

Article

Examining German Media Coverage of the Re-Evaluation of Glyphosate

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Received: 1 March 2019; Accepted: 26 March 2019; Published: 30 March 2019



Abstract: This study investigates media coverage of the re-evaluation process of glyphosate from 1 January 2015 to 31 March 2018. In a comparative, qualitative print media analysis, the promotion of claims and the use of narratives of *Die Zeit*, a weekly newspaper, and *top agrar*, an agricultural trade journal, are explored. Results identify noticeable differences in both media outlets' news reporting. Whereas *Die Zeit* focused on potential health risks and the scientific controversy, *top agrar's* coverage emphasized the harmlessness of glyphosate. The multifaceted use of narratives by *Die Zeit* contrasts with the comparatively low use of narratives by *top agrar*.

Keywords: agriculture; claims-making; narratives; news values; qualitative content analysis

1. Introduction

Plant protection products aim to eradicate pests or weeds [1]. They consist of at least one active ingredient, which is the component that removes the pests or weeds. To ensure that these substances will not harm humans, animals, or the environment, the European Union (EU) has established an authorization process consisting of three main steps during which the active ingredient and the plant protection product must be assessed and approved. Then, the member states monitor the product's use. While new active ingredients usually receive an approval for ten years, approved ingredients can be renewed for up to 15 years [2].

The European license for glyphosate, an active ingredient first commercially introduced by the US firm Monsanto (acquired by the German company Bayer in 2018) in 1974, was due to expire in 2012 [3]. Glyphosate is commonly applied in agriculture, forestry [4], and horticulture [5], but also in urban areas (parks, streets, golf courses) and along transportation routes [4]. Today, glyphosate is the most dominant broad-spectrum, non-selective, systemic herbicide used globally [6]. In the EU, glyphosate is mostly used before sowing crops. Its application facilitates better crop growth, reduces the need for ploughing, and consequently minimizes soil erosion and carbon emissions [1]. Further, glyphosate is used, albeit to a lesser extent, in post-harvest treatments. It can also function as a desiccant and plant-growth regulator when applied at a lower dose [7]. Alternatives to glyphosate-based herbicides are scarce. During the past two decades, the patents of many alternative herbicides expired [8]. Thus, when abstaining from using glyphosate, farmers expect mechanical treatments to increase [9]. Depending on the soil, climate, and cultivation practices, production costs will increase as a result [10]. Site-specific weed management strategies (i.e., precision-farming) present an option, as they result in a more productive and resource-efficient agriculture [11] and, thus, reduce the use of herbicides [12]. However, their costs act as a barrier for farmers and prevent adoption [13]. Furthermore, new breeding techniques (e.g., CRISPR/Cas) could improve crop resistance, but are strictly regulated in the EU [14].

Glyphosate was initially considered an effective and yet environmentally friendly herbicide [15] with relatively little ecological and toxicological side effects [16]. However, a review [17] highlights numerous studies that demonstrate negative effects of glyphosate on organisms, unicellular [18] and multicellular [19], invertebrates [20], and vertebrates [21,22]. While the active ingredient adheres to soil particles, its metabolite aminophosphonic acid (AMPA) is more mobile [6]. Thus, both glyphosate and its metabolite have been detected in soils, groundwater, and surface waters [23].

Another aspect that led to public concerns regarding glyphosate in Europe were practices of its producer, the agrochemical company Monsanto. Monsanto sold a broad-spectrum herbicide, which contains glyphosate as an active ingredient, alongside with genetically modified (GM) crops [24]. Since most GM crops are resistant to other herbicides produced by different agrochemical companies, farmers wishing to use these GM crops had no alternatives to contractual agreements with Monsanto. These dependencies and Monsanto's market power were criticized in the European public [24].

In 2015, glyphosate gave rise to health concerns during its re-evaluation in the EU. The World Health Organization's (WHO) International Agency for Research on Cancer (IARC) concluded that glyphosate, among other herbicides, "is probably carcinogenic to humans" [25]. This placed the herbicide into the spotlight of the media and sparked a scientific controversy, as well as a public debate on potential health risks and industrialized agriculture as a whole. The modernization of agriculture, including the increasing use of herbicides, has created benefits as well as risks for society [26]. Correspondingly, news reports might emphasize potential risks of a technology, but ignore its benefits for society or vice versa [27]. Studies [27–29] indicate that the news media constitute the primary source of information on risks and hazards for the public. While the media is recognized as a risk communicator [30], it is also a business competing for readers, viewers, or listeners [31]. The gatekeeping approach acknowledges the media as a stakeholder with its own interests, deciding which information will make it into the news [32]. Accordingly, the media may prefer unusual or spectacular risks over risks that are more common [33]. Eldridge and Reilley [34] highlight that disasters, official reactions, decisive scientific information, and a scientific controversy spark the media's attention. Particularly, the media often emphasize scientific conflicts of interest because they symbolize human interest and intrigue [35]. Several researchers [36,37] underline the importance of the media in shaping the public's perception of risks, especially when the risk is presented with limited, ambiguous, or contradicting scientific information [35]. Generally, a focus on risks compared to benefits will lead to a more negative perception by the public [29]. Even though the media is just one part of the risk communication process, they can contribute to risk amplification or attenuation [37]. Abrams and Meyer [38] indicate that trade journals tend to de-emphasize agricultural risks, while research on mass media outlets shows a persistent, negative voice on biotechnology [39] and pesticides [26].

The purpose of this study is to compare media coverage of the re-evaluation of glyphosate in the EU in *Die Zeit*, an elite newspaper, and *top agrar*, an agricultural trade journal. The glyphosate case presents a unique research opportunity to investigate how the media presented the scientific controversy during the re-evaluation. Following Holt and Barkemeyer [40], media coverage in particular newspapers is an important information source for experts who advise politicians. Because media coverage of sustainability-related issues has significantly increased, the communicative power of media to influence politicians in charge of sustainability policies should not be underestimated. Specifically, the study examines which claims and claims-makers were featured by the two media outlets. It explores why media targeted at practitioners in the agricultural sector report differently than weekly newspapers targeting the wider public. Further, the study examines the use of narratives and stylistic devices, which build the foundation of a well-written text. Accordingly, the study's findings contribute to concepts of claims-making and narratives. In doing so, the present study will improve the understanding of how the media cover agricultural and sustainability topics in particular scientific uncertainties, risks and benefits, as well as conflicts of interest related to current agricultural production. A better understanding of media coverage of the highly controversial re-evaluation of glyphosate will provide insights into how the media influence and interfere with critical public debates concerning sustainability and agrochemicals.

2. Background

As the producer of glyphosate, Monsanto initiated glyphosate's renewal procedure [3] by submitting an application to Germany, the designated Rapporteur Member State (RMS). As RMS, Germany was in charge of drafting the renewal assessment report to examine any risks associated with glyphosate. Slovakia acted as Co-RMS and supported Germany in preparing the renewal assessment report (RAR). The RAR included the assessments of three German and one Slovakian institution, which analyzed different aspects of glyphosate [41]. When the IARC classified glyphosate as probably carcinogenic in a first press release in March 2015 [26], the renewal process of glyphosate was already in progress, and the public consultation had already taken place. In August 2015, the Federal Institute for Risk Assessment (BfR), one of the German institutions responsible for the assessment, submitted an addendum to its final report including all studies mentioned by the IARC [42]. Correspondingly, the European Food Safety Authority (EFSA) concluded that glyphosate "is unlikely to pose a carcinogenic hazard to humans" [43] (p.1). Generally, to achieve a decision regarding any active ingredient, the EU Member States need to vote. If the vote does not result in a majority pro or contra the active ingredient, the EU Commission can postpone the decision. Indeed, the Standing Committee of the European Commission was not able to decide on the extension of glyphosate as an active ingredient and, consequently, postponed the decision several times with a final extension by 31 December 2017 [3].

In May 2016, the Joint Meeting of the Food and Agriculture Organization's (FAO) Panel of Experts on Pesticide Residues in Food and the Environment, and the WHO Core Assessment Group on Pesticide Residues published a report on glyphosate. The panel concluded that "glyphosate is unlikely to pose a carcinogenic risk to humans via exposure from the diet" [44] (p.2). In March 2017, the Risk Assessment Committee (RAC) of the European Chemicals Agency (ECHA) also evaluated glyphosate, concluding that glyphosate is not a carcinogen to humans, nor a mutagen, nor toxic for reproduction. According to the EU Commission, the same conclusion was reached by experts from 27 Member States as well as several authorities outside of the EU. On 28 November 2017, the Standing Committee of the EU Commission achieved a majority in favor of glyphosate after Germany, which had abstained from voting, voted for an extension (Figure 1). Consequently, the license of glyphosate was renewed for another five years [5].

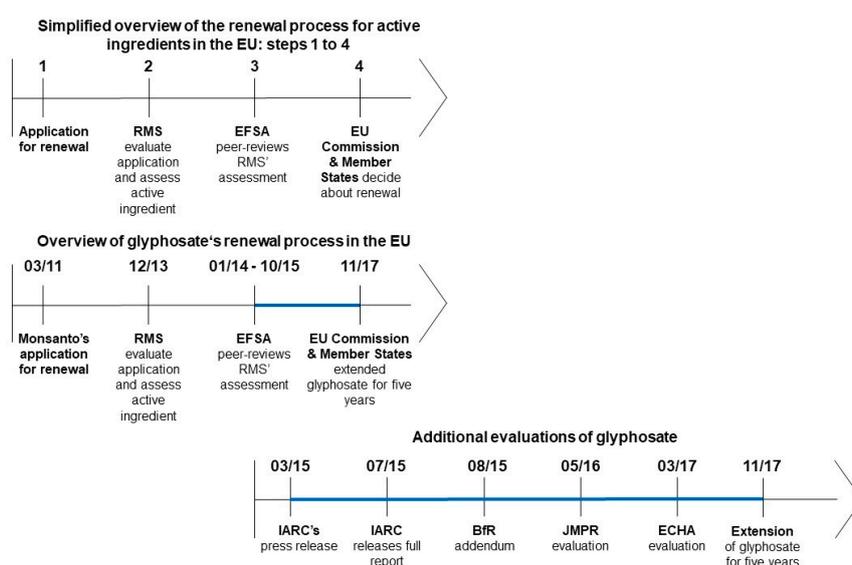


Figure 1. Renewal process and evaluations of glyphosate. Source: Authors' own elaboration based on the relevant institutions' web pages [3,5,25,41–44]. Note: RMS = Rapporteur Member State, EFSA = European Food Safety Authority, IARC = International Agency for Research on Cancer, BfR = Federal Institute for Risk Assessment, JMPR = Joint Meeting on Pesticides Residues, and ECHA = European Chemicals Agency.

3. Literature Review

The first part of the literature review addresses how the type of media outlet influences the media's selection of claim-makers and their claims. The second part looks at how the use of stylistic devices and narratives reinforce a claim. To gain a holistic understanding of a news text, it is crucial to analyze the context as well as the language applied by the media. Thus, claims-making and narratives are strongly interrelated and build the foundation of this study.

When writing about risks, journalists will often rely on sources from different stakeholder groups, especially when they are not experts in the areas themselves [31]. These stakeholders make claims about risks and their consequences. As the claims progress, the meaning of a risk itself is constantly being re-formed [45]. Generally, claims that receive high media coverage have a higher probability to be accepted by the audience [46]. Moreover, the type and, thus, the organizational structure of media outlets influence how topics are covered. Trade journals view themselves as an industry partner, delivering high-quality knowledge [47]. They are essential communication channels to update farmers on agronomic and environmental topics [48]. At the same time, studies show that advertiser pressure constrains, financially and editorially, the reporting of agricultural trade journals [38,48]. Hence, agricultural trade journals refrain from publishing articles that may cast their advertisers or the advertisers' products in a questionable way [38,49]. Further, the reporting of these journals emphasizes technical solutions that increase agricultural production capabilities to solve contemporary problems in agriculture. Thus, environmental problems caused by agricultural practices, as well as social topics and conflicts of interest, tend to be less prominent in the journals' reporting [50].

Newspapers communicate to the wider public [51]. When reporting on agriculture, they tend to focus on conflictual topics and events [52], underrepresenting the farming perspective [49]. Research shows relatively scarce reporting of newspapers on environmental risks [45]. In addition, news space is a decisive factor on how agricultural topics are covered. News stories compete within a section, but also with other sections for news space. Only when journalists succeed in selling their story to their editors is a topic placed in the news [53]. Another aspect that distinguishes newspapers from trade journals are journalistic preferences. Whereas newspaper journalists emphasize the speed of reporting, trade journalists stress accuracy. Additionally, journalists working for newspapers view it as more important to criticize unacceptable situations in society [54]. Particularly when exposing conflicting science, newspaper journalists may pursue a watchdog role [36]. Thus, the type of media, organizational structure, target audience, and advertisers influence which claims are published.

Narratives and emotive words can be powerful tools to trigger emotional reactions. They enable their readers not only to establish a connection with a story, but also to fully immerse themselves in it [55]. Molek-Kozakowska [56] showed that emotive words might reduce complex scientific topics to personalized interpretations, impeding critical judgement on a topic. The foundation of any narrative is the language. It is a way of expressing, indicating, highlighting, and emphasizing values [57]. For example, the repetition of catchwords throughout a text intensifies the message of a story and motivates the audience to read the text [58]. Molek-Kozakowska [56] underlined that stylistic devices such as metaphors, speculation, and personalization stem from popular journalism and intent to engage the public. Especially, metaphors increase the news appeal for the public [59] and at the same time can be used to emphasize news values like negativity and proximity [60].

The concept of narratives analyzes how a story is written, whereas news value research considers additional factors that raise the attractiveness of a story. According to news value research, the media give preference to topics that encompass timeliness (a recent development or event), proximity (relevance for readers), and impact (wide in scope, scale). Topics that focus on negativity (conflict, death, disaster, negative consequences) and superlativeness (a news aspect that can be linguistically intensified, e.g., the world's greatest) yield the overall news value and boost the attractiveness for media outlets to publish a particular news aspect [61]. One way to achieve newsworthy stories is to sensationalize them by personalization. Personalization describes a story's focus on humans triggering events [60]. Dramatization is an important narrative approach that refers to a story's grammar to

structure and connect events in an exciting way. Emotionalization forms another meaningful element and refers to the way of presenting news. Thus, science-related news will turn into popular news when using a language that is easy to understand for lay persons [56].

Following McCombs and Shaw [62], agenda-setting in media, more precisely the framing and presentation of events and news in the media, is crucial because this form of pre-shaping contributes to how readers understand events. Concerning glyphosate, media outlets play an important role in the process of re-evaluation, as they inform and entertain the public [33]. They contribute to shaping people's perceptions of, and opinions about, agriculture and sustainability [63]. Newspapers and other mass media outlets tend to amplify controversial topics such as glyphosate, while agricultural trade journals do the opposite [64]. Based on political orientation, target audience, as well as the sequence of events and their communicative power, media reports can lead to polarization in public opinion [65].

4. Methods

This study applied a qualitative research approach that was explorative in nature. Qualitative research contributes to new insights on well-investigated topics and adds to existing theories [66]. The case study design selected for this study allowed an in-depth analysis of the glyphosate case. Case studies are particularly suitable when investigating contemporary events. More specifically, this study used a single case approach. This approach was suitable for unusual cases that deviate from everyday events [67]. The declaration of glyphosate as being probably carcinogenic by the IARC during its re-evaluation not only sparked a scientific controversy, it distinguished the glyphosate case as exceptional compared to other active ingredients. Moreover, two subunits of analysis were incorporated. Baxter and Jack [68] highlighted that an analysis can be carried out on two levels, within and between the subunits. Whereas the glyphosate case serves as a single case, the news reporting of each media outlet represents the subunits. In this study, the two subunits were chosen on the basis of the dichotomy in readership.

The present study used a qualitative content analysis. The research procedure focused on the content or content-related meaning of texts by considering the characteristics of language as a tool of communication. Further, Altheide & Schneider [69] highlighted that qualitative content analysis is a useful tool to examine the form, production and presentation, audience, and author of a news text. An important characteristic of this inductive research approach was the emergence of the information most relevant to answer the research question(s) during the research process [70]. Correspondingly, the process of constructing a qualitative content analysis included several recurrent steps: researchers began by deciding on a research problem and framed the research questions accordingly [70]; this was followed by the collection of articles, which were read several times to fully immerse in the text. Then the data was coded, and categories were established and, when appropriate, revised [69].

The first author of the study, a first-year research assistant, collected the data and carried out the analysis. They also actively coded all articles identified. The second author, a researcher with several years of experience, was responsible for training the first author as well as quality checks of the coding process. They reviewed the coding frequently, provided feedback, and discussed the development of the coding scheme with the first author. Questions and doubts regarding the coding were frequently discussed among these authors. The coding scheme was revised several times and all articles revisited before the final coding round. The final coding scheme was discussed with the third author of the study, a researcher with over 20 years of experience in qualitative research. This approach to coding served to achieve systematic and consistent results. Codes were then aggregated to categories (for an example see Table 1). Accordingly, codes and categories were rooted in the textual material from which they were developed through the constant contrast and comparison method. In the categorization process the authors were particularly attentive to avoiding overlap to assure that categories were internally homogenous and externally heterogeneous. This meant that the codes in one category belonged to each other through their meaning, while different categories were clearly distinguishable from each other.

Table 1. Exemplary codes for the category ‘Consequences for agriculture’ with excerpts, which present claims from the media outlets.

Code	Definition	Claims Presented by <i>Die Zeit</i>	Claims Presented by <i>top agrar</i>
Resistance	Media indicate that there may be an increasing use of selective herbicides, in case glyphosate is banned.	“Also, because resistance increases, more agrochemicals would have to be used several times a year. Because many herbicides are not as efficient as glyphosate” (<i>Die Zeit</i> , 6 August 2015).	“Without glyphosate, more selective herbicides would have to be used. In addition, the variety of active ingredients that are available would decline. Leaving behind an active ingredient is very important” (<i>top agrar</i> , May 2016).
Economic consequences	Media outlets present economic consequences of banning glyphosate.	“The consequences of a glyphosate ban could reduce crop production from 5% to 10%, speculate scientists of the University of Giessen. Their colleagues from Goettingen estimate that these shortfalls can be compensated for example, by ploughing more often” (<i>Die Zeit</i> , 24 July 2015).	“Currently glyphosate is being pilloried by the public. Yet, no one talks about the benefits of the active ingredient. The University of Goettingen investigated the consequences of banning glyphosate” (<i>top agrar</i> , May 2016).
Ecological consequences	Newspaper presents out of the box solutions regarding a possible ban of glyphosate.	“If we want to harvest more because of a growing world population, and if we want to use less fertilizer and agrochemicals, then the classical methods will not be sufficient. Scientists are confident that those new technologies like CRISPR/Cas, Talen or ODM are suitable for ecological farming” (<i>Die Zeit</i> , 9 March 2017).	Not found

Source: Authors’ own elaboration (quotes have been translated from German). Note: CRISPR/Cas, Talen or ODM are standard methods of genome editing. These methods are used to cut DNA units from a DNA sequence. They are based on adaptive defense mechanism of bacteria.

Die Zeit was chosen as a media outlet because it is considered an elite weekly newspaper. Weekly newspapers are characterized by offering less news compared to daily newspapers, but they have a multitude of in-depth analyses and comments. Because of its high journalistic level, *Die Zeit* is one of the opinion leaders in Germany [71]. Its readers possess a high interest in politics, culture, and science [72] (Table 2). The introduction of glyphosate to agriculture superseded earlier weed management practices with selective herbicides [54]. In 2014, agriculture accounted for 90% of the global glyphosate use [7]. Accordingly, an agricultural trade journal was selected as the second subunit for this study, because a prohibition of glyphosate would have had severe effects on contemporary farming practices. The trade journal *top agrar* is the market leader throughout German speaking countries in the farming sector. Agricultural managers and top decision-makers belong to *top agrar*'s core audience. In particular, it reaches medium to large-scale farmers [73] (Table 2). Generally, comparing a weekly newspaper with a trade journal is especially beneficial as both media outlets focus on in-depth reports and contextualization [51].

Table 2. Characteristics of the media outlets selected.

Media Outlet	Type of Media	Characteristics	Readership	Frequency	Sold Circulation	First Edition
<i>Die Zeit</i>	National newspaper	Elite media outlet	Decision-makers, German citizens	Weekly	500,000	1946
<i>top agrar</i>	Trade journal	Leading agricultural trade journal	Agricultural managers and top decision-makers of the farming sector	Monthly	106,483	1972

Source: Authors' own elaboration based on *Die Zeit* [72] and *top agrar* [73].

The articles of *Die Zeit* were obtained through its online archive. To collect the articles of *top agrar*, they were first researched through the online archive, but they were obtained by scanning the printed version in the university library. Both media outlets' articles were selected on the basis of their titles. Glyphosate was the only key word used to find all articles. Glyphosate, as an active ingredient, encompasses a variety of topics, including the agrochemical industry, genetically modified (GM) plants, and the use of herbicides in agriculture. The present study concentrated on how the two media outlets covered glyphosate during the re-evaluation process. Consequently, the inclusion of keywords like herbicides, GM, Monsanto, etc. were beyond the focus of this study.

In 2002, the EU approved the use of glyphosate in agriculture (European Commission, 2018b). This approval concerned initially only farmers. *Top agrar* began reporting on glyphosate in its June 2000 issue. *Die Zeit* released its first article on 21 November 2012. The sampling period encompassed reporting before and during the scientific controversy, as well as the initial period after the European extension of glyphosate, and included articles from 1 January 2015 to 31 March 2018.

5. Results and Discussion

In the period March 2015 to November 2017 the re-evaluation process on glyphosate actively progressed (Figure 2). During this time the two media outlets reported on the process; however, reporting styles and foci differed slightly. In the beginning of the media discourse in 2015, *Die Zeit* laid emphasis on the potential health risks caused by glyphosate. It portrayed the IARC as a leading authority in health risk evaluations and seized the chance to cast glyphosate in a broader context. *Die Zeit* focused on agrochemicals that were broadly discussed in the past, such as DDT (Dichlorodiphenyltrichloroethane), which were highly efficient and, at the same time, highly toxic. In an article on 29 December 2015, *Die Zeit* referred to the histories of these agrochemicals as 'stories of being late', referring to the harm caused by their application, as well as the long time period until they were prohibited. *Die Zeit* then compared these stories to glyphosate, questioning whether in

the future the active ingredient would be banned as well. On the contrary, *top agrar* compared the IARC and its classification of probably carcinogenic with sausages and meat products (Table 3). When the BfR announced that “glyphosate is not carcinogenic” [42] (p.2), *Die Zeit* did not only present the contrasting evaluations of the IARC and BfR, it discussed them at length, explaining the purpose of both institutions and the reasons behind their evaluations [74]. Unlike *Die Zeit*, *top agrar* briefly explained, in one article (*top agrar*, April 2016), the discrepancy between the IARC and the BfR. Further, it stressed the importance of the BfR as an institution in the evaluation process (Table 3).

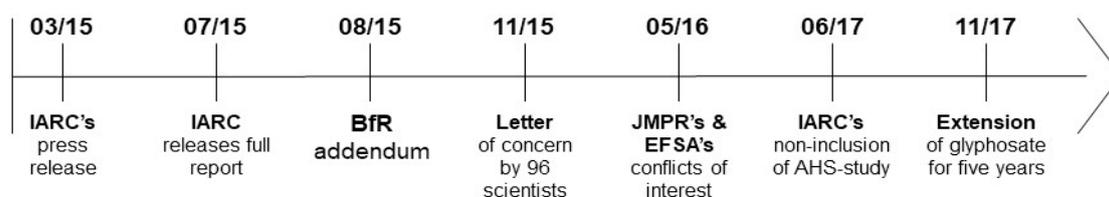


Figure 2. Timeline with the most important media highlights regarding glyphosate’s re-evaluation. Source: Authors’ own elaboration based on *Die Zeit* and *top agrar*. Note: IARC= International Agency for Research on Cancer, BfR = Federal Institute for Risk Assessment, ECHA = European Chemicals Agency, JMPR = Joint Meeting on Pesticides Residues, and EFSA = European Food Safety Authority.

Table 3. Key institutions and their claims regarding the re-evaluation of glyphosate.

Institution	<i>Die Zeit</i>	<i>top agrar</i>
IARC	“For more than a year the IARC examined studies about glyphosate and concluded that it is ‘probably carcinogenic’. Their researchers are known globally for their authority. The British Guardian calls the IARC ‘highly respectable dissenter’ (<i>Die Zeit</i> , 24 July 2015).	“The IARC concluded that ‘glyphosate is probably carcinogenic’. Similarly dangerous are, according to the IARC, sausages and meat products” (<i>top agrar</i> , December 2015).
BfR	“The BfR refers to studies that were preselected by the agrochemical industry. They provided the BfR with summaries of scientific publications and with studies that are publicly inaccessible. The BfR rejects any accusation that it was influenced by the industry” (<i>Die Zeit</i> , 24 July 2015).	“(. . .) Interview of <i>top agrar</i> with Prof. Dr. Hensel, president of the BfR: “The BfR included all available studies and other sources in its scientific evaluation (of glyphosate). In total, more than 1000 studies, documents and publications” (<i>top agrar</i> , September 2015).
EFSA	“(. . .) several members of the EFSA (. . .) were or are in close contact with the International Life Science Institute (ILSI). (. . .) None of the accusations were proven” (<i>Die Zeit</i> , 5 May 2016).	“The daily intake of glyphosate could be increased from currently 0.3 to 0.5 mg/kg bodyweight according to EFSA” (<i>top agrar</i> , December 2015).
JMPR	“The British Guardian cites a lawyer of the ClientEarth group, who clearly sees a conflict of interest if the security of glyphosate is evaluated by scientists that received money directly from the industry” (<i>Die Zeit</i> , 18 May 2016).	“Within the WHO they do not agree on glyphosate. Contrary to the IARC, is the evaluation of the JMPR, a joint working group of FAO and WHO. (. . .) Worldwide, there is not one single institution sharing the evaluation of the IARC” (<i>top agrar</i> September 2015).

Note: IARC = International Agency for Research on Cancer, BfR = Federal Institute for Risk Assessment, ECHA = European Chemicals Agency, EFSA = European Food Safety Authority, FAO = Food and Agriculture Organization, and WHO = World Health Organization. Source: Authors’ own elaboration (quotes translated from German).

As the glyphosate discourse progressed, *Die Zeit*’s reporting concentrated on the scientific debate, most prominently featuring the differing evaluations, as well as the conflicts of interest associated

with the BfR, Joint Meeting on Pesticides Residues (JMPR), and the EFSA. In doing so, *Die Zeit* covered several claims as well as a letter of 96 scientists published in November 2015 that questioned the objectivity of the BfR. In May 2016, it uncovered the close collaboration of EFSA with the International Life Science (ILSI) institute, which collaborated closely with the agrochemical industry. Further, it highlighted that the chairperson as well as the co-chairperson of the JMPR both occupied positions in ILSI. *Die Zeit* underlined the significance of this conflict of interest by referring to the *Guardian*, the British daily newspaper, which was also an elite media and a watchdog [75]. In doing so, it emphasized the importance of this conflict of interest and simultaneously supported its own argument. Further, in 2017, *Die Zeit* even uncovered a potential conflict of interest related to the IARC. It declared that “The IARC paid no attention to the latest results of the Agricultural Health Study” (*Die Zeit*, 28 June 2017). IARC chairperson, Aaron Blair, was accused of concealing important information from the Agricultural Health Study (AHS). The AHS did not find a correlation between glyphosate and non-Hodgkin’s lymphoma [76].

Top agrar did not report on the conflicts of interest associated with the BfR, JMPR, and EFSA. It reported the JMPR’s evaluation and simultaneously used the opportunity to denounce the credibility of the IARC (Table 3). It also featured EFSA’s claim, following the BfR’s evaluation, that glyphosate was unlikely to cause cancer. In December 2015, *top agrar* featured EFSA’s intention to increase the threshold value for glyphosate uptake [43]. *Top agrar* did not cover the possible conflict of interest related to the IARC. Overall, *top agrar* promoted claims and claims-makers that supported the approval of glyphosate compared to the detailed but emotionally charged reporting of *Die Zeit*.

Die Zeit emphasized the health risks associated with glyphosate, referring to IARC in most articles. As an elite newspaper, *Die Zeit* seemed to fulfill its central role as an informer on risks and hazards [45,77]. Reisner & Walter [52] criticized newspapers for their shallow agricultural reporting. However, the present study’s findings suggested that a differentiation needed to be made between types of newspapers. *Die Zeit* is a weekly, national newspaper and covers highly controversial topics considering different angles [51]. Its detailed reporting on the discrepancy between the IARC and BfR, as well as all other institutions, contradicted the findings reported previously [52]. However, it is important to consider how the media cover an issue. *Die Zeit*’s in-depth reports on the glyphosate case were informative and, at the same time, emotionally charged. Thus, it was evident that *Die Zeit* acted as a gatekeeper for informing important and particularly newsworthy risks [29].

By contrast, *top agrar* briefly informed its readers on the next steps in the evaluation process. The trade journal focused on the presentation of claims from the BfR, the JMPR, and the EFSA, which all approved the use of glyphosate. *Top agrar*’s editorial focus seemed to point to the financial and editorial dilemma that trade journals face when relying on their customers for advertising revenues and news stories [38,49]. Naturally, the agrochemical industry places advertisements in relevant trade journals to offer its products to farmers. This might have influenced *top agrar*’s reporting on the glyphosate case. Reports did not address the possibility that glyphosate could cause negative effects for humans or the environment. Instead, *top agrar*, refrained from publishing critical claims and perspectives, and they promoted claims that supported glyphosate’s harmlessness. In doing so, *top agrar* also acted as a gatekeeper for risk information, attenuating the risks associated with glyphosate [37]. However, whether this was connected to, or influenced by, advertiser pressure as indicated in prior studies [38,49] needs further investigation. Editors of trade journals for farmers have been found to attenuate risks, but also, they address different agricultural risks compared to mass media [38]. While the *Die Zeit* reported on risks associated with glyphosate, *top agrar* focused on risks caused by weed resistance.

Unlike *top agrar*, *Die Zeit* extensively reported the conflicts of interest associated with the BfR, the EFSA, and the JMPR. This corroborated earlier findings that newspaper journalists were more likely to pursue a watchdog role, criticizing unacceptable situations and practices, compared to trade journals [55]. However, in line with earlier findings [35], *Die Zeit* seized the dramatic energy of every conflict of interest to market the initially rather ordinary re-evaluation process of glyphosate. Trade

journals for farmers previously have been found to investigate agricultural conflicts insufficiently [49]. Indeed, *top agrar* did only mention criticism of the BfR as an institution, but neglected other conflicts of interest.

Another characteristic of *Die Zeit's* reporting was that it repeatedly reported that scientists from the IARC, BfR, as well as other institutions involved were fighting about the carcinogenic properties of glyphosate. However, in August 2017 the reporting of *Die Zeit* changed. It acknowledged the dependence of farmers on glyphosate, criticizing green politicians, as well as non-governmental organizations for having mobilized the public. Subsequent articles (29 November 2017; 17 January 2018) highlighted technological trends in agriculture to remove weeds more efficiently. *Die Zeit* further discussed future implications for agricultural decision-making processes because of the glyphosate case, which drew attention to agriculture among the public. *Top agrar* also reported on a scramble about glyphosate (issues July, October, and November 2017), however, to a lesser extent than *Die Zeit*. *Top agrar* repeatedly demanded more objectivity as well as an honest discussion from politicians, the media, and the public regarding glyphosate's re-evaluation. By demanding an honest discussion, *top agrar* reacted to the increasingly emotionalized debate. In 2017, shortly before its extension, both media outlets raised the issue of trust regarding glyphosate's evaluation process. *Die Zeit* presented the prohibition of glyphosate as necessary to re-establish trust in European politics. The trade journal, by contrast, considered the procedure in the glyphosate case as questionable and portrayed a loss of trust in European politics, because glyphosate had not been extended yet. After its extension, *top agrar* published short news (January 2018), reporting briefly on glyphosate's extension.

“An orderly retreat (. . .) from glyphosate could provide clarity to farmers and industry and show the way to a compromise. A continuation of this paralysis would be a disaster to Europe's political credibility. (. . .) Even if the field poison would not pose any health hazards: Politics and science did not succeed in eliminating doubts” (*Die Zeit*, 27 September 2017).

“According to European Health Commissioner Vytensis Andriukaitis, 27 agencies globally conclude that glyphosate is not carcinogenic. Why do politicians not finally extend it? The current back and forth melts away any trust in political decisions. It seems that emotions are valued higher than scientific findings – that is more than bitter” (*top agrar*, November 2017).

Contrary to *top agrar's* target audience of farmers and industry [73], *Die Zeit* targets the public and decision-makers in politics and the economy [71]. Research of Schulze et al. [32] showed that media outlets are oriented towards their customers. Both media outlets analyzed clearly reflected the perspectives of their audiences. *Top agrar*, which addresses farmers and industry, showed its disapproval of the emotional debate on glyphosate, demanding an honest discussion; *Die Zeit*, which addresses German citizens and political decision-makers, compared the scientific controversy to a fight and a political disaster. Further, as a trade journal and industry partner [47], *top agrar* identified with the harmlessness of glyphosate, as indicated by many evaluating institutions worldwide.

During the media discourse, *Die Zeit* repeatedly called glyphosate a “weed killer” or a “poison.” Particularly the headlines, subheadlines, and lead paragraphs revealed a variety of stylistic devices such as metaphors and malapropism. The applied metaphors were used as a means to attract *Die Zeit's* audience. For example, in a lead paragraph, it concluded that the label carcinogenic for a chemical equal a “death sentence” (*Die Zeit*, 9 July 2015). In the same article, *Die Zeit* compared glyphosate to a “magical cure”. The combination of metaphors and negative catchwords from lexical fields around risk and danger created a pointed message on the properties of glyphosate. Furthermore, this comparison belonged in the superlativeness category in news value research [61]. Malapropism refers to the intended and humorous replacement of a word that is phonetically but not semantically related (e.g., dance a flamingo instead of flamenco) [78]. *Die Zeit* used the title of the German dating TV show “Farmer searches wife” (“Bauer sucht Frau”), broadcasted by the German private TV channel Radio

Télévision Luxembourg (RTL), since 2005, for its headline in an article (29 November 2017). The word wife was replaced by weed, “Farmer searches weed”. The intention of the TV show is that German farmers find a partner [79]. By changing the wording to weed, *Die Zeit* laid a strong emphasis on weeds and their significance for farmers. Thus, the subheadline named digitalization of weed removal strategies, which was discussed in the subsequent article. Linguistically, this malapropism secured the attention of the audience, as the TV show seemed well-known among the German public.

Unlike *Die Zeit*, *top agrar* did not use alternative terms for glyphosate. However, the trade journal also used metaphors during the media discourse (“acquittal for glyphosate”, December 2015) and referred several times to a “scramble about glyphosate” (April 2016, July and October 2017). While *Die Zeit* consistently portrayed a “fight” about glyphosate, *top agrar* reported once (July 2017) that the opponents of glyphosate were partially successful, referring to a signature campaign of environmental organizations collecting 1,070,865 signatures from 22-member states [1]. In an interview of the president of the BfR, *top agrar* (September 2015) also presented the back and forth regarding the re-evaluation as a “fight”, polarizing supporters and opponents.

“Glyphosate: toxic quarrel [headline]. Not carcinogenic now, is it? A bizarre study battle rages over the weed killer glyphosate [subheadline]” (*Die Zeit*, 28 June 2017).

“Fight about glyphosate intensifies [headline]. Glyphosate opponents do everything to prevent the extension [subheadline]” (*top agrar*, November 2017).

Calling glyphosate a “weed killer” or a “poison” and reporting on a “toxic quarrel” entailed a negative connotation for the herbicide and its re-evaluation process, which evoked emotions or visualizations [56]. The repetition of these words was used to intensify the message as well as to maintain the readers’ interest in the news story [58]. In addition, the metaphors used by *Die Zeit* emphasized the negative and sensational attributes associated with the glyphosate case.

Corroborating Nelkin [59], the metaphors used by *Die Zeit* indeed seemed to have increased the news appeal for readers by emphasizing news values like negativity and proximity [60]. Considering its readership, the general public and German decision-makers [72], the language used, particularly in headlines and subheadlines, seemed to fulfill its task to attract and engage readers. Similarly, the combination of metaphors and negative catchwords emotionalized glyphosate and dramatized the issue of its re-evaluation. In a five-country comparison, Lück, Wessler, Wozniak & Lycarião [80] identified German daily newspapers to score second regarding the use of narratives. Even though the media outlets investigated were daily newspapers, which differed in readership and structure, this might explain the repeated use of narratives by *Die Zeit*. Nevertheless, the use of narratives cannot solely be attributed to nationality, as *top agrar*’s use of narratives and stylistic devices was rather distinct. By demanding an “acquittal for glyphosate” and repeatedly referring to “a scramble about glyphosate”, *top agrar* fueled the polarization between the general public and farmers regarding contemporary agricultural practices. This emotional representation of the re-evaluation seems rooted in the nature of the topic, as farmers would have been immediately affected by glyphosate’s prohibition. This might explain *top agrar*’s heavy use of stylistic devices regarding the re-evaluation, while it usually uses fewer stylistic devices. Overall, the multitude and the intensity of narratives and devices used by *Die Zeit* seemed to have attracted and engaged its readers. By contrast, the low use of narratives by *top agrar* could be attributed to its customers.

The media discourse of glyphosate investigated in the present study encompassed a variety of news values that seemed to have yielded its attractiveness for the media. Firstly, the possible health risks of glyphosate would affect society and make the topic highly relevant for readers. Particularly in the last decade, food quality and safety have been at the center of concerns of industry, government, science, and the public [81]. Secondly, the scientific controversy including the conflicts of interest regarding glyphosate’s possible carcinogenic properties seemed to have yielded its news value. Thirdly, a prohibition of glyphosate would have had severe effects for the agrochemical industry and for farmers, demonstrating the impact of glyphosate as a news topic. To summarize, the present study identified

the following news values: impact, proximity (relevance to the reader), negativity, superlativeness, scientific controversy, and conflicts of interest. Contrary to *top agrar*, which focused on the impact of a glyphosate ban and its proximity to farmers, *Die Zeit* used proximity (relevance to decision-makers and the general public), negativity (uncertainty regarding the carcinogenic properties of glyphosate), the scientific controversy, as well as the conflicts of interest associated with the re-evaluation to construct the story of glyphosate.

6. Conclusions

The story of glyphosate raises questions on how scientific uncertainties, risks and benefits, as well as conflicts of interest related to modern agriculture are reported by the media. The detailed news discourse of *Die Zeit* emphasized the health risks and the scientific controversy associated with glyphosate. While this could indicate *Die Zeit's* watchdog role, criticizing unacceptable situations in society [54], scientific controversy and conflicts seem to have increased the attractiveness of the glyphosate case. *Top agrar* promoted claims and claims-makers supporting the approval of glyphosate. Concurrently, its reporting lacked information on the differing evaluations and conflicts of interest (except the conflict of interest related to the BfR). *Top agrar's* editorial focus points to the dilemma trade journals face when relying on their customers for both advertising revenues and news.

The results of the present study showed that each media outlet is an interpreter of risk. Indeed, contemporary agriculture faces a multitude of challenges [82], which will intensify the increasingly political discussion of scientific questions related to agriculture and sustainability in the media [36]. Prior research on the reporting of agricultural trade journals focused on the US [38,49,52]. However, the European public is becoming increasingly aware of agricultural issues, such as food safety [81], GM food [36], and as this study showed, pesticides. Thus, future research would do well to interview European agricultural editors of newspapers and agricultural trade journals on how they cover critical topics leading to public polarization such as agricultural risks and sustainability. This is particularly important because newspaper coverage influences politicians and experts as they make final decisions on policies with sustainability impacts, such as banning glyphosate. Further, analyzing how advertiser pressures influence the reporting on risks will further clarify the role of the media in communicating risks in society and in influencing and interfering with public opinion building.

This study identified several news values [61] such as impact, relevance, negativity, and superlativeness. Further, the study showed a different use of narratives (spectrum and intensity) applied by the two media outlets. The multitude and the intensity of narratives detected, particularly in the headlines, subheadlines, and lead paragraphs, by *Die Zeit* seemed to have attracted and engaged its readers [83]. The low use of narratives by *top agrar* could be attributed to its customers. The present study's findings provided insights into the use of narratives and stylistic devices in print-media outlets. Results regarding narratives could be a starting point for future research. This would contribute to the understanding of how narrative mechanisms are used by newspaper and trade journal editors to present agricultural and scientific news, which is especially important in the context of sustainability.

Additionally, the role of narratives and news values in social media could be investigated, because social media allows direct interactions among readers, politicians, and other stakeholders. Different from print media, posts on social media are usually rather short and need to be on point. They can be highly influential, spread quickly, and responses are immediate. These posts are not necessarily neutral, they are often provocative, and the information shared is emotionalized. For policy decisions regarding sustainability, the narrative can get in the way of sound policy. Therefore, the analysis of posts on social media could be particularly useful for further studies. Posts on social media also have the potential to severely interfere with the unbiased presentation of scientific facts in the public [84]. The topic of glyphosate may be prone to so-called fake news, because various individuals, governmental institutions, as well as corporations with contradicting interests are involved in the debate. All of them are interested in and concerned about their credibility and reputation, which both can be severely harmed by the effects of fake news [85].

Generally, this study identified noticeable differences in the news reporting between *Die Zeit*, an elite weekly newspaper, and *top agrar*, a monthly agricultural trade journal. The only commonality was that each media outlet portrayed a coherent narrative of glyphosate, selecting its claims and claim-makers accordingly. The use of narratives and stylistic devices increased the attractiveness of the stories presented. A limitation of the study is the focus on German print media rather than digital news content, for example, online newspapers and trade portals as well as online news platforms. An extension of this work across platforms and national boundaries (particularly to other European countries) could provide information on cross-country differences in claims-making and the newsworthiness of glyphosate.

Author Contributions: Conceptualization, V.V.; Data curation, V.V. and M.R.; Formal analysis, V.V.; Investigation, V.V.; Methodology, V.V., M.R., and V.B.; Project administration, V.V. and V.B.; Resources, V.B.; Supervision, M.R. and V.B.; Validation, V.V., M.R., and V.B.; Visualization, V.V.; Writing—original draft, V.V.; Writing—review & editing, M.R. and V.B.

Funding: This research received no external funding.

Acknowledgments: The authors like to thank the three anonymous reviewers for their valuable input.

Conflicts of Interest: The authors declare no conflict of interest in the context of this study and its publication.

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