2. In line with this, the Commission shed light on sustainable tourism in Europe. Sustainable tourism in this regard includes the production of waste; however, no further information on this topic is provided in this tourism agenda. Second, different governance *discourses* prevail regarding river cruise ship-generated waste management onshore. In the environmental protection arrangement, where the state is dominant, actors indicate that liabilities were shifted to the river cruise sector because "[River cruise companies] always have arranged [waste management] by themselves" (personal communication 4). While in the (market-oriented) tourism arrangement, there is a central thought that resource provision for waste reception facilities should be within the scope of state actors (expert interview 8).

Third, an example of a goal-oriented *discourse* for the inland navigation sector is the CDNI which aims for the 'harmonisation of the sorting of household waste' on board and along the waterways [44] and fix attention to recognisable waste symbols. This *discourse* will improve river operators' recycling practices and eventually the reduction of waste volumes [44]. Furthermore, the 'greening' *discourse* is omnipresent in PA2. A key objective of the CCNR is 'greening' the entire inland navigation fleet (expert interview 2). In this context, greening means seeking a zero-emission fleet (both with regard to water and air) hence, the CCNR strongly focuses on alternative fuels. The CCNR indicates that they do not focus on plastics as data about the plastic waste generated by inland waterway transport operators is absent (expert interview 2).

## Discourses Dynamics of Interaction

In recent years, the *discourse* of plastic pollution has been integrated into EU land-based policies like the SUP-Directive (PA1). This land-based policy's narrative also affects the freshwater environment as the consumption of disposable plastics decreases. Regarding EU water-based policies, most attention was paid to plastic pollution in the marine environment instead of the presence of plastics in the freshwater environment (e.g., plastics not included in the WFD). Hence, this predominant marine environmental focus is obstructing policymakers to opt for a more source-based approach (*discourse*) when coping with plastics. In PA2, on the other hand, there is a strong focus on the reduction of emissions to enhance environmentally friendly river cruising (indicating a strong connection between the PAs), however, there is a missing link with plastic emissions. A prime example of this is 'greening' the inland navigation fleet *discourse* that creates the impression that plastic waste and pollution are also considered; however, plastics is neglected here (PA2).

### 4.2. River Cruise Companies' Practices Related to Plastics

#### 4.2.1. Matter

##### Plastic Products Provided on Board

In general, this study shows that the companies studied try to limit the use of plastic products on board, yet one can distinguish a few frontrunners in this regard (cases 5 and 6). The findings show that primarily ceramic tableware was provided in the restaurants, bars, and kitchens onboard all vessels because it has a more luxurious appearance in comparison to plastic tableware. In line with this, refillable glass water bottles are provided (case interviews 1.3, 3, 5, and 7), just as aluminium ones in the cabins (case interview 6). Contrarily, we found that the less progressive river cruise companies do also offer PET bottles to their passengers (case interview 4). After ordering at the bar, passengers can take food and drinks to the outside deck. The river cruise sectors' frontrunners opt for large-size food and beverage packaging instead of individual packaging to reduce their

plastic footprint (case interviews 5 and 6). The other cases revealed that individual packaging is still provided on the deck, leading to accidental losses when passengers lose sight of their waste. Companies have also replaced the small single-use plastic bottles of shampoo and soap with large refillable containers (case interviews 2, 4, 6, and 7). To further reduce plastic use, some river cruise companies discuss options for alternative *materials* with their suppliers (case interviews 2 and 6):

“A few years ago, we already chose to ban single-use plastics; then we switched from plastic straws to paper straws. Besides, we focus on banishing [plastic] packaging materials. We are in conversation with subcontractors of suppliers so that [where it is possible] we have [plastic] packaging converted to paper packaging.” (case interview 6)

#### Onboard Waste Facilities

The river cruise companies studied all have one thing in common: waste is separated by the crew members at non-public places like the kitchen and bar. Different bins are provided for plastic, paper, glass, and residual waste streams. To facilitate waste separation, a plasticised paper indicating the category of waste is shown on each bin (case interviews 1.3, 2, 5, 6, and 7). Overall, English words are used, which is necessary, due to the international character of the crew. For passengers, however, separating waste onboard is not supported. Due to the limited space on board, just one waste bin for all categories of waste is available in cabins (case interview 1.3). On the outside deck, waste bins without waste-separation options are placed. Most of the cases opt for closed bins at the deck due to the exposure to weather conditions, while some provide fire-prevention bins with an open lid (case interviews 1.1 and 1.2).

#### Waste Facilities Onshore

The research findings indicate a lack of uniformity regarding the waste infrastructure onshore (case interviews 1.3, 3, 4, 6, and 7). Every two to three days, river cruise vessels must dispose of their waste onshore. This means that during a multiple-day cruise journey, they are confronted with different rules related to waste management. An example is that, along the Rhine catchment area, river cruise companies pay per trash bag, per kilo, per cubic meter, per passenger, or the prices for waste management are included in port fees (case interviews 1.2 and 1.3). The prices for waste disposal also vary, for instance disposing of one waste bag costs between 8 and 18 euros.

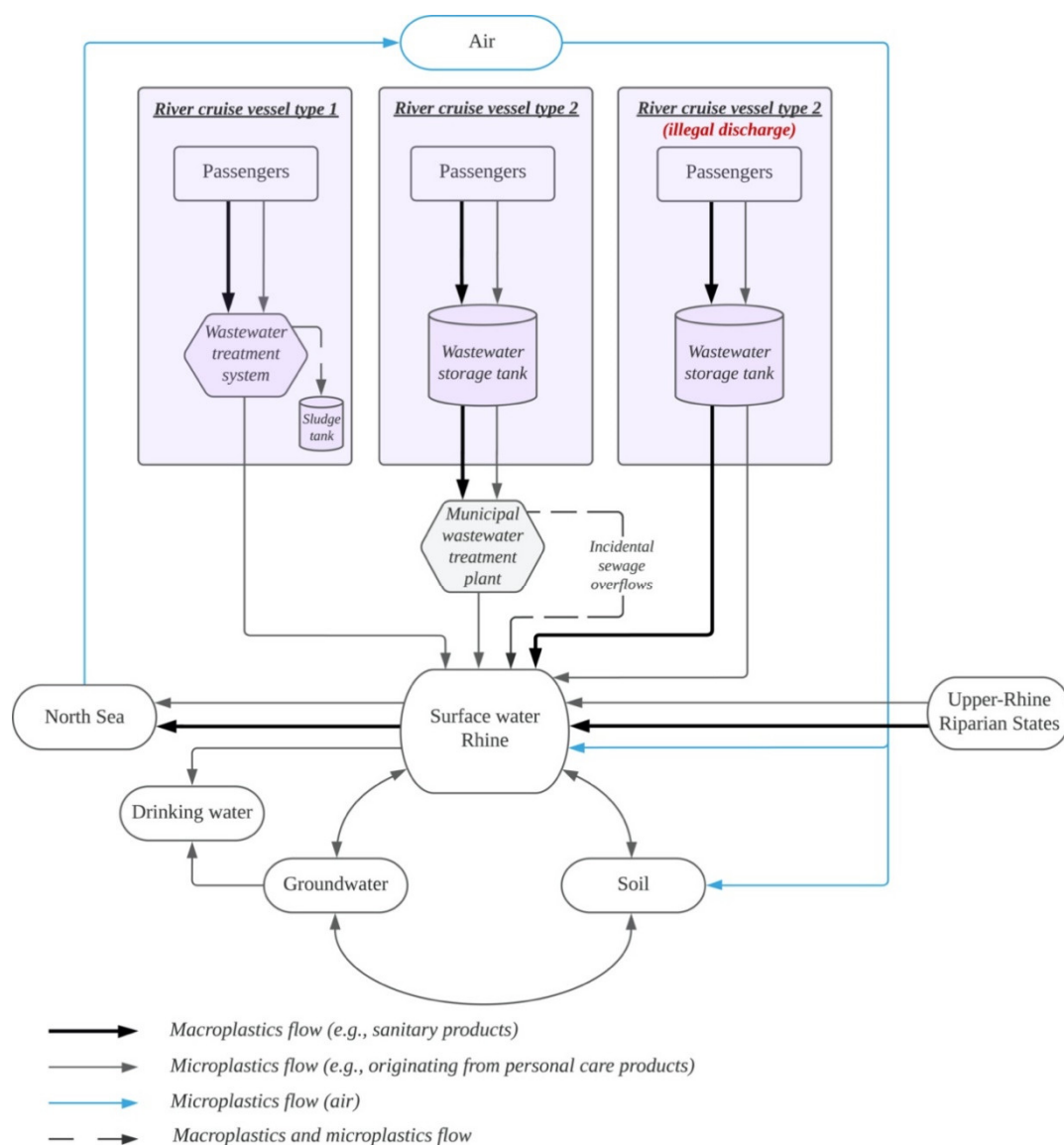
Waste is separated onboard all vessels (Section 4.1.1); however, in the harbours, there is often only one container provided for all waste streams. This dampens the river cruise companies' motivation to separate waste on board (case interviews 1–7). Contrarily, in large harbours like Vienna, Amsterdam, and Würzburg, there is strong harbour-based self-regulation seen in the well-organised facilities like the separate containers for the different waste streams (case interview 6). What is also demanding for the companies is the lack of sufficient waste reception facilities onshore (case interviews 1.1, 1.3, 2, 3, and 7): “The places where waste can be disposed onshore are no longer omnipresent, that is the biggest issue” (case interview 2). This is an obstacle because if large volumes of waste are stored onboard for long periods, this is unpleasant and unhygienic for passengers (case interviews 1.1, 1.2, 3, and 5). Furthermore, it is indicated that there are limited wastewater and sludge reception facilities onshore (case interviews 2 and 3). As a result, some river cruise vessels illegally discharge wastewater—that might contain plastics—into the river environment:

“Onboard the other vessel we have a wastewater tank, and the wastewater is disposed at places where it is possible. And if this is not possible, and the tank is full, wastewater is discharged into the river environment.” (case interview 2)

### Wastewater Treatment

Each passenger produces around 70 litres of wastewater per day onboard a river cruise vessel [43], which might contain macroplastics (e.g., sanitary products flushed down the toilets) and microplastics (e.g., from personal care products). Therefore, the issue of wastewater treatment deserves special attention in this contribution. All river cruise companies provide passenger instructions about the vacuum system onboard to prevent obstructions to the sewage system. It is important to note that these instructions do not elaborate on the possible impact of plastics (present in wastewater) on the environment. To ensure that fewer sanitary products end up in the toilets, pictograms are used to portray which items cannot be flushed down (case interviews 3 and 5) or the text “only toilet paper” is shown on the toilet lids (case interview 7). Remarkably, onboard two vessels, no sanitary waste bin is present in the cabins to support correct sanitary waste disposal (cases 1.1 and 1.2).

Modern river cruise vessels are equipped with an onboard wastewater treatment system (vessel type 1, Figure 2). These wastewater treatment plants are intended for removing organic matter and nutrients [45]; this system inadvertently retains sanitary products flushed down toilets. When the purified water flows into the river, a proportion of microplastics is spilt into the environment. Wastewater treatment systems with a microplastic filter do exist for vessels; however, this technique is not used onboard river cruise vessels due to the absence of requirements regarding microfiltration in ES-TRIN (hard regulations) (personal communication 1, see Appendix B). In contrast to modern river cruise vessels, the older ones (representing the largest group, see Box 1) only have an onboard wastewater tank (vessel type 2, Figure 2). Hence, these older vessels discharge wastewater at a municipal wastewater treatment plant, resulting in an indirect flow of macroplastics (personal communication 5) and microplastics into nature [46]. Next to that, river cruises with a wastewater tank can illegally discharge wastewater into rivers; in this case, the total amount of plastics present in the sewage pollutes the environment.



**Figure 2.** Distribution of macroplastics and microplastics from wastewater generated by passengers in the bathrooms onboard river cruise vessels to aquatic environments, adapted from Derksen [46].

**Box 1.** Wastewater treatment and storage capacity.

## River cruise vessel type 1:

- A wastewater treatment plant onboard has a capacity of approximately 15 cubic meters (comparable to the size of one cabin) [43].
- After four to five weeks, type 1 vessels have to empty their sludge tank onshore (average sludge tank capacity: 10 cubic meters).
- Annually, about five new river cruise vessels with a wastewater treatment plant are constructed in Europe (personal communication 6).
- When constructing new vessels, river cruise companies are obliged to install a wastewater treatment plant on board following ES-TRIN regulations (personal communication 6).

## River cruise vessel type 2:

- A wastewater storage tank onboard has an average capacity of 20 cubic meters (case interview 3).
- Every two to three days, type 2 vessels have to empty their wastewater storage tank (cases 1–4).
- It is estimated that around 350 European river cruise vessels still have a wastewater storage tank onboard (personal communication 6).

## 4.2.2. Competences

The case studies show that river cruise companies independently acquire knowledge and skills that are relevant for onboard waste separation. One of the frontrunners aims to diminish the impact of human activities on the environment even further. Following this, their crew members started collecting data about the consumption of materials during operations (see Table 5). The data aids the company to set (plastic) reduction targets and improving their waste reduction skills (case interview 6).

**Table 5.** Amount of waste generated onboard one river cruise vessel in 2019.

Waste Stream	Amount of Waste in Litres
Plastic	50.000
Paper	100.000
Glass	40.000
Biomaterial	40.000
Metal	15.000
Chemical	5.000
Residual	150.000
Total	400.000

Note. Data of one river cruise vessel with a capacity of 130 passengers and 40 crew members.

In addition, this company tried to set the right example and promotes sustainable river cruise tourism by modelling best practices to the entire industry [47]. Next to this, they share their knowledge with the European River Cruise Association (case interview 6):

“[A working group at the European River Cruise Association level], that is something that is missing. (...) I mean, we [as a river cruise company] have shared our knowledge and findings always, but if it has been taken up as such [by other companies]. I do not know.” (expert interview 8)

### Passenger's Sanitary Waste Disposal Skills

Despite the passenger instructions regarding sanitary waste disposal, sanitary napkins, incontinence materials, wet wipes, and tampons (which often contain plastics) are flushed down the toilets on a structural basis (case interviews 1.2, 2, and 8). One of the interviewees pointed out that “if toilets are clogged, nine times out of ten the blockages are caused by sanitary napkins” (case interview 2). Next to these (macroplastic) products, underwear, guest towels, and jewellery also end up in the wastewater (case interviews 1.3 and 2; personal communication 2). This reflects a lack of (sanitary) waste disposal *competencies* of passengers and poses environmental risks because plastic items directly or indirectly could pollute the river (see Figure 2).

### 4.2.3. Meaning

Different *meanings* associated with river cruise tourism are identified in this contribution. One of these is the *discourse* of ‘ooze luxury’, which is used by all cases to characterise their operations. This narrative affects the companies’ plastic practices in several ways. On the one hand, this *discourse* ensured that ceramic tableware instead of plastic tableware is used onboard as the latter is perceived as a cheap(er) material (positive impact of PA2 *discourse* on PA1). On the other hand, waste separation by passengers does not fit the river cruise companies’ perception of comfort and luxury:

“That was a choice, we did not want to put a bin in the rooms where the waste will be separated in this way because we are in the five-class service segment after all, and we sell a luxury product, so we have chosen to not separate waste in passengers’ rooms.” (case interview 6)

Furthermore, river cruise companies have a particular interest in possessing a Green Award (see Box 2) because it brings financial benefits like discounts on port fees. The companies can also use this certificate as an advertising tool to promote their ‘green’ image. The concept of ‘greening’ will be used in communication with prospective customers via the website or social media (case interview 1.3) (interference of greening *discourse* identified in PA2). By emphasising that they offer river cruise journeys on a ‘green’ vessel, the companies try to enhance customer appreciation. Furthermore, this *discourse* is used to stand out from the competition in the market (case interview 1.3).

### Box 2. Green Award and wastewater treatment.

- Green Award sets codes of conduct for an onboard wastewater treatment plant.
- Vessels with a wastewater storage tank on board are not eligible for this certificate (case interview 1.3).
- Expectedly by 2023, only vessels with a Green Award will be allowed in large harbours like Amsterdam (case interview 1.3), constraining type 2 vessels (Figure 2) the access to vital wastewater reception facilities.
- Within the river cruise sector, there is a demand for clear future requirements regarding wastewater treatment plants because at this moment it is not guaranteed that a plant installed in 2021 will still be approved in 15-or 20-years’ time (case interview 2).
- For newbuild river cruise vessels, the investment costs for a wastewater treatment plant are between 400.000 and 500.000 euros (case interview 2).
- Because of adaptations to the vessels’ casco, the investments for a wastewater treatment plant onboard type 2 vessels are about 200.000 to 300.000 euros extra compared to newbuild vessels (case interview 7). These expenses hinder type 2 cruise companies to shift to a purification plant (case interviews 2 & 7).
- The ‘greening’ *discourse* identified in PA2 is also linked to the Green Award.



Moreover, one of the frontrunners informs their customers via the website about their philosophy and plastic reduction goals before booking a trip (case interview 6). Their objective is that “more than 60 identified types of single-use plastics across the entire operations, including straws, water bottles, plastics bags [needs to be banned by 2022]” (case interview 6) (influence of the SUP-Directive central to PA1), reflecting a robust environmental policy. However, other river cruise companies are nowadays not fully aware of the environmental impact of plastics. This study reveals that there is a poor understanding of the fragmentation of macroplastics into microplastics and the accumulation of plastics in the ecosystem (case interviews 1.2 and 1.3).

#### 4.2.4. Concluding Remarks on Plastic Practices Onboard

In this section, we provide an analytical view of the core findings of river cruise companies’ onboard plastic practices with the aid of the *meaning*, *matter* and *competence* elements.

First, the ‘greening’ discourse (*meaning*) in the tourism arrangement (PA2) has a positive influence on river cruise companies’ emission reduction competencies. Unfortunately, plastic emissions are not included in this narrative. Despite this, the river cruise companies independently acquired skills to reduce their plastic use during operations. In addition, all companies autonomously developed crew members’ *competencies* regarding waste separation, indicating a general understanding of the environmental benefits of waste separation (*meaning*). In line with this, the prevalent tourism discourse of ‘ooze luxury’ is compatible with sustainable (plastic) waste handling by the crew. In contrast, the passengers do not have to separate their waste due to the companies’ perception of offering a luxurious and comfortable travel experience to the passengers (*meaning*). Hence, this luxury discourse is subject to different interpretations. The lack of waste separation options in public spaces and cabins (*matter*) hinders passengers to deal with waste in an environmentally conscious manner. This negatively affects the passengers’ *meaning*-making related to waste handling and this obstructs the development of waste separation skills.

Second, the river cruise companies use passenger instructions and waste symbols to prevent obstructions to the sewage systems (*matter*). However, the companies with a wastewater storage tank (vessel type 2, see Figure 2) do not point out that sanitary products (macroplastics) flushed down the toilet could possibly pollute the river environment. This might be attributed to the fact that these river cruise operators do not want to admit that they (sometimes) illegally discharge wastewater (*meaning*). Moreover, the wicked problem of microplastic pollution is not recognised by the river cruise market (vessel types 1 and 2, Figure 2). It is questionable whether the companies are not aware of their microplastic emissions—because these particles are invisible to the naked eye—or whether they do not want to acknowledge that they leave a trail of microplastics in the river environment. Hence, the connection between the bathroom sinks including toilets and the freshwater environment in the context of macroplastics and microplastic pollution is not made in PA2 (*meaning*).

#### 4.3. The Influence of Governance on Practices

In this section, we first briefly discuss the influence of governance on practice, followed by a somewhat more detailed description of the PAs (*rules of the game* and *discourse*) influence on practices.

This study shows that there is a discrepancy between the two policy arrangements regarding the governance *discourse*. Namely, in the Rhine environmental protection arrangement (PA1), where the state is dominant, the idea prevails that the market must resolve issues regarding river cruise operators’ waste management. While in the tourism arrangement (PA2), where the market is dominant, there exists the general idea that the state should facilitate waste reception onshore. It is important to note that the market does not have sufficient (financial) resources to resolve this problem. Due to the lack of hard regulations imposed by the state; waste management onshore is arranged based on self-

regulation in the harbours. As a result, river cruise operators are confronted with different playing fields regarding waste handling along the Rhine catchment area which hinders proper waste management. This imbalance in dominant *discourses* in the state and the market also led to the absence of a dense network of waste reception facilities. As a consequence, some river cruise companies illegally discharge wastewater into the freshwater environment, contributing to the plastic waste influx in rivers.

With regard to PA1 and PA2, regulations fall short of effectively tackling plastic-related problems in the freshwater environment. A prime example of such a regulation in PA2 is the Green Award (in the market sphere). On the one hand, the Green Award positively influences the environmental protection of the Rhine regarding emission reductions (influence of PA2 on PA1). However, it does not (yet) encompass the issue of plastics. Moreover, there is a major countereffect of Green Award's initiative to encourage the transition towards onboard wastewater treatment systems: the largest group of river cruise vessels—without a wastewater treatment plant—will be excluded from large harbours expectedly from 2023 onwards, unintentionally constraining type 2 vessels (Figure 2) the access to essential wastewater reception facilities in these ports and possibly causing more illegal wastewater discharges in the river (see Box 2). There are also some inadequacies regarding the PA2's waste convention for the inland navigation sector (CDNI) in the state sphere. CDNI covers household waste and wastewater from river cruise vessels. Surprisingly, in the Netherlands CDNI's largest waste subscription type (i.e., major consumers [type 3]: facilitates the disposal of (just) 500 kilo of household waste per year) and their waste facilities' capacity are inappropriate for the large amount of waste generated by this tourism sector (see Table 5). This restricts river cruise companies' access to waste facilities with separation options along the international waterways.

In the meantime, there is also an EU top-down regulation to reduce plastic pollution, called the Single-Use Plastics Directive (positive influence of PA1 on PA2). This hard regulation is transposed to the member state level and affects river cruise companies' practices related to plastics as for instance plastic straws are no longer provided to the passengers. This targeted intervention diminishes accidental losses of single-use plastics on the outside deck. Moreover, the provision of paper straws instead of plastic ones is a powerful instrument to raise passenger awareness about disposable plastics and their environmental impact, affecting passengers' *meaning-making* as well.

In conclusion, regulations in the environmental protection arrangement and the tourism arrangement both show opportunities for improvements. To overcome deficiencies, one should seek for more collaboration and exchange between the state and the market spheres; or in other words, finding a balance on the continuum between government and governance. In accordance, the next section elaborates upon the needed policy interventions for dealing with the wicked problem of plastic pollution in the freshwater environment, just as practical recommendations to urge river cruise companies to deal with plastics more sustainably are provided (see Section 5.2).

## 5. Discussion

### 5.1. Summary of Findings

Plastic pollution of the rivers contributes significantly to the waste influx into oceans. The purpose of the present research was to examine Rhine River cruise companies' plastic practices and the governance influencing these practices. The results show that the policy domains of Rhine environmental protection and river cruise tourism do not deviate considerably. More specifically, in both arrangements the issue of plastic pollution in the freshwater environment is not (yet) rooted in the *rules* and *discourses*, making it harder for policymakers to cope with this problem. We also encounter discrepancies between the two PAs. Notably, the governance *discourse* associated with river cruises' generated waste diverges substantially. In the environmental protection arrangement, where state responsibilities are dominant, waste management by the market is expected. On the other hand,

in the tourism arrangement, where the market is ruling, a general understanding prevails that waste reception facilities should be facilitated by the state. This imbalance hampers river cruise companies' eco-friendly waste management and possibly causes extra plastic pollution in the river. To give rise to river cruise companies' plastic waste management routines with higher sustainability and to reduce the sectors' plastic emissions, we developed a set of policy and practical recommendations.

## 5.2. Policy and Practical Recommendations

This study has provided deeper insights into the *discourses* guiding current (policy) practices regarding river cruise tourism and the environmental protection of the Rhine. It is worthwhile mentioning that in both PAs a general *discourse* shift is needed to promote sustainable river cruising. First, the plastic pollution *discourse* in the environmental protection PA with its strong marine environment focus should be expanded to plastics in the freshwater environment as well. Second, in the tourism PA, the *discourse* of 'greening' could be broadened to also include the issue of plastics. These *discourse* shifts are interwoven in the recommendations listed below.

### 5.2.1. Recommendation for the European Commission

#### European Directive on Plastics in the Freshwater Environment

Water-based policies on plastic waste in the freshwater environment are currently lacking. This study reveals that there is an urgent need to tackle the issue at its source in the freshwater environment. Therefore, a key policy priority could be the introduction of a European Directive on Plastics in the Freshwater Environment. This novel Directive could address the precautionary principle to ensure that measurements for dealing with plastics are not postponed due to a lack of research data on this topic and to combat environmental degradation caused by plastics in the short term [48]. In addition, the European Commission (EC) could also include plastics in the WFD's list of priority substances. This will enable the member states to develop policies and practices concerning plastics in rivers, harmonise and streamline existing regional and national policies across Europe, and contribute to the achievement of the MSFD's aims.

### 5.2.2. Recommendations for River Committees and CDNI

#### Action Programme on Plastics

River basin commissions have played an important role in improving water management at the catchment level by setting ambitious targets. The ICPR's action programmes have strongly improved the Rhine's water quality, its ecological system, and its flood risk management. Concerning plastics, this commission could also play an important role by setting up an Action Programme on Plastics. Plastics are part of the ICBR's ambitions mentioned in the Rhine 2040 programme. A collaboration with the International Commission for the Protection of the Danube River (ICPDR) could be fruitful, as the Rhine and the Danube are the most popular European cruising rivers.

#### Establishing a Dense Network of Waste Reception Facilities along the Rhine River

The CDNI convention covers household waste and wastewater generated by river cruises. However, CDNI's waste subscription system and waste reception facilities are not suitable for the river cruise sector. A key policy priority for the CDNI should, therefore, be the inclusion of this tourism sector and plan for the coordination of a dense network of waste reception facilities that meet the river cruise operators' needs. In line with the CDNI's *discourse* of 'harmonisation of the sorting of household waste', a colour coding system in inland shipping waste disposal on board and along the international waterways could be a powerful tool to enhance uniform waste management. Another intervention to boost proper waste handling could be the provision of an overview of waste(water) and sludge reception facilities along the Rhine catchment area, which is currently missing.

Making these data available on a platform will ensure that nautical experts who often travel fixed routes also explore other ship-generated waste delivery options.

### 5.2.3. Recommendations for the River Cruise Sector

#### Connecting the Ooze Luxury Discourse to Passengers' Waste Separation

Crew members separate waste at non-public spaces, indicating a sensitive approach toward the environment. A remarkable finding is that passengers do not have possibilities to separate their waste in public spaces and cabins. Access to space and the luxury perception discourages river cruise companies to opt for waste separation options for the passengers. It would be helpful when river cruise companies' idea about comfort and luxury aligns with sustainable waste management by passengers to further reduce waste volumes. A possible way to increase passenger awareness is the provision of compact luxury garbage separation systems in cabins and public spaces onboard.

#### Preventing Plastic Pollution on the Outside Deck

Due to the lightweight characteristic, plastics might blow overboard accidentally; therefore, banning plastics on the upper deck is desirable. The normative *discourse* of 'plastic-free zones where the wind blows' needs to be spread throughout the entire sector by the European River Cruise Association. In communicating this norm, raising awareness about the environmental impact of plastics is crucial.

#### Raising Awareness about Plastic Emissions via Bathroom Sinks and Toilets

The lack of sanitary waste bins could lead to passengers' incorrect waste disposal through the toilet, and, eventually, macroplastic losses in the environment. It is recommended that the European River Cruise Association communicates the norm of having a sanitary waste bin in each cabin to all river cruise companies so that this preventive measurement is implemented onboard. Furthermore, continued efforts are needed by the companies to raise passengers' awareness about the link between their bathroom and the river environment. Accordingly, educating passengers and the provision of stickers (illustrating this connection with the environment) on the toilet lids will enhance passengers' *meaning-making* and skills to sustainably cope with sanitary waste. Another important finding is that river cruise vessels are also a source of microplastic pollution in the freshwater environment. A targeted intervention could be the use of microplastic free refillable personal care products in the cabins. The application of awareness-raising stickers on the refillable containers will encourage passengers to opt for environmentally friendly care products without microplastics when at home. Therefore, this invisible form of plastic pollution will be disclosed to a wide audience.

### 5.2.4. Recommendations for a Transition to Sustainable Waste(Water) Management

#### Inclusion of Plastics in the Green Award and ES-TRIN Regulations

As previously discussed, the 'green' narrative does not encompass plastic reduction nor the issue of plastic pollution. Currently, Green Award is working on a separate certification system for river cruise vessels (personal communication 6; case interview 7). This advancement leaves ample room for Green Award to link sustainable tourism to consciously dealing with plastics.

There is a demand for clear future requirements concerning onboard wastewater treatment systems within the river cruise sector. For the environmental protection of the Rhine (PA1), guidelines need to be developed for the optimisation of macroplastic and microplastic filtration onboard. DG Environment should collaborate more extensively with DG MOVE and the CCNR to include an additional wastewater treatment step for microplastic filtration in the ES-TRIN. In addition to adjustments to this European legal framework, a subsidy programme should be established to create economic incentives for desired behaviour (soft regulation in the state sphere) [27]. In the first place, grants will

enhance the largest group of cruise operators with a wastewater storage tank on board (vessel type 2, see Figure 2) to shift to an advanced wastewater treatment system with a built-in microfilter. Second, the provision of grants for modern vessels with a wastewater treatment plant on board (vessel type 1, Figure 2) will support the incorporation of a microfiltration system. A positive side effect of adding this extra wastewater treatment step is the purification of medicinal residues in the wastewater (a growing *discourse* within PA1) (personal communication 6). To conclude, this transition towards wastewater treatment systems including an inbuilt microfilter onboard will diminish the influx of macroplastics and microplastics in the river, an important keystone in protecting the environment.

### 5.3. Recommendations for Future Research

This contribution revealed a demand for uniform and widespread waste collection systems along the Rhine catchment area. To supplement the policy recommendation to establish a dense network of waste reception facilities along the Rhine River, an in-depth transnational study on current waste collection facilities in the harbours needs to be carried out to explore the organisation of waste separation and the storage capacity, as well as the treatment of household waste. Examination of best practices related to (plastic) waste management in harbours and the potential for expansion is essential. Moreover, the river cruise companies' needs concerning suitable complementary locations for these waste reception facilities should be scrutinised.

## 6. Conclusions

We have conducted the first study dedicated to waste generated by river cruises, both in terms of the 'plastics practices' of river cruise companies and the various policies that are relevant for environment and tourism related to plastics and cruising. We have found important omissions in dealing with waste on the Rhine River and formulated practical recommendations for these. We hope that practices will improve and our recommendations are translated in new policies for river cruises, in order to continue enjoying clean rivers all over Europe.

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## Appendix A

**Table A1.** Documents analysed.

Number	Document	Focus
1	Water Framework Directive (2000/60/EC)	River environment
2	Dutch River Basin Management Plan Rhine 2016–2021	Rhine river environment
3	ICPR Rhine 2020 programme	Rhine river environment
4	ICPR Rhine 2040 programme	Rhine river environment
5	Marine Strategy Framework Directive (2008/56/EC)	Marine environment
6	Single-Use Plastics Directive (2019/904/EU)	Reducing the impact of plastics on the environment
7	CDNI Consolidated Convention (January 2019)	Waste generated during navigation on Rhine and inland waterways
8	Water Management Act	Integral water management
9	Treaty of Lisbon	Legal basis tourism
10	Europe, the world's No 1 tourist destination—a new political framework for tourism in Europe	Tourism
11	2030 Perspective: Destination Netherlands (2018)	Tourism
12	Green Award programme of requirements (January 2018)	Sea shipping and inland shipping
13	ES-TRIN (2021)	Inland shipping (technical standards)

## Appendix B

**Table A2.** Expert interview respondents.

Interview	Function Respondent	Date
1	Advisor Ecology and Water Quality at Rijkswaterstaat	15 April 2021
2	Policy officer Central Commission for the Navigation of the Rhine	22 April 2021
3	Researcher plastic monitoring at Wageningen University & Research	10 May 2021
4	Multi-level water governance expert at Utrecht University	18 May 2021
5	Advisor Waste and Circularity at Rijkswaterstaat	21 May 2021
6	Researcher plastic monitoring at Radboud University	25 May 2021
7	Advisor Water Quality and International Coordination at Rijkswaterstaat	28 May 2021
8	Vice-president European River Cruise Association	1 June 2021
9	Advisor Waste and Behaviour at Rijkswaterstaat	8 July 2021

**Table A3.** Personal communication with experts.

	Personal Communication	Date
1	An organisation supplying wastewater treatment systems for inland navigation vessels	16 August 2021
2	A company supplying wastewater treatment systems onboard river cruise vessels	9 August 2021
3	Rijkswaterstaat advisor in Enforcement	10 June 2021
4	Rijkswaterstaat Advisor in Traffic and Water Management	9 June 2021
5	Harbour master at the port of Arnhem and Nijmegen	8 July 2021
6	An organisation supplying wastewater treatment systems for inland navigation vessels	24 August 2021 16 March 2022

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