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## REVIEW

# Societal perceptions of aquaculture: Combining scoping review and media analysis

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## Abstract

Aquaculture has been recognised for achieving multiple United Nations Sustainable Development Goals; its further growth depends on understanding, and responding to, societal perceptions in a broader context. Thus, this study aims to understand societal perceptions of aquaculture through a scoping review and media analysis. A scoping review identified 151 academic studies for inclusion in our five identified research clusters: (1) social acceptability, (2) growth and development, (3) media coverage, (4) sustainable aquaculture, and (5) consumer perceptions. Further, newspaper articles ( $n = 100$ ) were sampled from the United Kingdom, Denmark, France, Spain, Turkey, and China; elsewhere all articles identified were included (Poland, 79; Hungary, 29; India, 70). The findings suggest that scientific and newspaper articles tend to present sustainability aspects in a simplified form. Key stakeholder groups include fish farming enterprises, civil society, governmental officials, scientists, and business leaders both within aquaculture value chains (retailers/wholesalers, technology industry) and outside of them (fisheries, tourism). Also, other stakeholders included the public (indigenous groups, residents, consumers). The stakeholder groups perceived aquaculture differently and depending on the circumstances and context, their perceptions ranged from positive to negative. Many factors influenced their perceptions, including aquaculture's impact on multiple sustainability dimensions, knowledge, transparency, personal interests, types, and location of aquaculture practises, regulations, experience, and sociodemographic characteristics such as age, gender, education, and income. We recommend that aquaculture practitioners focus on context-specific multifaceted strategies—prioritising transparency, communication, and accountability—and provide essential knowledge to ensure that societal perceptions of aquaculture are based on accurate, empirical information.

## KEYWORDS

newspapers, public perceptions, social acceptability, sustainable aquaculture, sustainable dimensions

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## 1 | INTRODUCTION

Aquaculture has been recognised as one of the critical food sectors to achieve a range of United Nations Sustainable Development Goals (SDGs) by 2030, SDG1: 'No Poverty', SDG2: 'Zero Hunger', SDG3: 'Promoting health and wellbeing', SDG12: 'Responsible consumption and production', SDG13: 'Climate change', and SDG14: 'Life below water'.<sup>1-4</sup> Substantial evidence shows that aquaculture provides significant socioeconomic opportunities for coastal and rural communities.<sup>5-8</sup> Further, aquaculture products are rich sources of both macro- and micronutrients and provide food and nutrition security for many vulnerable groups.<sup>9-11</sup> Increasing use of genomic tools to assist selective breeding is improving already low feed conversion ratios compared to terrestrial animals<sup>12</sup> and a variety of approaches ranging from therapeutics to better management practice and system design are improving resilience to disease—eventually leading to improving sustainability of production.<sup>13</sup>

There is a strong public interest in developing national legislation supporting the development of conventional/traditional aquaculture towards more sustainable practices through responsible, resilient and conservation aquaculture principles and strategies.<sup>2,14-16</sup> Conceptually, responsible and resilient aquaculture prioritises more on environmental sustainability, social responsibility, and economic viability,<sup>17</sup> while 'conservation aquaculture' focuses on biodiversity conservation to minimise environmental impact.<sup>18,19</sup> Similarly, a recently proposed 'restorative aquaculture' principle aims to provide direct ecological benefits to the environment.<sup>20</sup> So far it has been responsible and resilient principles and strategies that have been assured by third-party certification and with increasing influence in markets, signposting responsible consumption opportunities.<sup>21</sup>

Aquaculture production has grown rapidly in Asia for decades, now producing over 90% of global farmed production.<sup>22</sup> In contrast, production is currently negligible in Europe (<3%), the Americas (<4%), Africa (<2%), and Oceania (<0.2%). Costa-Pierce and Chopin refer to the new geographies of aquaculture—'almost everywhere outside of Asia where aquaculture is new and not traditional' but aquaculture was only ever traditional in relatively small areas of Asia<sup>23</sup> and growth has been slow or even in decline within this new geographies.<sup>6</sup> Certainly, the level of aquaculture development within regions is also variable. For example, the production of Atlantic salmon in the European region has increased by more than 33%, and sea bass by 29%, while mussel production declined by 5% in 2021 compared to 2011. However, the increased dependence of high-income European countries on farmed aquatic food imports from low- and medium-income countries and insecurity concerning the product's environmental, social, and safety credentials have resulted in substantial negative media coverage in the past.<sup>24,25</sup> Efforts to stimulate local production have yet to be delivered, for which strict governance and regulatory environments are considered the biggest obstacles rather than a lack of technological capacity or problems with the economy.<sup>5,26,27</sup> Further, researchers argue that an improved understanding of societal perceptions of the sector is critical for aquaculture expansion and advancement.<sup>24,28-31</sup> Thus, studies that aim to understand how society

perceives different aquaculture practises and their products in a broader context are crucial to supporting the continued evolution of aquaculture towards greater sustainability while boosting public acceptance of the sector.

This review differentiates from previous studies<sup>24,32,33</sup> through (1) its methodological rigour (2) its geographical framing that spans a range of production-consumption contexts, and (3) its focus on linking perceptions to contemporary sustainability dimensions. The objective of the study is to synthesise and analyse scientific and newspaper articles to determine if they mention multiple dimensions of sustainability before portraying aquaculture as positive, negative, or neutral. A comprehensive analysis was conducted on scientific articles to understand the various dimensions of sustainability mentioned, without categorising them based on sentiment, while sentiment analysis was performed on newspaper articles to classify the portrayal of aquaculture. Further, efforts will be made to identify key stakeholders, their roles, and factors influencing their perception of aquaculture. This research is organised into two complementary steps: a systematic scoping review to understand the societal perceptions of aquaculture through the scientific literature and a media analysis of the portrayal of aquaculture in mainstream newspaper outlets. In this study, the findings from the systematic scoping review informed the design of media analysis. This study set out to use both methods to develop a more comprehensive and triangulated analysis of prevailing perceptions, which has been the main limitation of previous perception studies of aquaculture.<sup>34-37</sup>

## 2 | MATERIALS AND METHODS

### 2.1 | Systematic scoping review

A systematic scoping review was performed to identify and synthesise relevant scientific literature. Specifically, and similarly to a systematic review, a systematic scoping review follows a detailed protocol specifying the review process in advance.<sup>38,39</sup> Still, it aims to capture a holistic understanding of a broader research topic than a systematic review. This study strictly followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) extension for scoping reviews guidelines.<sup>40</sup> In this study, the questions guiding the systematic scoping literature review were: 'How was stakeholder perception documented in aquaculture literature: who were the relevant stakeholders, what perception did they have towards aquaculture, and what factors influenced their perceptions towards aquaculture?'

#### 2.1.1 | Data collection

The three scientific databases, Web of Science, Scopus, and Google Scholar were consulted to search research articles published from 1 January 2015 to 15 January 2023. The authors discussed and agreed upon the broad and inclusive search terms to capture a wide

range of relevant aquaculture perceptions literature. An example of a search string employed in the Scopus database was as follows: (ALL (aquaculture OR farm\* fish OR aquafarm\* OR mariculture OR polyculture)) AND (TITLE-ABS-KEY (perception\* OR belief\* OR attitude\* OR imag\* OR opinion\*)) and the string was adapted to the syntax of each database. The reference sections in the identified academic articles were thoroughly checked for other potential articles.

The inclusion criteria were all types of records, including reviews, books, reports, conference papers, and original articles; documents published from 1 January 2015 to 15 January 2023; records published in the English language; records available as full texts; and records that are relevant to the purpose of the study. Exclusion criteria included search terms used in a different context to the research question (for instance, management and conservation aspects of aquaculture, economic and demand analysis, technological aspects of aquaculture, and perception towards wild fisheries); records that are not relevant to the aim of the study that is, records with the primary aim of understanding societal perceptions of aquaculture.

### 2.1.2 | Data analysis

The scientific articles following inclusion criteria were imported into the Zotero software to manage the citations.<sup>41</sup> Initially, a thesaurus file was created to ensure consistency for different spelling and synonyms in the text data (for instance, farmed fish was exchanged with aquaculture). For identifying the research cluster, thematic clustering was employed through the visualisation of similarities (VOS) software version 1.6.20 environment.<sup>42</sup> The association strength of the co-occurrence terms in the text data in the title and abstract fields was considered for determining the research clusters. A co-word map was produced with a minimum of eight occurrences of words in the text data using the VOS mapping technique for displaying research clusters.<sup>43</sup> Some of the terms considered not relevant for analysis were removed, for instance, countries and cities. The counting method was set to binary and the network and overlay visualisation scales were set to 1.00. Each article was then associated with a research cluster where it best fit. This process included screening the title and abstract for the terms defining the research clusters as well as reading the full text to align the meaning of the research cluster. This task was undertaken independently by three reviewers, and in case of disagreement, a fourth reviewer was consulted to reach a consensus through discussion. Finally, the article was summarised based on the article's information concerning the author(s) and year of publication, research design, topic focus, stakeholder involvement, and aquaculture/sustainability attributes (see Appendix A).

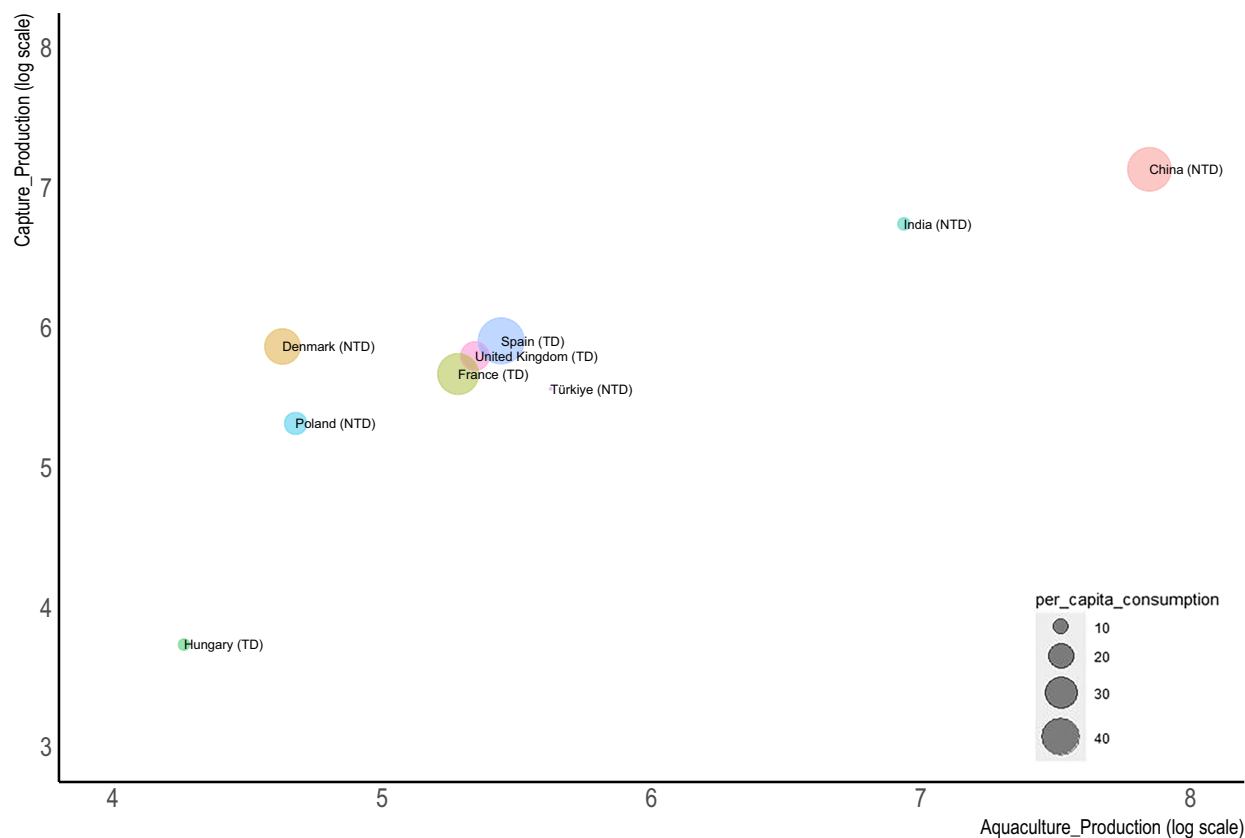
## 2.2 | Media analysis

National, regional, and local mainstream newspaper media of the United Kingdom, Denmark, France, Spain, Poland, Hungary, Turkey,

China, and India were analysed for articles on aquaculture perceptions. The countries selected for the media analysis were based on their production level (aquaculture versus wild-caught), aquatic food trade deficit, per capita consumption of aquatic foods, geographical location, and current and potential future roles in world aquaculture. For example, China was the largest aquaculture producer, with one of the highest per capita consumption and no aquatic food trade balance deficit. Meanwhile, Hungary is the lowest aquaculture producer, with one of the lowest per capita consumption and has an aquatic food trade deficit balance. Further, the inclusion of both Asian (China and India) and European (United Kingdom, France, Spain, Denmark, Poland, Turkey, Hungary) countries in the media analysis provided a greater geographical and cultural range to the analysis allowing deeper insights, and a more nuanced understanding of cross-cultural dynamics shaping the portrayal of societal perceptions of aquaculture among a significant portion of the global population. Figure 1 shows a comparative analysis between them.

Table 1 shows the keywords search terms and databases/online archives used and the number of newspaper articles analysed in each country. The keywords search terms, and the databases/online archives were adjusted according to the country. The main reason for this was not being able to locate potential newspaper articles with a standard database/online archive. Further, to locate potential newspaper articles in selected databases for country analysis, we had also to adjust the keyword search terms. Despite the adjustments, we intended to locate as many potential newspaper articles as possible in each country.

Inclusion criteria were subject matter (the primary focus of articles on societal perception of aquaculture), article types (wire, feature, or editorial), period (1 January 2015 to 15 January 2023), and official languages of selected countries (see Table 1). We employed a random quota sampling technique to select 100 newspaper articles from countries with more newspaper articles. Following the inclusion criteria, each newspaper article entered content and stakeholder analysis process, including a 'summative content' analysis. This type of analysis explores certain words in the article quantitatively but also seeks to assess the contextual use of the phrase.<sup>45</sup> Terms to conduct a summative content analysis were identified from the findings of the scoping review. The particular benefit of this approach is that it combines quantitative and qualitative techniques to investigate what is communicated and how specific topics are represented in newspaper articles.<sup>46</sup> An Excel worksheet (see Appendix B) was created to summarise each newspaper article that contains information including the headline, published data, publisher, country, headline, stakeholder involved, sustainability attributes/topics, significant findings, sentiments/tones, and types of aquacultures reported. Articles were counted according to the topic and subject involved; therefore, the sum of the topic rankings may be higher than the number of articles analysed due to the multiple themes some articles cover. For example, the same article includes mentions of both environmental benefits of aquaculture as well as social benefits.



**FIGURE 1** Comparative analysis between countries selected for newspaper media analysis. Data on per capita aquatic food consumption (kg/year/capita) and production (tonnes live weight) were taken from the Food and Agriculture Organisation<sup>44</sup>; both the x-axis and y-axis are in logarithmic scale for better visualisation. NTD, no aquatic food trade deficit; TD, aquatic food trade deficit.

### 3 | RESULTS

#### 3.1 | Scoping review

The initial Web of Science, Scopus, and Google Scholar search yielded 12,504 potential records. Following the eligibility criteria, 11,648 articles at the title level and 655 at the abstract level were excluded. Full texts of 201 articles were further evaluated to include 151 for the scoping review. Figure 2 shows the selection process of articles based on the PRISMA systematic scoping review procedure.

##### 3.1.1 | Thematic clustering

Thematic clustering of selected scientific articles identified five research clusters: (1) Social acceptability, (2) Growth and development, (3) Media coverage, (4) Sustainable aquaculture, and (5) Consumer perceptions. Figure 3 shows the co-word map of the co-occurring terms in scientific literature. The first research cluster, 'Social acceptability', outlined the public acceptability of different types of aquacultures. The second research cluster, 'Growth and Development', is closely related to research cluster 1, but this research cluster investigates multiple stakeholder perceptions about aquaculture's growth and development. The third research cluster,

'Media coverage', examines media analysis to uncover conflicts interest between multiple stakeholders. The fourth research cluster, 'Sustainable aquaculture', describes the sustainability aspects of aquaculture, particularly from the perspective of the fish farming industry. Finally, the 'Consumer perceptions' research cluster examines consumer perceptions of aquaculture and its influencing factors.

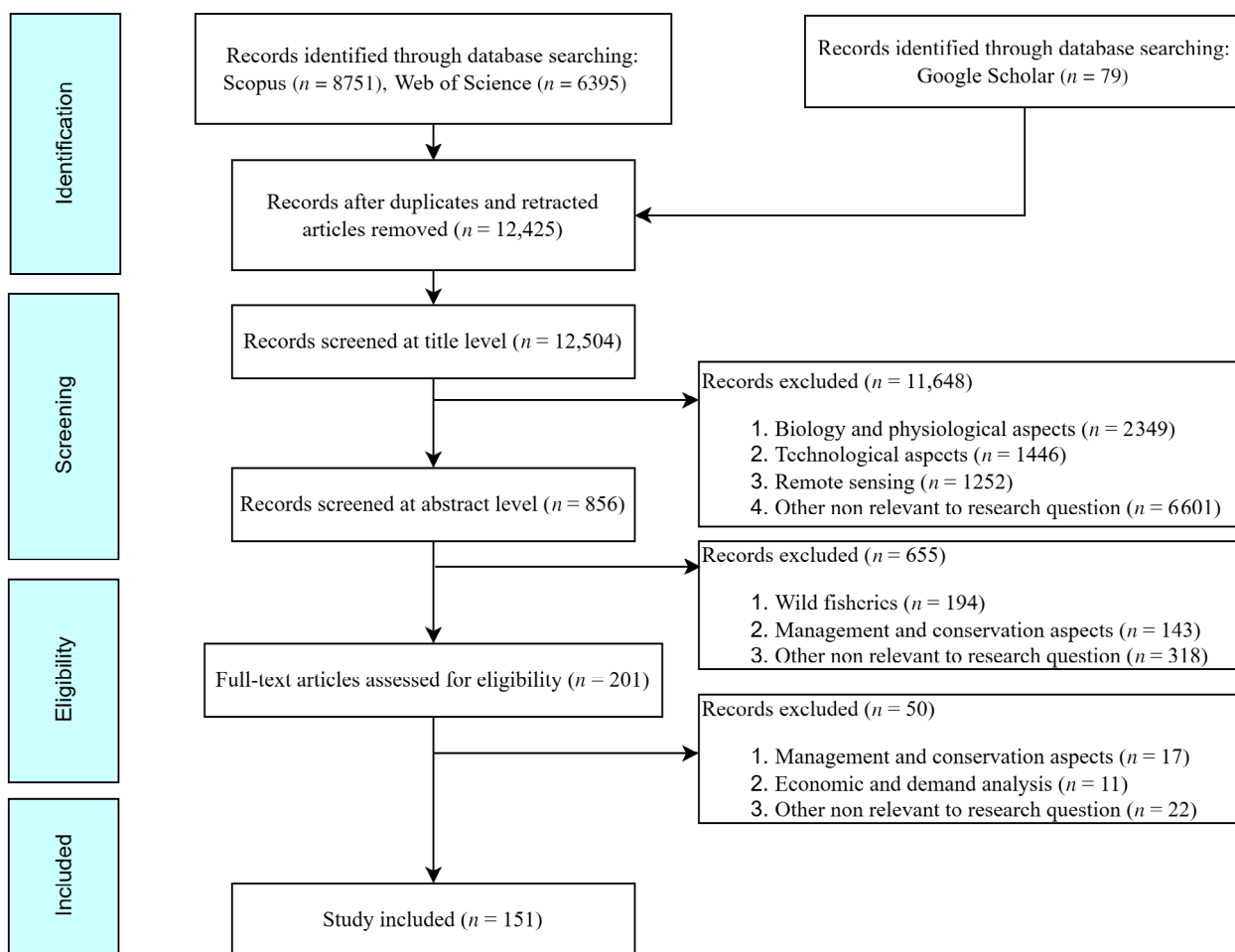
#### 3.2 | Characteristics and analysis of the research clusters

Table 2 shows the characteristics of the identified research clusters. Most of the research was conducted in Europe (49.7%), followed by North America (25.2%). Notably, Asia, the highest aquaculture production region, had only 6.6% of research focusing on understanding societal perceptions towards aquaculture. The main focus of most of the studies was user perceptions (42.3%), that is, individuals who interact with or utilise aquaculture products, often consumers. Furthermore, such user, often consumer, perceptions were mainly concentrated in research cluster 5, 'Consumer Perceptions' and the articles were based on studies conducted primarily in Europe. More than half of the research articles focused on aquaculture in general (53%), while others specified finfish aquaculture (9.9%), marine aquaculture (9.3%), and shellfish aquaculture (7.3%). More than one-third

**TABLE 1** Keyword search terms, databases, and the number of newspaper articles analysed in each country<sup>a</sup>.

	United Kingdom (English)	Denmark (Danish)	France (French)	Spain (Spanish)	Poland (Polish)	Hungary (Hungarian)	Turkey (Turkish)	China (Chinese)	India (Hindi/English)
Keywords	Aquaculture Farm fish Aquafarming Mariculture Polyculture	Akwakultura, fiskeopdræt	Aquaculture, Pisciculture, Conchyliculture, Saumon elevage	Acuicultura, Piscicultura	Akwakultura, Hodowla ryb, Gospodarka rybacka, Polikultura	Haltenyésztés, Akvakultúra, Tógazdaság	Su Ürünleri Yetiştiriciliği, Akuakültür, Su Ürünleri Çiftliği	水产养殖 鱼养殖 虾养殖 蟹养殖 贝养殖 藻养殖 海水养殖 淡水养殖	मात्स्य पालन, एक्वाकल्चर, मछली पालन
	Perception, Belief, Attitude, Image, Opinion	Opfattelse, Synes, Tenke	Opinion, Perception, Croyance	Opinion, Percepción, Creencias	Opinia, Postrzeżenie, Percepcja, Zdanie, Punkt widzenia	Vélekedés, Hozzáállás, Vélemény, Megítélés	Algı, Görüş, Fikir	观念 信仰 态度 形象 意见 观点 看法	अनुभूति, रवैया, छबि, राय
Databases	Nexis	Infomedia	Europress	Hemeroteca nacional	AGRO, SIGZ, newspaper websites	Arcanaum	Sabah, Türkiye, Sözcü, Milliyet, Hürriyet	Chinese National Knowledge Infrastructure	ProQuest
Results	2072	1455	424	445	79	29	1147	146	130
Analysed	100	100	100	100	79	29	100	100	70

<sup>a</sup>The term under the country is the language used in each country.



**FIGURE 2** PRISMA systematic scoping review flow diagram.

of the publications explored the perceptions of stakeholders about sustainability aspects (two or multiple dimensions) of aquaculture. In contrast, others explored perceptions in general (46.3%), risks and benefits (7.9%), and access arrangement (2.6%).

### 3.2.1 | Research cluster 1: Social acceptability

This research cluster investigated the social acceptability of aquaculture, with the general public being the key stakeholder group. The findings indicated that they have positive, neutral, and negative perceptions of aquaculture depending on the specific aquacultural activities, location, knowledge about aquaculture, its impact on socioeconomic benefits, and environmental risks.

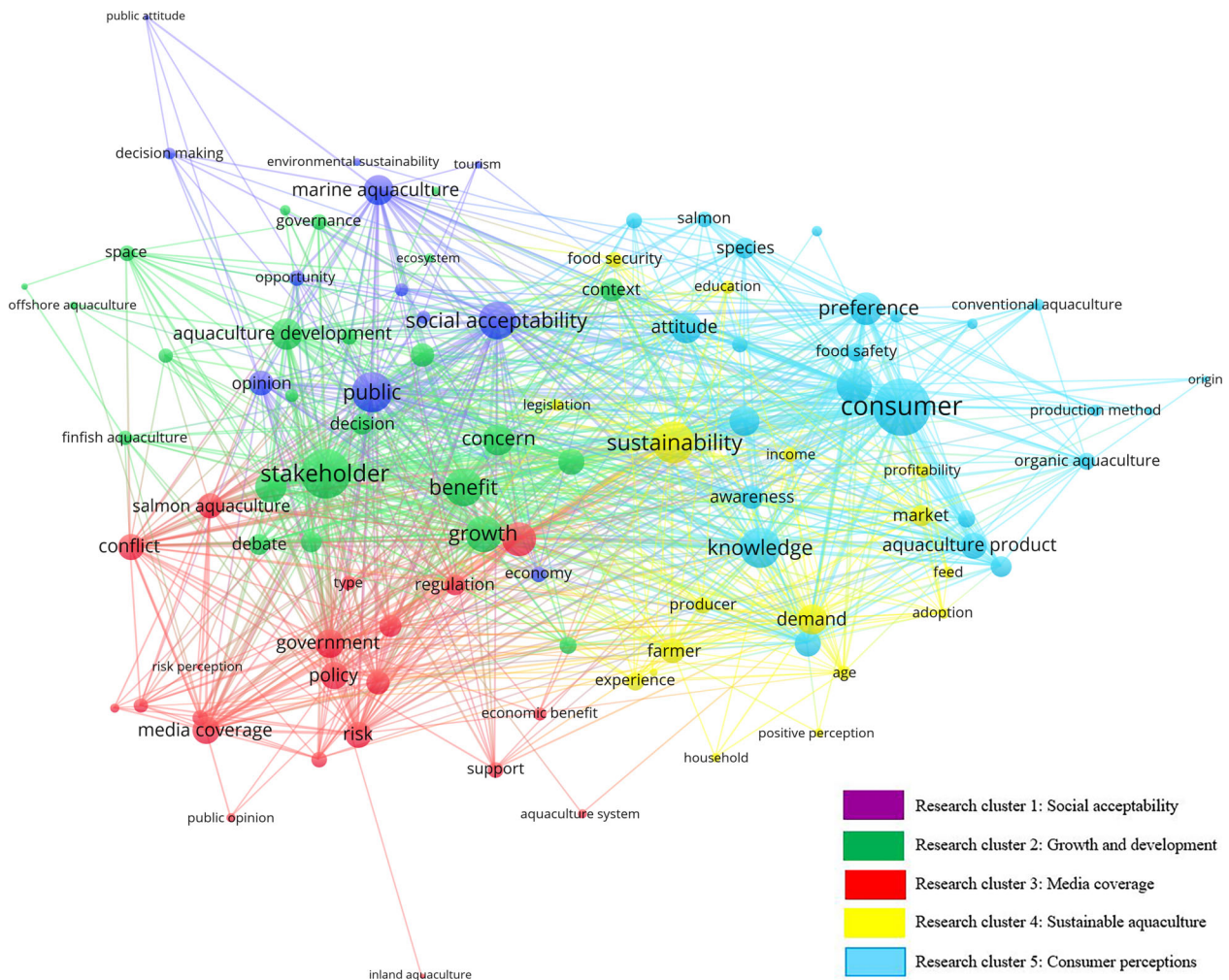
Perceptions about the type of aquaculture activities vary across countries. For example, a survey found that the Italian and Israeli public tended to have a more positive perception of integrated multi-trophic aquaculture (IMTA) than conventional aquaculture, but Norwegians were uncertain of its potential benefits.<sup>47,48</sup> IMTA—the integrated culturing of fed species, such as finfish, inorganic extractive species such as seaweeds, and organic extractive species such as suspension- and deposit-feeders remains largely a conceptual

model.<sup>49</sup> Based on the idea that the wastes of one cultured species support the production of another, it has not been adopted by commercial actors despite intense research interest—mainly due to regulatory challenges. Across the geographies assessed, most of the general public had a more positive perception towards farming mussels and seaweed.<sup>50–53</sup> In Atlantic Canadian communities attitudes were more divided with an understanding that farming bivalves could stem pollution, but also that impacts specifically on the ocean floor, and broader coastal ecology were possible.<sup>35</sup>

A review paper on European aquaculture concluded that as most aquaculture activities operated in public spaces and interacted with a wide range of other resource users and local communities; their social acceptability was closely related to the location of its operation.<sup>33</sup> Although some general public groups in Spain perceive areas closer to the coast are most suitable for aquaculture development,<sup>50</sup> more generally conflicts with other economic and recreational uses close to the coast and resultant adverse impacts, especially on aesthetics<sup>47,54–58</sup> were the main perception. However, in one specific case, Northern Norway, attitudes were more accommodating and neutral regarding its impacts on fishing and commercial and recreational uses.<sup>59</sup>

Knowledge about aquaculture among stakeholders also seems to determine the social acceptability of aquaculture. The public with a





**FIGURE 3** Co-word map constructed from the frequency of co-occurred terms.

broader understanding of aquaculture tended to support the development of this sector more than others.<sup>60–63</sup> For instance, Whitmore and colleagues found that men who graduated from college and non-whites in general in the United States claimed greater subjective knowledge of aquaculture and thus were significantly more supportive of aquaculture.<sup>63</sup> While women with lower levels of education, and whites rated their subjective knowledge lowest. Such studies do not differentiate between familiarity and knowledge, however, the approach of Flaherty et al.<sup>64</sup> who uses a specific knowledge question (what species are produced in their area?) allows the separation of real knowledge rather than a self-reported assessment of knowledge.

The findings suggest that perceptions of aquaculture sustainability are critical in determining social acceptability among the general public but the articles that link such negative or mixed perceptions do not relate them to specific or quantified negative environmental impacts.<sup>59,65–67</sup> Most European and North American public generally perceive aquaculture as a threat or a severe threat to the marine environment, including eutrophication, harmful/disruptive to wild stocks,

heavy metal contamination, and pollution. Therefore, demonstrating environmental sustainability was highly prioritised by such studies to improve public confidence in aquaculture products.<sup>64,68–71</sup> In contrast, aquaculture has been associated with local job creation and supporting the local economy and products. Attitudes associated with the socioeconomic impacts of aquaculture have been crucial for supporting (or opposing) aquaculture rather than with environmental impacts in some parts of the world, such as the United States, Ireland, and Norway.<sup>51,54–56,67,72</sup> The trade-offs between socioeconomic and environmental impacts are rarely made explicit in these articles and an opportunity to reflect on their interconnectedness and interdependency is lost.

Another dimension of social acceptability identified by the two papers was that lower fish prices are a positive aspect of aquaculture to consumers.<sup>58,73</sup> At the same time, food safety, mainly relating to disease transfer, lower quality, and poorer taste, are considered negative aspects of aquaculture for others.<sup>47,73</sup> Sinner and colleagues found that cultural impacts such as community identity and culture



TABLE 2 Characteristics of the research clusters and the per cent of the total sample (N = 151).

% (n)	Categories	Social acceptability, N = 30	Growth and development, N = 24	Media coverage, N = 35	Sustainability aspects, N = 23	Consumer perceptions, N = 39	Total
	Primary article location						
	Asia			2.8 (1)	30.4 (7)	5.1 (2)	6.6 (10)
	Africa		4.2 (1)		8.7 (2)		2 (3)
	Australia	3.3 (1)		14.3 (5)	8.7 (2)		5.3 (8)
	Europe	40 (12)	62.5 (15)	37.1 (13)	30.4 (7)	71.8 (28)	49.7 (75)
	North America	43.3 (13)	20.8 (5)	34.2 (12)	4.3 (1)	17.9 (7)	25.2 (38)
	South America	6.6 (2)		8.6 (3)	4.3 (1)		3.9 (6)
	Global	6.6 (2)	16.6 (4)	8.6 (3)	13.0 (3)	7.7 (3)	9.9 (15)
	Primary article focuses						
	Growth and development	13.3 (4)	33.3 (8)		26.1 (6)		11.9 (18)
	Multiple sustainability aspects	6.6 (2)	12.5 (3)	5.7 (2)	21.7 (5)		7.9 (12)
	Policy and regulation	3.3 (1)	12.5 (3)		4.3 (1)		3.3 (5)
	Profitability				8.7 (2)		1.3 (2)
	Conflict of interests		16.6 (4)	42.8 (15)	4.3 (1)		13.2 (20)
	Social acceptability	6.6 (2)	8.3 (2)	2.8 (1)	8.7 (2)		4.6 (7)
	Risk perception	3.3 (1)	4.2 (1)	2.8 (1)			2 (3)
	User perception	46.6 (14)	8.3 (2)	14.3 (5)	17.4 (4)	100 (39)	42.3 (64)
	User impacts	10 (3)	4.2 (1)	5.7 (2)	4.3 (1)		4.6 (7)
	Public perception	10 (3)		2.8 (1)	4.3 (1)		3.3 (5)
	Transparency and communication			22.8 (8)			5.3 (8)
	Types of aquacultures analysed						
	Aquaculture in general	53.3 (16)	58.3 (14)	42.8 (15)	39.1 (9)	66.6 (26)	53 (80)
	Aquaculture products, in general					10.3 (4)	2.6 (4)
	Finfish aquaculture		8.3 (2)	31.4 (11)		5.1 (2)	9.9 (15)
	Marine aquaculture	23.3 (7)	8.3 (2)	8.6 (3)	8.7 (2)		9.3 (14)
	Integrated multitrophic aquaculture	3.3 (1)	8.3 (2)		13.0 (3)	7.7 (3)	5.9 (9)
	Shellfish aquaculture	20 (6)		5.7 (2)	13.0 (3)		7.3 (11)
	Organic aquaculture				13.0 (3)	7.7 (3)	3.9 (6)
	Offshore aquaculture		12.5 (3)				2 (3)
	Others (age, inland, etc.)		4.2 (1)	11.4 (4)	13.0 (3)	2.5 (1)	5.9 (9)

TABLE 2 (Continued)

% (n)	Categories	Social acceptability, N = 30	Growth and development, N = 24	Media coverage, N = 35	Sustainability aspects, N = 23	Consumer perceptions, N = 39	Total
	Aquaculture/sustainability attributes						
	Economic and environment	6.6 (2)		2.8 (1)	4.3 (1)	5.1 (2)	3.9 (6)
	Social and environment	3.3 (1)	4.2 (1)		8.7 (2)		2.6 (4)
	Socioeconomic		12.5 (3)		17.4 (4)		4.6 (7)
	Social, economic, and environment	23.3 (7)	25 (6)	22.8 (8)	4.3 (1)	2.5 (1)	15.2 (23)
	Multiple dimensions (social, economic, health, quality, environment, etc.)	16.6 (5)	20.8 (5)	25.7 (9)	21.7 (5)	2.5 (1)	16.5 (25)
	Risks and benefits	10 (3)	8.3 (2)	14.3 (5)	8.7 (2)		7.9 (12)
	Access arrangement	3.3 (1)	8.3 (2)			2.5 (1)	2.6 (4)
	Perception in general	36.6 (11)	20.8 (5)	34.3 (12)	34.8 (8)	87.2 (34)	46.3 (70)

Note: Research cluster 1: Social acceptability. Research cluster 2: Growth and development. Research cluster 3: Media coverage. Research cluster 4: Sustainable aquaculture. Research cluster 5: Consumer perceptions.

were the only significant predictors of social licence scores determining the public acceptability of aquaculture in New Zealand, whereas environmental, economic, and social impacts were not.<sup>62</sup> In contrast, economic impacts for benefits to coastal communities were not critical to the social acceptability of aquaculture in Europe.<sup>33</sup>

### 3.2.2 | Research cluster 2: Growth and development

The growth and development cluster was closely linked to research cluster 1 (Societal acceptability; Figure 3); but more focused on the views of direct stakeholders in the sector such as governmental officials, civil society stakeholders (environmental nongovernmental organisations (NGOs), activists, community groups), the fish farming enterprises (fish farmers, industry associations or groups), business leaders [both within aquaculture value chains (retailers/wholesalers, technology industry) and outside of them (fisheries, tourism)], and scientists (researchers, students, other specialist expertise such as law) perceptions towards the growth and development of aquaculture.

The findings suggest that governmental officials, the fish farming industry, scientists, and business leaders (particularly retailers/wholesalers technology industry) tended to have neutral to positive perceptions towards aquaculture's growth and development. In contrast, civil society stakeholders (particularly environmental NGOs, activists, and some community groups) and business leaders with perceived competing interests (particularly fisheries and tourism) had more neutral to negative views.<sup>74-77</sup> The general public had less polarised perceptions of aquaculture growth and development, ranging from positive to negative.<sup>78,79</sup>

The growth and development of aquaculture are central to debates on food security and sustainability. Pro-aquaculture stakeholders, including the fish farming enterprises, governmental officials, and scientists, perceived that expanding aquaculture increases food production and contributes to national food security; a decreased dependence on aquatic food imports was a key positive attribute in Europe.<sup>80-82,83</sup> Furthermore, they perceived that growth in aquaculture would strengthen related industries throughout the value chain and create new business structures and areas. Other perceived benefits include decreased pressure on wild stocks, but only if aquaculture shifted its reliance on wild-caught fish to alternative feed ingredients and improved water quality (in the case of shellfish aquaculture or IMTA).<sup>84</sup> The position of civil society stakeholders (especially environmental NGOs, activists, and some community groups) was that aquaculture expansion resulted in disease outbreaks and threats to genetic robustness in wild populations, chemical pollution, and visual pollution of the coastal landscape. Further, in the case of marine aquaculture, they perceived that it would create more traffic congestion at sea and in harbours, pollution, and various risks (e.g., accidents and oil spills). Overall their objections to the growth and development of aquaculture were based on their judgement that adverse risks to the natural environment outweighed the benefits of further expansion.<sup>24,81,85-87</sup>

TABLE 3 Newspaper articles characteristics.

% (n)	Categories	United Kingdom, N = 100	Denmark, N = 100	France, N = 100	Spain, N = 100	Poland, N = 79	Hungary, N = 29	Turkey, N = 100	China, N = 100	India, N = 70
Stakeholder involved	Government officials	23	70	14	21	22.7 (18)	24.1 (7)	66	63	42.8 (30)
	Business leader	8	69	19	19	7.6 (6)	-	44	-	5.7 (4)
	Civil society group	59	16	38	11	17.7 (14)	17.2 (5)	2	-	22.8 (16)
	Fish farming industry	55	71	38	39	39.2 (31)	62 (18)	90	51	12.8 (9)
	Scientists	13	15	18	15	36.7 (29)	13.8 (4)	9	16	15.7 (11)
	Public	3	3	23	37	5 (4)	-	4	-	-
	Article focus	8	27	17	37	19 (15)	13.8 (4)	40	48	17.1 (12)
Sustainability attributes	Multiple sustainability aspects	4	32	5	5	13.9 (11)	17.5 (5)	24	14	37.1 (26)
	Policy and regulation	4	28	6	8	19 (15)	13.8 (4)	26	16	5.7 (4)
	Profitability	8	5	13	9	5 (4)	20.6 (6)	3	13	2.8 (2)
	Conflicts of interests	4	20	4	4	2.5 (2)	6.9 (2)	2	-	11.4 (8)
	Social acceptability	4	3	8	5	8.8 (7)	3.4 (1)	6	4	1.4 (1)
	Risk perception	44	8	17	6	15.2 (12)	6.9 (2)	-	-	10 (7)
	User perceptions	13	4	10	-	6.3 (5)	13.8 (4)	-	3	8.5 (6)
	User impacts	5	2	10	2	2.5 (2)	10.3 (3)	1	-	1.4 (1)
	Public perception	2	19	9	9	2.5 (2)	-	2	-	2.8 (2)
	Transparency and communication	2	20	1	15	5 (4)	-	-	2	1.4 (1)
	Economic	25	26	31	20	36.7 (29)	31 (9)	78	59	27.1 (19)
	Social	28	29	29	15	29.1 (23)	24.1 (7)	67	46	12.8 (9)
	Environment	55	36	15	18	16.4 (13)	17.5 (5)	12	25	11.4 (8)
Quality, health, and safety	12	25	25	13	1.2 (1)	3.4 (1)	3	4	-	
Multiple sustainability aspects	3	21	9	21	6.3 (5)	17.5 (5)	13	16	24.3 (17)	
Access arrangement	2	-	4	7	20.2 (16)	6.9 (2)	3	16	5.7 (4)	
Animal welfare	12	-	6	2	12.6 (10)	-	-	1	-	
Perception in general	3	23	17	12	7.6 (6)	20.6 (6)	1	2	31.4 (22)	
Types of aquaculture	Aquaculture in general	41	84	49	62	20.2 (16)	44.8 (13)	70	59	52.8 (37)
	Aquaculture products, in general	-	1	2	-	-	-	-	-	10 (7)
	Finfish aquaculture	46	4	2	7	-	-	-	-	12.8 (9)
	Marine aquaculture	-	4	-	-	5 (4)	-	1	3	20 (14)
	Shellfish aquaculture	4	-	33	2	-	-	3	2	1.4 (1)

TABLE 3 (Continued)

% (n)	Categories	United Kingdom, N = 100	Denmark, N = 100	France, N = 100	Spain, N = 100	Poland, N = 79	Hungary, N = 29	Turkey, N = 100	China, N = 100	India, N = 70
	Organic aquaculture	1	-	-	-	-	-	1	-	-
	Offshore aquaculture	-	6	7	13	1.2 (1)	-	8	4	-
	Other (cage, inland, freshwater, etc.)	3	1	6	11	73.4 (58)	58.6 (17)	17	13	2.8 (2)
	Polyculture	1	-	-	-	-	-	-	19	-
	Seaweed	3	-	1	3	-	-	-	-	-
	Positive	33	48	54	70	48.1 (38)	79 (23)	95	87	58.5 (41)
	Negative	45	14	29	16	35.4 (28)	6.9 (2)	1	4	22.8 (16)
	Neutral	20	38	17	14	16.4 (13)	13.8 (4)	4	9	18.5 (13)

The fish farming enterprises, business leaders, and scientists view that novel aquaculture practices such as IMTA, greater use of plant-based feed ingredients, organic practice, polyculture, and the combination of offshore wind energy farms with aquaculture might improve the public image of aquaculture.<sup>88-92,93</sup> However, they acknowledged that negative public perceptions of aquaculture in general, regulatory and financial constraints, and poor knowledge about the potential of these innovations among policy makers are challenges for expanding such practices. However, the potential cost-effectiveness and broader economic benefits of a move to such practices have not been considered in this literature.

### 3.2.3 | Research cluster 3: Media coverage

The research cluster examines media coverage of aquaculture and the conflict of interests between key stakeholder groups. Around one-third of the publications were focused on finfish aquaculture indicating the level of public controversy over finfish aquaculture.

In general, on a global scale, coverage of aquaculture is positive,<sup>94-96</sup> but the literature identified that the mainstream media in developed countries was proportionately more hostile towards aquaculture than in developing countries.<sup>34,97</sup> Predominant stakeholder groups referenced within mainstream media were fish farmers and government officials. Civil society stakeholders (environmental NGOs, activists, and community groups) were represented more than scientists and experts. The weakest voices were those of non-producers within the seafood value chain such as retailers, processors, and product and service suppliers.<sup>94,96</sup> In general, civil society stakeholders (environmental NGOs, activists, and community groups) tended to be critical of the sector.

Furthermore, studies have found that most of the general responses from aquaculture enterprises or government agencies that are included in the media coverage are typically defensive towards criticisms or concerns of civil society stakeholders.<sup>96,97</sup> In contrast, the media seek out 'expert' opinions from academics and specialists employed in the private and public sectors. In French newspaper articles, Govaerts<sup>98</sup> found that positively framed news was based on engagement with the fish farmers industry and the government, with most articles focused on economic, scientific, and technological attributes. At the same time, news framed negatively involved a higher proportion of stakeholders from the civil society stakeholders with most articles focused on health and safety, governance, and ecological attributes.

Overall, environmental impacts are more prominent in newspaper media discourse than other topics (e.g., social, cultural, and economic).<sup>95,97,99-102</sup> However, some studies suggest that many newspaper articles communicate benefits or a balance of benefits and risks.<sup>34,96</sup> For instance, Rickard and colleagues<sup>103</sup> found that newspaper articles often touted the environmental benefits of farming shellfish and seaweed as a 'green operation' with no adverse environmental effects. Generally, threats to wild fish and wildlife, disease and parasites, fish escapees, and the use of antibiotics and

pesticides were the most salient reported perceived environmental impacts of aquaculture.<sup>94-96,98,102,104,105</sup>

There are consistent findings that the rapid expansion of finfish farming in Western countries has increased social conflicts and concerns.<sup>34,104,106-109</sup> Narratives developed by civil society stakeholders towards the salmon industries in New Zealand focus on public health concerns 'a potentially unhealthy and unclean product'; environmental issues, 'damaging the local environment'; and the discourse around local development, 'threatening local democracy and public resource'.<sup>110</sup> Conflicts and concerns over community impacts, indigenous rights, use of space, transparency, and public consultation were also prominently featured. The growing presence of civil society stakeholders in the media implies support for the public's changing role in the aquaculture discourses.<sup>97,107,110,111</sup> In contrast, after analysing 273,319 tweets from 2006 to 2021, Glutting<sup>112</sup> found that most tweets from stakeholder groups (academic/researcher, fish industry/worker, environmental NGOs/conservation, government officials, indigenous and media) generally had a positive sentiment and trend over time. Communications were particularly positive among the academic/researcher and the fish farming industry/worker groups, clear evidence of an 'echo chamber effect'.<sup>113</sup>

### 3.2.4 | Research cluster 4: Sustainable aquaculture

The research cluster investigated sustainable aquaculture with a specific focus on the perception of the economic and social aspects of aquaculture. This research cluster explores perceptions towards sustainable aquaculture by fish farming enterprises and value chain stakeholders, who themselves are key stakeholder groups.

Aquaculture is generally perceived by the fish farming enterprise and aquaculture value chains stakeholders as a practice with viable components for adaptation to climate impact and food security in many parts of the world. But to maintain adherence to environmental and ecological issues, its sustainability aspects require proper monitoring, control, and surveillance.<sup>6,114</sup> Currently, ensuring sustainable and responsible aquaculture has become essential for developed economies. At the same time, civil society stakeholders perceived that government officials were not doing enough to address environmental threats. The aquaculture sector seeks to avoid increased production costs and damage to their reputations, which have all contributed to the rise of certification offered by various organisations, including the aquaculture stewardship council (ASC) and best aquaculture practises (BAP). The third-party, standard-setting organisations perceived that international certification standards are vital tools to increase consumer trust in aquaculture products, provide legitimacy to the industry, and reduce liability by ensuring compliance with sustainability dimensions.<sup>6,24,115,116</sup>

Conceptualised and non-conventional aquaculture practices such as IMTA, aquaponics, and organic were mainly perceived as sustainable compared to traditional conventional aquaculture, even though they are practised on a small scale or commercially underdeveloped and often lack evidence of sustainable performance. Therefore, most

of these studies focused on alternative aquacultural practices to traditional conventional aquaculture and were small pilots. For instance, Australian scientists considered seaweed farming expansion to be developed in line with the United Nations Sustainable Development Goals and have various benefits, including local ecosystem services, food provisioning, and economic opportunities.<sup>117</sup> Similarly, many European fish farmers and scientists, those involved in European projects, believe that IMTA allows European aquaculture to be more economically and ecologically sustainable and provides food security and resilience in the region.<sup>118,119</sup> A systematic review by Gambelli et al.<sup>120</sup> found that organic aquaculture can improve living conditions for fish farmers in developing countries. However, all species are not guaranteed profitability due to higher feed costs and lower yields. Furthermore, Lembo and colleagues<sup>121</sup> found that stakeholders perceived IMTA as in line with organic principles, while recirculation aquaculture systems were not while in reality these practices have not yet been applied at scale for commercially important farmed fish species such as salmon. However, polyculture, which is the norm in commercial practice in Asia in contrast to Europe, is considered a more sustainable practice and a recent pilot study has found that adopting polyculture practises (integrating shrimp-tilapia-seaweed) resulted in higher economic gains and more significant reductions in feed and pond preparation costs among Vietnamese farmers.<sup>122</sup>

In general, the fish farming enterprises were very satisfied with the productivity of sustainable aquaculture practices.<sup>116,122-125</sup> However, some farmers discontinued practising aquaculture because of the inherent risks.<sup>126,127</sup> Others perceived that the main drivers for the adoption of aquaculture practices among fishermen/farmers/fish farmers include a decline in the availability of wild stocks, increased earnings potential from aquaculture production, advantages of working from home over migration, increased household food availability, and perception of fish demand following the growth in urban-driven purchasing power.<sup>122,125-128</sup> In contrast, barriers to the adoption of aquaculture included the provision of quality feed and seeds/fingerlings, inadequate financial return, insufficient knowledge and technology, legislation and regulatory challenges, disease outbreak and mortality, and perceived negative societal perception.<sup>116,119,126,127,129-131</sup> Sociodemographic characteristics, age, gender, occupation, fishing experience, education, and household size were influential for the adoption or expansion of aquaculture.<sup>116,124,127,128,132</sup>

### 3.2.5 | Research cluster 5: Consumer perceptions

This research cluster investigated the consumers' perceptions of aquaculture and the factors influencing these perceptions. The findings suggested that most consumers generally have a negative perception of aquaculture compared to wild fisheries.<sup>133-144,145</sup> In general, consumers perceived wild fisheries products are natural, healthier, nutritious, safer, and tastier, with higher quality and firmer flesh, while aquaculture products are cheaper, lower quality, and more readily available than wild fisheries.<sup>136,142,146,147</sup> However, some studies

concluded that most consumers are not able to differentiate between aquaculture and wild fish products at the point of purchase or that, aquaculture products actually had better sensory attributes (taste and overall liking) than wild fishery products.<sup>134,148</sup>

Recent studies have suggested that consumers are beginning to perceive aquaculture more positively.<sup>149–153,154</sup> One study, by Nguyen and colleagues<sup>151</sup> found US consumers' perceptions were beginning to believe that aquaculture products are safer to eat, better tasting, better quality and fairer traded than wild-caught fisheries. Positive perceptions were accentuated when the products were sourced from non-conventional aquacultural practices,<sup>139,152,155,156</sup> specifically, IMTA,<sup>157,158</sup> aquaponics,<sup>159</sup> and organic<sup>160–163</sup> systems. However, most of the consumers who participated in these studies had not tasted the aquatic food products grown in these practices and their perceptions are solely based on what they have read or heard. Consumers perceived eco-labelled aquacultural products as healthier, safer, tastier, and less fatty but more expensive and less available. Consumers, in addition to valuing sustainability eco-labels, focused on country-of-origin credentials and preferred aquaculture products originating from the European region.<sup>134,143,155,164–166</sup> Further, psychographic segmentation was used in two studies to identify aquatic food consumers.<sup>153,167</sup> The findings indicated that European consumers can be categorised by behaviour and that two groups were particularly likely to favour aquaculture products. 'Foodies'—people who tend to attach high value to food choice, demonstrate responsibility and seek out innovative products and consumption formats and 'Involved innovators' who have knowledge, and engage with seafood products especially if they are innovative.<sup>153,167</sup> Furthermore, Cantillo and colleagues<sup>166</sup> found a better acceptance of aquaculture and its products if they considered salmon a favourite species, tended to prefer products of European origin, and bought their food in supermarkets. In contrast, there was a lower acceptance of aquaculture and its products by those who regularly consumed seabream and bought their food products in retail outlets other than supermarkets.

Sociodemographic characteristics such as age, gender, education, household size, and income influence consumers' perceptions towards aquaculture products. For example, the study by<sup>166</sup> found that Spanish women with two or more children at home and households with a lower income level were more likely to accept aquaculture products.

### 3.3 | Characteristics and analysis of newspaper articles

The characteristics of newspaper articles from each country are shown in Table 3. The findings indicated variations in newspaper articles' focus, the stakeholder group represented, types of aquacultures reported, sustainability attributes considered, and their sentiment/ tone. In the *United Kingdom*, civil society stakeholders were predominantly represented in newspaper articles focusing on risk perception. There is growing concern regarding the negative environmental impact of finfish aquacultures, such as sea lice infections, fish escapees to the wild, and pollution in general. The overall sentiment

of the articles is negative due to the concerns raised about animal welfare and negative environmental impacts. Positive newspaper articles focus on socioeconomic benefits and technological innovations in finfish aquaculture. For instance, *Scotland* is a leader in producing high-quality salmon products for consumers, reducing seafood trade deficits, boosting the local economy, and providing equal opportunities for women. In *Denmark*, fish farming enterprises, governmental officials, and business leaders were predominantly represented in news articles focusing on policy and regulation aspects as well as the growth and development of sustainable aquaculture practices. Most of the newspaper articles (48%) were positive, generally reporting on fish farming activities implementing new sustainable initiatives such as documentation and labelling. Still, civil society stakeholders (particularly environmental NGOs) have placed environmental concerns at the centre of a political debate framed negatively (38% of total articles). In *France*, newspaper articles focus more on growth, development, and perceptions of risk, while civil society stakeholders and fish farming enterprises are equally represented. Most of the articles reported on aquaculture in general, followed by shellfish aquaculture which dominates production in France. There is a strong interest in promoting the domestic sector instead of imports, which seems to be a recurring theme in national newspapers; thus, most articles have positive sentiments. However, mentions of quality, health, food safety, and negative environmental impacts are recurring. In *Spain*, fish farming enterprises and the public were the predominant groups that were represented in newspaper articles. The predominant sentiments of newspaper articles were positive, focusing on the benefits of including aquatic food in the diet and how aquaculture has democratised access to this resource. Further, newspaper articles predominantly mentioned aquaculture's growth and developmental aspects and associated socioeconomic benefits. In *Poland*, the newspaper articles were generally positively focused on growth and development and policy and regulation aspects. The predominant stakeholder group represented were fish farming enterprises, followed by scientists and civil society stakeholders. New legislation, which will stop water and environmental subsidies for common carp (*Cyprinus carpio* Linnaeus, 1758), led to wide criticism from the fish farming enterprises. Civil society stakeholders were against the new recirculating aquaculture system (RAS) aquaculture facilities and showed increased concern about animal welfare issues, for example, selling live carp. In *Hungary*, newspaper articles were dominated by the fish farming enterprises, focusing on the low profitability of Hungarian pond aquaculture. Most articles highlighted socioeconomic benefits positively, but a few focused on aquaculture's negative environmental and social impacts. In *Turkey*, pro-aquaculture stakeholders (fish farming enterprises, government officials, and business leaders) dominated newspaper articles focusing on aquaculture's growth and development. Most articles discussed the positive socioeconomic benefits of aquaculture, resulting in more positively framed articles. In *China*, most stakeholders represented in newspaper articles are government officers (63%), followed by fish farming enterprises (51%) and scientists (16%) who emphasise the growth and development of aquaculture. The socioeconomic aspects of aquaculture and polyculture were often a



positive focus reflecting the rapid transformation of China from a middle-income to a high-income economy. Media tended to emphasise the demand for better quality seafood and efforts to improve the environment through scientific and technological innovation, farming improved aquaculture varieties, and improved legal systems and management levels. In *India*, governmental officials dominated newspaper articles on aquaculture followed by civil society stakeholders. Most of the articles focused on multiple sustainability aspects, followed by growth and development aimed at planning and a special budget allocation by the Union Government to implement new developmental projects to support small-scale aquaculture farmers. Most articles are framed positively, with a focus on strengthening export opportunities with government support. However, civil society stakeholders have contrasting views, including aquaculture's negative environmental and social impacts.

### 3.4 | Comparing and contrasting findings from the scoping review and newspaper media analysis

Most scientific literature and newspaper articles mention one or more sustainability dimensions in relation to aquaculture. However, due to the complexity of defining sustainability, both scientific literature and newspaper articles tend to simplify sustainability as a concept. Scientific literature conducted a more comprehensive and rigorous analysis of social perceptions, while newspaper articles provided a general overview of the social perceptions of aquaculture. Furthermore, the scientific literature covers a deep understanding of specific topics and issues, but newspaper articles tend to cover current events and trends. The scientific literature analysed mainly aimed to understand public perceptions of aquaculture, while newspaper articles aimed to shape societal perceptions typically through engagement and amplification of specific stakeholder voices. These result in the creation of a complex aquaculture discourse, discussing and responding to the multiple sustainability aspects of aquaculture.

The results of both analyses indicated that aquaculture tends to be perceived positively for its economic benefits and negatively for environmental risks. This is typical for food production where it has a significant impact on freshwater, greenhouse gas emissions, and land use, among others.<sup>168</sup> Further, social issues ranged from negative to positive, depending on the context. The scoping review in which a media coverage cluster (3) was identified supported the newspaper media analysis. The triangulation possible using these two approaches through analysis of newspaper articles revealed which stakeholder groups are primarily represented in the newspaper media coverage of nine different countries and how they perceived aquaculture. For example, in Spain, a country with a developed seafood-eating culture, the perceived benefits of including seafood in the diet and how aquaculture has democratised access to this resource resulted in a more positive sentiment in newspaper articles.

The relative dietary contributions made by aquaculture also impact representation in the media. Further, Chinese newspaper articles point to the fact that it has high aquaculture production and

seafood demand. Thus, articles focus more on policy and technological innovation for sustainable aquacultural growth and development. In contrast in *India* where average per capita consumption is very low the debate centres around aquaculture as an export opportunity or potentially, a livelihood opportunity for smallholders. Danish newspaper articles are characterised by discussion and debate around various aspects of aquaculture's sustainability, resulting in more balanced narratives around aquaculture that are neither overtly negative nor positive than in other European countries. The findings from both analyses indicate that, in general, perceived socio-environmental risks are a key agenda of civil society groups (particularly environmental NGOs, activists, and some community groups) and for business leaders with perceived competing interests (particularly fisheries and tourism). In contrast, perceived socioeconomic benefits are often touted by the commercial fish farming sector, governmental officials, and some business leaders (particularly retailers/wholesalers and the technology industry) in support of aquaculture.

## 4 | PRACTICAL IMPLICATIONS

As the aquaculture industry continues to grow in scale and value, its impacts on sustainability dimensions will be increasingly scrutinised; thus, aquaculture coalitions (pro-aquaculture industry groups) will increasingly need to respond to an evolving aquaculture discourse. One way to do this might be to implement different strategies (involve, collaborate, defend, or monitor) for 'effective' communication with stakeholder groups according to their positions regarding aquaculture.<sup>169</sup> Furthermore, this also connects with the advocacy Spectrum of Allies theory that divides stakeholder groups into five subsystems, (1) active allies, (2) passive allies, (3) neutrals, (4) passive opponents, and (5) active opponents.<sup>170</sup> The theory indicates that a focus on shifting the attitudes and perceptions of passive supporters and neutral observers is needed to win a campaign rather than just targeting active allies or opponents. Thus, the aquaculture coalition could maximise its social acceptability by shifting the attitudes and perceptions of those with neutral or diverse/mixed positions. In addition, aquaculture coalitions should involve more groups who are, or could be, supportive of the aquaculture industry and its products. This might also involve stakeholders who perceived aquacultural practices based on organic principles, the seaweed sector and even IMTA are more sustainable—even when commercial-level evidence for their viability is lacking and such perceptions are perhaps exaggerated by their advocates. Coalition building may be a crucial step for such stakeholders who might perceive established aquacultural practices to be unsustainable.

The findings from this study suggest that closer engagement with mainstream newspaper media (as an enabling force) and a broader range of civil society groups, particularly groups interested in the transformation of food systems, is required. Chatterton<sup>171</sup> argues that mainstream media are neutral and suggests hiring communication experts for regular media briefings covering contextual aquaculture topics. The findings from this study indicated that some stakeholder

groups are more informed/aware of aquaculture practises than others, suggesting that targeted communications would be most effective.<sup>172</sup> Social media platforms are a powerful way to communicate with the public, particularly younger consumers.

Swinburn<sup>173</sup> argues that ‘for some countries and regions, narratives around food security, food sovereignty or malnutrition may have greater currency, but whatever the narrative, it should be inclusive of the many groups and people passionate about all aspects of food—organic farming, animal welfare, reduction of antibiotic and pesticides, sustainable diets, food waste, etc.’. Ensuring a transparent narrative, open communication, realistic timelines and mechanisms to deal with trade-offs will be critical, however—eventually motivating governments to support aquaculture growth and expansion. In this sense, aquaculture coalitions can increase collaboration with stakeholders having diverse positions to promote sustainable aquacultural practises. One such effort is the Global Salmon Initiative (GSI)—a pre-competitive collaboration aimed at making significant improvements across the salmon sector regarding social responsibility, environmental impact, and social contributions through global collaboration and research, pooling of resources, and sharing of knowledge.<sup>174</sup> Such initiatives are claiming significant results, as the 2021 GSI Sustainability Report indicates that approximately 48% of the production of members' GSI is now ASC certified, and the average use of antibiotics in their production has reduced by nearly half since 2013.<sup>175</sup> The transparent disclosure of such a report is essential for the general public and relevant stakeholders to better understand risks and commitment to sustainability and transparency. A similar approach for other commercially farmed species such as tilapia, shrimp, and prawns might also enhance positive perceptions of aquaculture among stakeholders, but progress is likely to be constrained by the much greater diversity of systems and contexts than is the case for cage salmon farming.

Some of the perceptions of aquaculture held by environmental advocacy groups are based on reality and the challenges faced by any intensive food production systems but different organisations use different strategies to advance their goals ranging from confrontation and criticism to positive engagement.<sup>176,177</sup> Aquaculture coalitions can influence outcomes by taking a proactive approach and beginning an evidence-based discussion of social and environmental risks with NGOs that have legitimate concerns. Initiatives such as aquaculture or seafood dialogues organised by the World Wide Fund for Nature (WWF) over the years can involve representatives from the aquaculture industry, NGOs, governments, scientists, and others to build a framework for discussion, a significant step in addressing negative perceptions. Further, engaging environmental actors within the governance of aquaculture certification might be decisive in changing their perceptions.

Furthermore, many scientists argue that the perceived negative environmental risks of aquaculture can be addressed through collaborative research between fish farming enterprises and specialised science/research institutions.<sup>5,14,178</sup> Specific tools such as Life Cycle Assessment (LCA), and overarching frameworks such as the

Ecosystem Approach to Aquaculture (EAA) could help steer aquaculture towards greater sustainability. Increasingly, third-party standards are applying these tools to improve individual farms' sustainability<sup>27,179</sup> and there are many initiatives to understand and improve governance on different scales.<sup>180</sup>

There may be opportunities for fish farmers to build bridges with public- and private-sector-led initiatives (such as certification, subsidy policies, and standards, among others) in constructive ways that explicitly promote sustainable aquaculture practices.<sup>181</sup> For example, business-to-business certifications such as Global Good Agricultural Practices (GlobalGAP) may be more effective in focusing on food safety and socially and environmentally responsible farming practice standards. However, creating and using international certifications and standards to improve environmental performance remain irrelevant to small-scale aquacultural practises in many countries, particularly in the Global South. Sustainability labelling schemes can impose undue pressures on small-scale farmers and studies have indicated that without external support (e.g., from a collective or co-op, donor-funded project, government, or NGOs), small-scale aquaculture producers are often excluded from markets that require sustainable certification.<sup>182,183</sup> Moreover, there are claims that such certification schemes can result in increased prices for eco-labelled aquaculture products,<sup>184</sup> adversely affecting poorer consumers' access to farmed aquatic foods.<sup>185</sup> There is some evidence that eco-labelled certifications based on Northern norms are losing leverage in emerging markets such as China, which demand alternative criteria to determine sustainability.<sup>186</sup>

The sustainability aspects of aquaculture are not only an abstract attribute for many of the public (particularly consumers) but one whose benefits may not be apparent to them. Evidence suggests that most aquatic food consumers focus more on price and food safety than sustainable production practises and eco-labels.<sup>187,188</sup> Influencing consumer decision-making towards sustainable aquaculture products is challenging, as evidenced by the intention-behaviour gap. Therefore, White and colleagues<sup>189</sup> proposed that consumers are more influenced to engage in pro-environmental behaviours when messages or tactics incorporate the following psychosocial factors: social influence, habit formation, self-esteem, feelings and cognition, and tangibility. In addition, aquaculture practitioners could apply behavioural approaches such as the Social, Habit, Individual, Feeling and Cognition, and Tangibility (SHIFT) to overcome barriers to changing consumer behaviour towards buying sustainable aquaculture products.<sup>189</sup>

## 5 | CONCLUSIONS, LIMITATIONS, AND FUTURE STUDIES

The present systematic scoping review and newspaper media analysis synthesise the main findings from scientific and newspaper articles focused on understanding societal perceptions of aquaculture in the broader context. In particular, the scoping review identified five research clusters, (1) social acceptability, (2) growth and development,

(3) media coverage, (4) sustainable aquaculture, and (5) consumer perceptions. While comparing and contrasting findings from the scoping review and newspaper analysis, the results suggest that scientific publications and newspaper articles mention the sustainability aspects of aquaculture in simplified form.

The primary stakeholder groups identified were the fish farming enterprises (fish farmers, aquaculture associations or groups), civil society stakeholders (environmental NGOs, activists, community groups, media), governmental officials, scientists, and business leaders both within aquaculture value chains (retailers/wholesalers, technology industry) and outside of them (fisheries, tourism). Also, other stakeholders included the public and can be disaggregated as indigenous groups, residents, and consumers. Further, these stakeholder groups perceive aquaculture differently and depending on the circumstances and context, their perceptions range from positive to negative. Many factors influence their perceptions, including aquaculture's impact on sustainability dimensions, knowledge, transparency, personal interests, types, and location of aquaculture practises, regulations, experience, food-related and dietary lifestyles, as well as sociodemographic characteristics such as age, gender, education, household size, occupation, and income. The environmental risks of aquaculture were perceived particularly negatively by some stakeholders especially environmental NGOs, while the economic benefits were perceived positively. Furthermore, aquaculture's social and cultural aspects ranged from positive to negative depending on the context and circumstances.

There are several limitations to this study. First, the keywords used for the search might have limited the inclusion of relevant articles, for instance, where societal perception was not necessarily the focus. Second, the scoping review was limited to English, while newspaper media analysis was limited to the official languages of the selected countries the author felt comfortable with. Third, most articles exploring the research cluster 'Media Coverage' also analysed newspaper media. Therefore, comparing, and contrasting aquaculture perceptions on social media platforms, newspaper articles, and the scientific literature was limited. Further, social scientists have argued that media analysis can provide valuable insights into how societal perceptions of aquaculture are framed, represented, and discussed in the media, but has limited in its ability to fully capture and understand societal perceptions of aquaculture.<sup>190,191</sup> Thus, future studies could complement media analysis with other research methods such as mixed methods, and content analysis of public discourse, among others to gain a more holistic understanding of societal perceptions of aquaculture.

Fourth, studies with in-depth analysis of sociodemographic characteristics influencing societal perceptions of aquaculture are under-represented, thus, it was difficult for us to explain some of the findings of primary articles. Future studies might also consider conducting a qualitative study to explore sociodemographic and lifestyle characteristics that influence societal perceptions of aquaculture.

Lastly, none of the scientific articles was longitudinal, so understanding what factors changed the societal perceptions of aquaculture over time was limited. Interpreted scientific and newspaper articles

might be prone to unconscious bias. Finally, most of the articles only mentioned the sustainability aspects of aquaculture in a simplified form, indicating that stakeholders did not necessarily focus on the sustainability aspect of aquaculture to base their perceptions. Therefore, future research could investigate whether stakeholders perceive one sustainability dimension of aquaculture as more critical than others and whether they perceive each sustainability dimension differently to base their perceptions.

## AUTHOR CONTRIBUTIONS

**Mausam Budhathoki:** Conceptualization; methodology; software; data curation; formal analysis; investigation; visualization; project administration; writing – original draft. **Sezgin Tunca:** Data curation; formal analysis; investigation. **Raquel Lopez Martinez:** Data curation; formal analysis; investigation. **Wenbo Zhang:** Data curation; validation; writing – review and editing; supervision; formal analysis; investigation. **Saihong Li:** Data curation; supervision; writing – review and editing; formal analysis; validation; investigation. **Bertrand Le Gallic:** Data curation; supervision; funding acquisition; writing – review and editing; validation; conceptualization. **Karen Brunsø:** Supervision; funding acquisition; writing – review and editing; validation; data curation. **Priya Sharma:** Data curation; investigation; formal analysis. **Piotr Eljasik:** Data curation; formal analysis; investigation. **Gergo Gyalog:** Writing – review and editing; supervision; formal analysis; investigation; data curation. **Remigiusz Panicz:** Supervision; validation; writing – review and editing. **David Little:** Supervision; writing – review and editing; conceptualization; methodology; resources; funding acquisition; validation.

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## CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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