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Using Media Framing to Explore the Food-Energy-Water Nexus: The Case of the Rio Negro Basin in Uruguay

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ABSTRACT

Addressing the call for qualitative and empirical approaches to the food, energy, and water (FEW) nexus studies, this research examined newspapers to explore public discussion framing the understanding of the FEW systems interconnections. We conducted a media content analysis on news articles in Spanish between January 2015 and December 2020 for the main river basin in Uruguay to explore the impacts of increased agriculture productivity on the FEW nexus interactions. As described in the media, we summarized problems, solutions, and calls for action when describing sectoral interdependencies. Results show that the dominant public discussions were event-driven and focused on water quality and climate variability. For instance, the water-energy nexus spiked when a drought impacted hydropower generation, and the food-water nexus spiked due to cyanobacteria blooms, creating impacts beyond the FEW sectors, such as tourism. We concluded by highlighting how FEW nexus goals may enhance the discussion and solutions framing.

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Introduction

In many world regions, agricultural intensification affects sectoral interdependencies between food, energy, and water (FEW) systems. For instance, in Latin America and the Caribbean, FEW systems are tightly coupled through agricultural production and hydropower generation (Bellfield 2015). Over the last two decades, territories such as the South American country of Uruguay have experienced an accelerated agricultural expansion in response to increased global demand (Redo et al. 2012). Despite a relatively modest population of approximately 3.5 million people, Uruguay's agricultural systems feed nearly eight times its current population. Plans are in place to double current production by 2050 (Inter-American Development Bank, Sustainable Development Solutions Network (IBD & SDSN) 2021). The Rio Negro Basin (RNB), covering 40% of Uruguay's territory, exhibits significant FEW nexus interactions, with extensive agricultural activity, predominantly

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livestock, and three dams used for irrigation and hydropower generation (Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente (MVOTMA) [Ministry of Housing, Territorial Planning and Environment] 2018). Thus, it is a "food-energy-water nexus hotspot" due to its substantial FEW system interactions (Mohtar and Daher, 2016; Daher et al. 2019). The empirical exploration of the FEW nexus interactions in the RNB region offers valuable insights into the interdependencies, tradeoffs, and synergies among the three interconnected FEW sectors.

To understand the underlying processes connecting the FEW systems in the RNB, we respond to the call for empirical and qualitative research aiming to provide rich contextual information that complements quantitative, modeling, and engineering studies (Albrecht, Crootof, and Scott 2018; Cai et al. 2018; Liu et al. 2018; Newell, Goldstein, and Foster 2019). This study utilizes media content analysis as a research method to examine frames and their influence on the understanding of the FEW nexus within the RNB. Analyzing framing in media coverage is a valuable tool in environmental studies and sustainability research, as it offers a snapshot of the active negotiation process of framing various issues under public discussion (Hurlimann and Dolnicar 2012). Several prior studies have examined newspapers data sources to explore environmental issues, including public discourse on land use and water quality (Schmid, Thompson, and Bengston 2007), media attention to water problems (Garcia et al. 2019), media coverage and framing of climate change over time (Stoddart, Haluza-DeLay, and Tindall 2016) and media understanding of conflict and cooperation dynamics among countries in a transboundary river (Wei et al. 2021). In our study, we conducted a media content analysis to explore how the FEW nexus is framed within the public discussion in media.

The present empirical study is a component of the larger research project titled "Nexus Exploration of Opportunities in Uruguay and Argentina (NEXO-UA)," funded by the U.S. National Science Foundation. The project aims to enhance joint institutional planning and decision-making across food, energy, and water systems (FEWS) by designing and utilizing new modeling capabilities. As part of the project, six years of pre-research project data were collected through media to establish a baseline of the FEW nexus interactions, identify short-term trends, and capture any gradual shifts in dynamics among the FEW sectors, providing valuable insights to inform the broader scope of the research project.

Bringing together FEW nexus, media framing, and collective action framing literature, we employed a media content analysis to examine how problems, solutions, and calls to action are framed within the local discourse on the interconnections among the FEW systems. An analytical codebook was developed to guide and validate the deductive content analysis of the news articles and address the research questions. The primary research question guiding this study is: How was the food-energy-water nexus in the Rio Negro Basin framed in media from 2015 to 2020? The study also addresses the following sub-questions:

a. What are the interactions between the food-energy-water systems?
b. What are the FEW systems' diagnostic, prognostic, and motivational framings?
c. How did media coverage of FEW systems and collective action framing change over time?

This research contributes significantly to the existing literature on the FEW nexus in Latin America and the Caribbean. It complements previous studies that have primarily utilized integrated assessment modeling techniques to explore resource interactions (Khan et al. 2020; Wild et al. 2021; Birnbaum et al. 2022) by providing an in-depth qualitative media content analysis. This qualitative approach offers valuable insights and complements the quantitative modeling studies, enhancing our understanding of the FEW nexus in the region. Our research provides a deeper understanding of the local context and discourse, bridging the gap between modeling and related approaches by making them more relevant to local perceptions, policy and decision-making processes, and stakeholder concerns. Furthermore, it establishes connections between regional and global scale processes, such as global agricultural trade dynamics and transboundary river management challenges, with the local socio-ecological context. This enables the illustration of the multi-scalar dynamics within FEW nexus research. Moreover, our study extends the existing body of literature on FEW nexus media framing (e.g., Jones, White, and Thiam 2022) by examining new geographic, cultural, and policy contexts, facilitating cross-case comparisons, and exploring the transferability of findings, thus contributing to enhanced theoretical generalization.

Conceptual Background

Food-Energy-Water Nexus

The food-energy-water (FEW) nexus is a theoretical perspective intended to understand and promote cross-sectoral collaboration among closely interconnected resource systems (Newell, Goldstein, and Foster 2019; Bazilian et al. 2011; Stephan et al. 2018; Cai et al. 2018). FEW nexus research has proliferated in recent years as scholars seek to comprehend and explain sectoral interdependencies (e.g., Cai et al. 2018; Perrone and Hornberger 2014; Mohtar and Daher 2012). Most FEW studies still navigate the interdependencies among two-way sectors, such as food-energy, water-energy, or food-water (Opejin et al. 2020). Scholars, such as Cai et al. (2018), propose to classify FEW interactions into three categories: i) physical, biophysical, and chemical, ii) resource input-output, and iii) institutions, markets, and infrastructure. Natural boundaries such as basins and aquifers determine the physical, biophysical, and chemical interactions. Resource input-output interactions involve the supply and demand between sectors and competition for resource allocation. The third category encompasses interactions occurring through institutions, markets, and engineering infrastructure, which may involve overlapping actors, policies, and systems but must be fully integrated. Advancing integration across the physical, input-output, and institutional boundaries of the FEW nexus systems is crucial for minimizing unintended consequences, enhancing resource security, and enabling more holistic policymaking and resource management (Lele, Klousia-Marquis, and Goswami 2013; Kurian et al. 2019). To achieve practical implementation of this integration, there is a growing demand for increased qualitative research that delves deeply into local systems (Albrecht, Crootof, and Scott 2018; Cai et al. 2018; Liu et al. 2018; Newell, Goldstein, and Foster 2019). Media framing analysis responds to this call by contributing to a deeper understanding of local FEW nexus systems, providing a partial picture of the political processes and dynamics of selecting, disseminating, and amplifying framings beyond the media.

Framing

Framing is the active construction of the meaning of how individuals perceive, interpret, and communicate reality. People use certain phrases or words to support one or another interpretation of a set of facts (Benford and Snow 2000). The process of framing issues reveals concerns by selecting certain aspects and making them salient (Hall and White 2008). Frames with greater credibility and salience in the interpretations of events can be amplified through the process of frame resonance (Benford and Snow 2000). When a framing resonates with real-world experiences, it can reflect the most commonly held beliefs, and it may shape public opinion (Benford and Snow 2000). Framing analysis can thus be useful for understanding a society's perspective and anticipating societal impacts on public policy. Framing analysis has been the focus of several studies examining environmental management challenges, such as the discourse on environmental policy formulation (e.g., Hall and White 2008) and collaborative water governance in river basins (e.g., Dewulf et al. 2011).

Collective action framing is a well-established approach to examining constructs that diagnose problematic conditions and attributions, predict solutions or alternatives, and motivate action for change (Benford and Snow 2000). It comprises three framing types: diagnostic, prognostic, and motivational. Diagnostic framing describes situations needing change and attributes the problem to who or what is to be blamed. Prognostic framing articulates a proposed solution to the problem and a plan or strategy for what is to be done. Motivational framing calls for people to act together and engage in concerted actions to achieve a common goal for change (Benford and Snow 2000). Collective action arenas, such as public forums and media, are where actors actively influence the circulation of ideas and develop, generate, and contest the construction of what is at stake (Benford and Snow 2000). Using framing analysis through collective action framing provides an opportunity to gain an in-depth understanding of a particular phenomenon through the components of problems, solutions, and proposed actions.

Methods

Media content analysis is a widely used method to study texts and make systematic inferences about the media content (Macnamara 2005). Content analysis sets up research with specific questions and a preselected theoretical set of codes (themes) to be explored within the text (Bernard, Wutich, and Ryan 2017). Researchers have become increasingly interested in applying media content analysis to understand environmental-technical issues (Stauffacher et al. 2015; Stoddart, Haluza-DeLay, and Tindall 2016; Lee et al. 2014; Neff et al. 2009). For instance, Stauffacher et al. (2015) explored which factors and issues drive media attention over time when framing deep geothermal energy. Likewise, Stoddart, Haluza-DeLay, and Tindall (2016) investigated thematic framing or issues categories shaping climate change in media. Other studies, such as Lee et al. (2014) and Neff et al. (2009), have used media to identify discourses on the livestock-climate change nexus. In understanding the FEW nexus, there is a limited investigation of the contribution of media to frame the understating of the FEW systems' interactions at the local level (e.g., Jones, White, and Thiam 2022). As media analysis provides an opportunity to understand the key characteristics of socio-ecological systems, and as

scholars have found a lack of research in qualitative studies on the FEW nexus (Opejin et al. 2020), we found that media content analysis provides a well-suited method to examine the nexus hotspot of the Rio Negro Basin while addressing this research gap.

Rio Negro Basin: socio-Ecological System Boundary

This study focused on the Rio Negro Basin (RNB) in Uruguay as the socio-ecological unit of analysis (Sternlieb et al. 2013). The river originates in Brazil, traverses Uruguay from east to west, discharges into the Río Uruguay (shared with Argentina), and ultimately flows into the South Atlantic Ocean. The river is fed by two main tributaries: Río Yí and Río Tacuarembó. Rio Negro serves multiple societal purposes, including hydropower generation, aggregate extraction, agriculture irrigation, livestock, tourism, bathing, fish farming, and sport fishing (Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente (MVOTMA) [Ministry of Housing, Territorial Planning and Environment] 2018). It also receives effluents from the departmental governments settled along its margins. Figure 1 illustrates the overlap of the RNB with nine departmental governments: Rivera, Cerro Largo, Tacuarembó, Durazno, Río Negro, Flores, Florida, and Soriano.

Using secondary sources to study a socio-ecological system in an unexplored local context requires well-defined geographical and socio-political boundaries (Sternlieb et al. 2013). Previous studies that relied on online databases provided limited guidance on defining search strings for the socio-ecological boundary to exclude results from the area under study. During a preliminary search, it became evident that delimiting the search to the correct study area was crucial. For instance, there are multiple Rio Negro in Latin America (e.g., in Argentina and the Amazon basin), and one of the departmental governments in Uruguay within the RNB is also named Rio Negro. Identifying the specific departmental government was essential for establishing the inclusion and exclusion criteria during the data cleaning process.

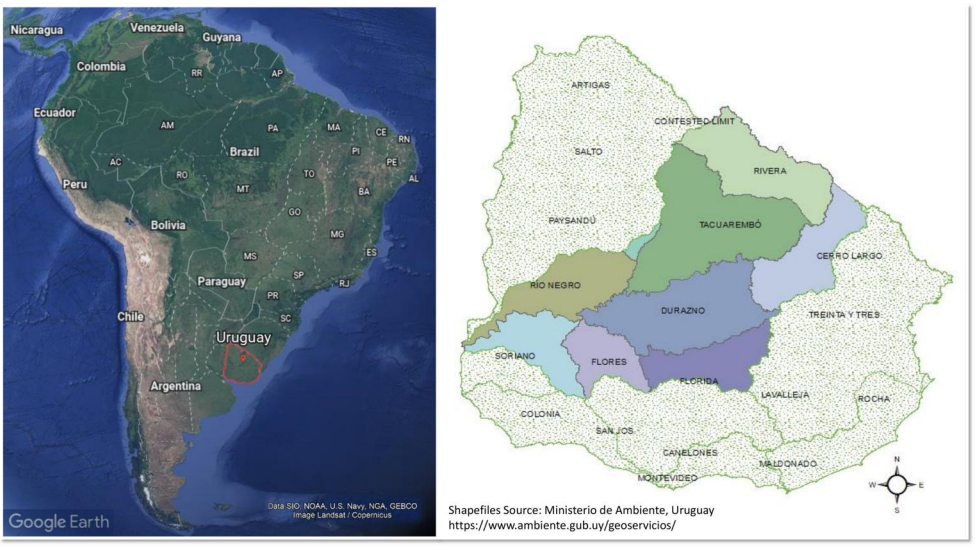

Figure 1. Location of the Rio Negro basin in Uruguay and departmental governments.

Data Collection

The Nexis Uni® database (formerly LexisNexis Academic) was selected to search news articles. This database is one of the most used news sources in the social sciences, with access to sources in the US and abroad. The search focused on news articles in Spanish because the availability of articles in English was scarce. Understanding the importance of ensuring a transparent explanation for our approach to collecting and selecting data, only news articles sourced from the Nexis Uni® database were included. Focusing on Spanish-language news articles, the official language in Uruguay, allowed us to dive into topics portrayed in the local context. Previous scholars using media as data sources have pointed out the importance of searching newspaper sources in the local language to examine the local perspectives (Wei et al. 2021). The time frame was limited from January 1, 2015, to December 31, 2020, which is six years prior to the beginning of the NEXO-UA research project. The searching scope was defined to ({Cuenca (basin)} AND {Rio Negro} AND {Uruguay} AND {Specific Keyword}). The specific keywords focused on the FEW sectors and related peripheral topics.

The first author, a native Spanish speaker, searched for Spanish news articles. An advanced news search was conducted for a variety of Spanish terms, including *Agua, Energía, Agricultura, Uso del Suelo, Calidad de Agua, Gestión del Agua, Sequía, Escasez del Agua, Inundaciones, Plan, Infraestructura, Comisión, Incertidumbres, Resiliencia, Desarrollo Sostenible, Cambio Climático,* and *Historia*. (English terms: Water, Energy, Agriculture, Land Use, Water Quality, Water Management, Drought, Water Scarcity, Floods, Plan, Infrastructure, Commission, Uncertainties, Resilience, Sustainable Development, Climate Change, and History). From this search, 165 articles were encountered. After reading the article titles, duplicates were determined and removed. The final screening yielded 70 unique pieces, which were sorted chronologically and included for content analysis. Notably, half of these news articles (50%) were published in El País, the top national and most circulated newspaper in Uruguay. El País focuses on social, economic, and political news of Uruguay, reaching a large population segment. The remaining half of the news articles originated from various sources. A portion (9%) was published by La República, a widely distributed newspaper in Uruguay. Additionally, local newspapers in Argentina accounted for 6% of the articles. Furthermore, a significant portion (35%) came from media outlets abroad and press release distribution service platforms, in which the Hispanic NewsWire Service contributed 10% of the articles. We included both Uruguayan and international news outlets to ensure that all potential frames were included in the analysis, as both domestic and international news outlets can shape public opinion.

Data Analysis

To support the newspaper analysis, the first author developed an analytical codebook following established procedures (Bernard et al. 2017; MacQueen 1998). The codebook structure consisted of six components: the code name, a short definition, a detailed definition, inclusion and exclusion criteria for when to use the code and content examples. Table 1 summarizes the codebook showing the code name and the short definitions. The codebook was based on the conceptual background of collective action framing (Benford and Snow 2000) and the FEW nexus (Cai et al. 2018; Stephan et al. 2018).

Table 1. Overview of the codebook used for deductive coding of the news articles.

Codes	Code Short Description
FEW Nexus Interactions	
Agri-Water Interaction	Intersections between the water and agriculture sectors
Energy-Water Interaction	Intersections between the water and the energy sectors
Agri-Energy Interaction	Intersections between the agriculture and the energy sectors
Collective Action Framing	
Diagnostic	The problem description or who or what is to be blamed
Prognostic	The solution or the plan of attack, and the strategies
Motivational	Call to act together to achieve a common goal for change

To validate the codebook, the first and third authors performed an intercoder reliability assessment with 10% of the data to ensure that independent coders would make the same coding decisions (O'Connor and Joffe 2020; Lombard, Snyder-Duch, and Bracken 2006). Cohen's Kappa coefficient formula was used to perform the intercoder reliability assessment. After two rounds of intercoder reliability assessments, all codes included in the codebook reached Cohen's Kappa between 0.86 to 1, a nearly perfect agreement (McDonald, Schoenebeck, and Forte 2019). News articles were imported to MAXQDA 20 mixed methods software to be analyzed using qualitative and quantitative approaches (Van den Bulck 2002; Curran 2002). The first author coded the news articles line by line manually to provide finer details in response to the research questions. After the text was coded, the quantitative analysis focused on measuring the frequency of content within and across news articles, and the qualitative analysis focused on examining the codes for an in-depth understanding of the content. The text was kept in Spanish and translated to be reported in the result section.

Results

We present the qualitative and quantitative results in two sections. In the first section, we characterize and describe the interactions among the FEW systems by food-water, water-energy, and food-water nexus and how these interactions have changed over time. Then, we classified the FEW nexus interactions according to the three categories proposed by Cai et al. (2018): (i) physical, biophysical, and chemical, (ii) resource input-output, and (iii) institutions, markets, and infrastructure interactions. In the second section, we discuss the changes in framing, providing an overview of the problem, solution, and motivational frames, and presenting the overlap between FEW nexus and collective action framing codes.

Food-Energy-Water Nexus Characterization

We identified a total of 69 instances where interactions between FEW sectors were discussed in the newspaper articles; these were identified more in domestic (57 instances) than in international (12 instances) news articles. The results include 7 instances of food-energy interactions, 16 instances of water-energy interactions, and 46 instances of food-water interactions. Figure 2 shows the percentage of instances in the public discussion focused on these nexus interactions over the period of analysis. The bar chart includes food-energy, water-energy, and food-water interactions between 2015 and 2020

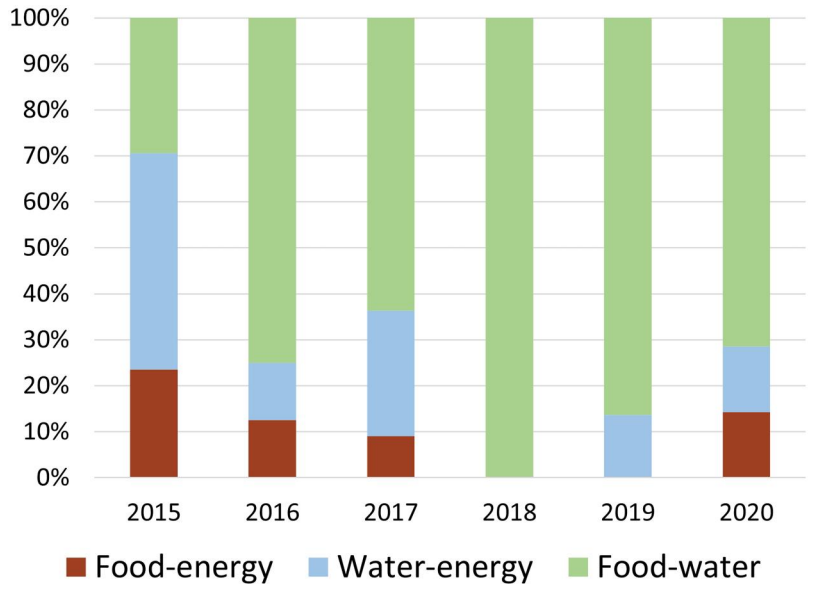

Figure 2. The percentage of instances of the public discourse focused on food-energy-water nexus interactions over time (2015–2020).

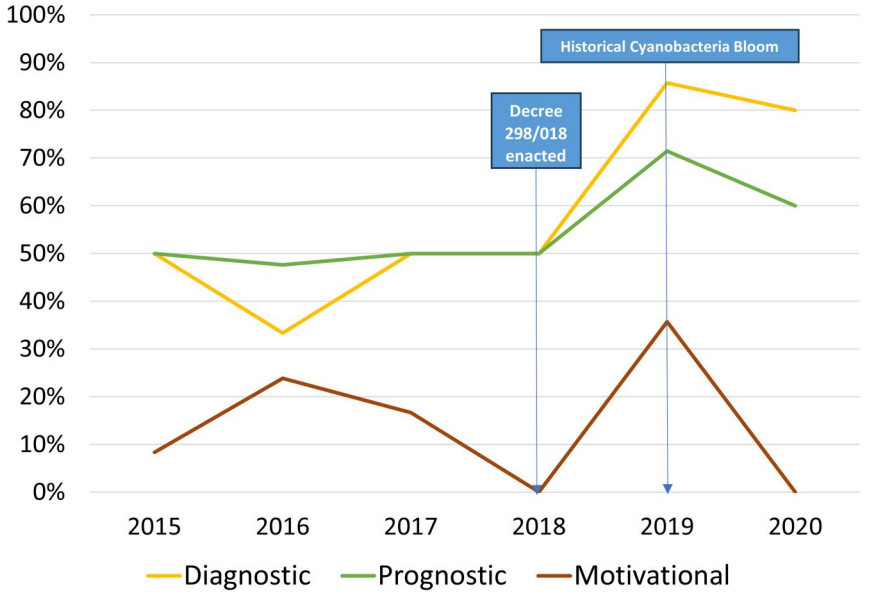

Figure 3. The percentage of articles per year with diagnostic, prognostic, and motivational collective action frames over time.

at one-year intervals. Most of the interactions focused on the food-water nexus over time, and it was the only focus on the news sample in 2018. Qualitatively, the Rio Negro food-water nexus mainly focus on how agricultural activities have impacted water quality. This situation has had a domino effect on other components of the FEW

systems, such as increased prices and difficulties in treating drinking water, and cattle mortality due to animals drinking contaminated water.

During the analysis period (2015–2020), the RNB experienced numerous nexus-related shocks, including drought in 2015, floods in 2017, and cyanobacterial bloom in 2019. The water-energy nexus was prominent in 2015 and covered 53% of the total articles due to drought. One news article (U9_2015) stated, "Uruguay has historically had a high share of hydropower in its electrical generation matrix and is very dependent on hydraulic conditions." During another scarce rainfall period in 2017, there was also public discussion on how Uruguay started diversifying its electricity supply mix by incorporating wind power to reduce climate vulnerability in the energy sector. The presence of reservoirs for hydropower generation, which is an energy-water interaction, also contributes to increased nutrient concentration due to the hydrological alterations. In 2019, the largest cyanobacteria blooms occurred, impacting other regions and sectors beyond the FEW nexus.

The total of 69 instances describing FEW nexus interactions yielded a total of 24 distinct interactions. Table 2 provides a detailed description of the 24 different interactions in the FEW nexus classified based on two-way sectoral interaction and Cai et al. (2018) three categories of interactions: (i) physical, biophysical, and chemical, (ii) resource input-output, and (iii) institutions, markets, and infrastructure. The first physical, biophysical, and chemical interaction category includes mostly climate and weather conditions compounded with basin features. The second category of resource input-output interactions encloses water demand from the agricultural and hydropower sectors, as well as agriculture outputs. The third category of institutions, markets, and infrastructure interactions consists of the effects of hydrological alterations on infrastructure, the eucalyptus pulp market, and the introduction of invasive species from commercial ships, leading to macrofouling in water and energy infrastructure. Despite the distinct nature of these 24 interactions, the analysis demonstrates that they can often be classified within multiple categories of interactions.

Collective Action Framing

We identified a total of 191 instances of collective action frames in the newspaper articles focusing on FEW systems issues, including 91 diagnostic frames, 82 prognostic frames, and 18 motivational frames. Diagnostic frames were more common in domestic (75 frames) than international (16 frames) news outlets, but there were no noticeable differences between prognostic and motivational frames. Figure 3 shows the percentage of articles per year with diagnostic, prognostic, and motivational collective action frames over time. The percentage of articles with diagnostic framing remained stable, with a decline in 2016 and a notable increase in 2019. Prognostic framing showed minimal change, except for a spike in 2019. Motivational framing remained consistently low, absent in 2018 and 2020, but rose in parallel with diagnostic and prognostic frames in 2019.

Diagnostic Framing

The media content analysis reveals a range of diagnostic framings, ranging from environmental to governance concerns. Over time, the interactions within the FEW nexus

Table 2. Summary of the interaction on the food-energy-water nexus discussed in the media.

	Physical, Biophysical, and Chemical	Resource Input-Output	Institutions, Markets, and Infrastructure
Food and Water Nexus			
1. Drought season affects the agricultural sector (e.g., rainfed agriculture)	X		
2. Agricultural activities pollute water (e.g., fertilizers)		X	
3. The drought period exacerbates levels of water pollution	X		
4. Algae blooms are caused by the presence of a high level of nutrients in the water (particularly phosphorus)	X		
5. Eucalyptus pulp mills contribute to water pollution			X
6. Eucalyptus pulp mills demand a lot of water, causing 20% less water in the basin (e.g., for afforestation)		X	
7. Cattle cannot drink from some waterways because they have been found an unusual level of toxins in cattle blood, and they are at risk of death from drinking contaminated water	X		
8. Some toxins are likely to remain in *tarariras* (wolf fish), native fish of the Rio Negro that is exported to Brazil	X		X
9. Livestock can be lost due to flood events	X		X
10. Flood events affected fishing activities	X		X
11. Increasing the number of irrigation reservoirs increases the source of cyanobacteria	X		X
12. Water residence time in large reservoirs increases nutrient concentration and promotes cyanobacteria blooms			X
13. Invasive Species (from commercial ships for global trade) cause macrofouling in the water piping system	X		X
14. Effluents from the dairy industry impact water quality		X	
Energy and Water Nexus			
15. Climate variability could affect energy tariffs for hydropower due to reduced rainfall	X	X	X
16. Climate variability could affect energy demand, such as high or low temperature, and hydropower may not cover the demand	X		X
17. Electricity supply across the country is mainly hydropower (74% of the total energy generation, 18.2% from Río Negro)		X	X
18. Transition to renewables (wind and biomass) has increased to manage the uncertainties inherent to hydropower production and climate variability		X	X
19. Events of rain, wind, and hail caused power outages	X		X
20. Flood events may affect the operation of water treatment plants	X		X
21. Hydroelectric dams cause water to reservoirs and nutrient concentration increases	X		X
Food and Energy Nexus			
22. UPM's pull mills result in an increase in the account of the country's installed electricity generation from biomass		X	X
23. Agro, fishing and mining consume 10% of fuels from gasoline and diesel oil (including biofuels)		X	X
24. Invasive Species (from commercial ships for global trade) cause macrofouling in cooling systems of power plants and industries	X		X

have resulted in water quality being the primary problem. One article (U4_2015) stated, "Uruguay went from boasting about the country's drinking water quality to having all surface water under the magnifying glass" due to pollution. A spokesperson from academia in the same article stated that "the agricultural sector made great progress, but the country did not invest enough in methods to protect water and avoid pollution." (U4_2015). The blame for the problem in the RNB is placed on human activity,

especially agricultural activities, hydrological alterations such as changes in river flow caused by the man-made reservoirs for hydropower and irrigation purposes and increasing concentration of contaminants from human-induced runoff, and on climate events such as droughts and floods. Climatic variability, less or too much rain, was blamed for the uncertainties it creates in Uruguay's agricultural and hydroelectric power sectors. Since Rio Negro could manage an important water flow, it is mentioned in the media that it has been considered to raise its high watermark to handle climatic variability. However, this can cause more frequent and widespread risks and floods in productive areas. Flood events have displaced thousands of people in events reported in 2017 and 2019.

Actor groups are also blamed for the problem, including farmers who use fertilizers up to twice as much as necessary and the government authorities who "have acted on the [pollution] emergency, but there has been a general slowness." The framing also blamed governance because "the government's policy is to increase the number of reservoirs for irrigation and therefore the source of cyanobacteria." As portrayed in the media, the Irrigation Act of 2017 is contested because it allows private individuals to operate irrigation reservoirs, and the government has no resources to monitor them, which can be detrimental to pollution control and increasing cyanobacteria sources. The diagnostic framing spikes in 2019 are explained by an episode of cyanobacteria blooms that reached waters in the metropolitan area, limiting the use of beaches and affecting the tourism sector in Montevideo. According to a spokesperson from academia, it was "the largest cyanobacteria blooming in history." A mix of factors was blamed, such as "the amount of nutrients, fertilizers, and organic matter that reach the water, added to the high summer temperatures and solar radiation, which creates conditions for the growth of these organisms." In addition, "high rainfall … caused overflows that led water with cyanobacteria [to] reach … the Río Uruguay and finally being washed into the Río de la Plata."

Additional frames blamed the water quality issues that have generated a conflict between countries in the region, especially between Argentina and Uruguay. "When [the river] enters Uruguay from Brazil, it comes with a significant [nutrient] load due to lack of sanitation in some cities … " explained a Uruguay National Government Official. According to a news article in 2016, the animosity in the relationship between Argentina and Uruguay increased between 2005 and 2010 due to Argentina's opposition to constructing a pulp mill in Uruguayan territory. While an international court ruling determined that pulp mills do not pollute, the lack of communication about the construction led to transboundary conflict. However, foreign investment in pulp mills brings several benefits to Uruguay, such as employment, the use of waste biomass-to-energy, and funding to replace aging infrastructure. The investment in the last pulp mill has no precedent in the country's economic history. However, pulp mill operations also make water less available in the river because of an increment in the eucalyptus afforestation, which is the primary input for this agro-industrial chain. Uruguayan scientists have asserted that phosphorus discharges [into the river] must be reduced, and an additional pulp mill may have the opposite effect. According to the main spokesperson from the Uruguayan academia, "eucalyptus trees demand a lot of water, and the huge plantations caused 20% less water [in the basin] and to reach 50% less in periods of

little rain" and "water reduction … impacts … phosphorous concentration and hydropower generation".

Prognostic Framing

The prognostic frames identify proposed solutions, strategies, or plans for problematic conditions. The frames here mainly focused on more policy, planning and implementation, monitoring, and enforcement strategies. Prognostic frames on police, planning, and governance strategies included establishing a Basin Committee. In 2015, the RNB experienced a drought, where prognostic frames focused on meeting the energy demand with higher participation of other renewable sources. Between 2017 and 2018, the same proportion of articles (50%) had diagnostic and prognostic frames, followed by a Presidential decree enacted in September 2018. The President of Uruguay passed a decree that mandates a plan to "prevent, control, stop and reverse the [river] deterioration process" and created an Interministerial Executive Coordination Committee (Comité de Coordinación Ejecutivo, in Spanish) to implement and monitor this plan. The decree also proposed creating the Rio Negro Basin Commission to analyze the proposed measures and propose actions or adjustments to plans to the interministerial committee. During the episode of cyanobacteria blooms in 2019, the prognostic framing increased. The government enacted another decree for a 3-year plan to address water pollution in the Rio Negro with five foci: drinking water and sanitation, biodiversity protection, local capacity building, sustainable production management, and data collection on the basin ecosystem. The plan should be implemented through a participatory process via the Rio Negro Basin Commission.

Prognostic frames on monitoring and enforcement emphasized the need to improve water quality. "Reducing the sources of nutrient pollution is the only way to mitigate the total phosphorus levels," according to a member of the Uruguayan academia. For example, the National Government and academia evaluated ways to adapt and flexible water quality standards of phosphorus and nitrogen to the local ecosystem. The rationale behind this proposal was that "water resources in regional countries (Brazil and Argentina) naturally have a higher level of phosphorus." For monitoring purposes, it has been proposed to improve hydrological detection capacity by activating the Uruguayan Department of National Defense to detect the pollution discharges into the river by overflying the area and employing NASA satellite imagery. To address the transboundary issues between Argentina and Uruguay, there is a proposal to start a Binational Environmental Laboratory. A main spokesperson from academia pointed out that "[water pollution] mitigation should be achieved with a joint plan that includes all the countries in the region."

Motivational Framing

Motivational statements were less frequent and centered on calls to address the water quality problem together. The motivational statements include calls to the "society as a whole" to be concerned about pollution, establishing a joint management plan that includes all countries in the region, and "side by side" work between national and departmental governments during flood events. In 2017, when the public discussion revived the conflicts between Argentina and Uruguay over establishing a new pulp mill, one ambassador recalled that "this is a good opportunity to launch the binational

Table 3. Co-occurrence matrix between two-way interactions of the food-energy-water nexus and collective action framing.

	Diagnostic	Prognostic	Motivational
Food-Water Nexus	23	19	6
Energy-Water Nexus	9	5	1
Food-Energy Nexus	4	3	0

environmental laboratory that the countries agreed to promote." An Official from Uruguay's National Government recognized that "[Río Negro basin] water is contaminated, and this concerns the authorities," therefore, "establishing the third pulp mill entails collaborative work to improve the whole system." In 2019, motivational framings increased in response to the episode of cyanobacteria blooms. The framings called for developing an interagency action plan for the basin management and the big picture thinking since it is "the great challenge Uruguay is facing," and it is not possible to "plan by sectors without considering that one sector activities always affect the other sectors."

Overlap between the FEW Nexus and Collective Action Framing

The overlap between the FEW nexus two-way interactions and the three collective action framing codes is presented in Table 3. This co-occurrence matrix shows that diagnostic codes were most common across all of the two-way interactions, with limited discussion of motivational codes across them. Diagnostic framing of food-water interactions was the most common co-occurrence, focusing on how agricultural activities pollute water quality. Motivational framing of food-energy interactions was the least common, with no co-occurrences; this stems from the limited presence of either code individually.

Discussion

Media frames are representations of the socio-political discourse, while complexities beyond the media sphere exist. In the case of this work, media framing analysis provides a partial picture of such processes within the food-energy-water nexus. Our empirical results show that two-ways sectoral interactions were the main framing issue, lacking in-depth discussion of three-way interactions in the media articles. This result is consistent with prior research, concluding that framing of three-way nexus thinking may remain less common in practice than in scholarly research (Opejin et al. 2020). Our analysis revealed that sectoral interdependencies discussed in the media mostly focused on interactions between the food and water sectors, which is understandable as the RNB is largely comprised of productive agricultural land. However, considering three-way interactions is critical in addressing the water sector, specifically water quality, because of the interdependencies among agriculture, hydropower, and climate variability. Considering Cai et al. (2018) conceptualization of nexus interactions, the analysis showed that these interactions were generally discussed as physical, biophysical, and chemical or as institutional, market-related, and infrastructure-related interactions, with less discussion of resource inputs-outputs. This suggests that the FEW nexus framing in the RNB may lack the focus on direct tradeoffs between food, energy, and water

resources. Increasing the discussion around inputs-outputs within the FEW nexus may be beneficial to examine resource efficiency and increase the resilience of cascading impacts, key goals of the FEW nexus (Estoque 2022). This finding should be explored further in future studies. The categorization of FEW two-way interactions and the three categories of interactions defined by Cai et al. (2018) suggest that interdependencies are tight and should not be ignored in future planning and action.

Looking at the collective action framing, the diagnostic frames suggest that agricultural activities, the hydrological alterations created by hydroelectric dams, and climate variability may be blamed for the compounded effect of lowering water quality. These types of problems could lead to compound events and have large-scale impacts. For example, in 2019, the RNB had the largest cyanobacteria blooms in the basin's history, reaching the city of Montevideo. This created FEW nexus impacts beyond the basin area and affected tourism activities such as using beaches. The number of diagnostic and prognostic frames was high and concurrent, suggesting that solutions were discussed and proposed jointly in the media. This includes Uruguay's initiatives to enact two consecutive decrees, a five-foci plan for improved water quality, creating the Interministerial Executive Coordination Committee, and the Rio Negro Basin Commission. The focus on policy and planning solutions identified in the media supports the call of previous studies for increased FEW nexus consideration in governance (Lebel et al. 2020; Ringler, Bhaduri, and Lawford 2013). However, only governance responses like Decree 298/018, approved in 2018 to stop and reverse the river deterioration process, may result in slow solutions because the historical cyanobacteria bloom occurred in 2019.

Examining the low number of motivational frames over time suggests limited calls to act together in addressing the problems affecting the FEW sectors. This may translate into a need for more collaboration between FEW resource managers and users, one of the purposes of the FEW nexus approach (Estoque 2022). Although motivational framings increased in response to the episode of cyanobacteria blooms in 2019, and the area may be trying to increase collaboration through the Interministerial Executive Coordination Committee and the Rio Negro Basin Commission, the media framing suggests that the role of these collaborations for FEW nexus considerations is yet to be seen. This result is similar to previous social network analysis findings, which have noted limited multi-sector collaboration in addressing FEW nexus challenges, especially outside of the water sector (Jones and White 2021; Daher et al. 2019). Based on the FEW nexus categorizations and collective action framing over time, we discuss several findings that emerged from the analysis.

First, our results highlight the role of shocks in media discourse based on how the nexus interactions and collective action framing changed over time (Figure 2). For example, after cyanobacteria bloomed in 2019, the diagnostic, prognostic, and motivational framings rose simultaneously. The diagnostic framing shows that cyanobacteria blooms have affected the tourism sector, beaches, and fishing activities and increased the difficulty and costs of water treatment for drinking water. Additionally, during the drought in 2016, there was an increased discussion of energy-water and energy-food interactions as the region considered the intersections between lower reservoir levels, decreased hydropower generation, and agricultural production. These findings

demonstrate how news media framing of nexus interactions changes over time-based on environmental shocks and support previous studies that noted increased media attention in response to a water problem (Garcia et al. 2019; Jones, White, and Thiam 2022). It also suggests that shocks to food, energy, and water systems can provide windows of opportunity for increased discussion and subsequent action, which could be an opportunity for increased FEW nexus application in policy and practice.

Second, our analysis suggests how media framing could show changes in international water basin conflict shifting from diagnostic to prognostic. The Rio Negro is an international inland watercourse whose management boundaries rely upon Brazil and Uruguay and whose discharge affects downstream Argentina; news articles noted that conflict between these countries peaked in the period between 2005 to 2010. After this period, however, our results show that the framing changed from diagnostic to prognostic over time. For example, since 2016, the media reported interest in cooperation between Argentina and Uruguay, invoking the Binational Environmental Laboratory. Argentina has called for consultation and collaboration, drawing on the good relationship between people and countries. Based on our framing analysis, the apparent change from conflict to cooperation could correspond to the intervention of national leaders from both countries expressed in the media, including both presidents and ambassadors, as Wei et al. (2021) also noted. This suggests that media framing may provide useful insight for identifying shifting perspectives on political responses to resource management.

Third, this research extends prior FEW nexus media framing studies (Jones, White, and Thiam 2022) in a new geographic, cultural, and policy context, facilitating cross-case comparison and exploring the transferability of findings, thus enhancing theoretical generalization. As with previous studies, it provides an avenue to examine interactions between FEW systems using secondary sources to understand the often overlooked interactions between these resources. However, this study extends beyond previous findings by using framing analysis to identify compound events within the nexus context and analyze responses to such events. Additionally, it conducts an analysis in an understudied basin, which could provide insights into other regions with similar conditions. Future studies using framing analysis of media articles could draw generalizations across multiple cases about how the media frames nexus events and responses to them.

Conclusion

Given the growth of agriculture in Uruguay in response to global demand, impacts on water quality in the Rio Negro basin (RNB) are an important concern. Environmental events, including drought, flood, and cyanobacteria blooms from poor water quality, impact multiple sectors throughout the food-energy-water (FEW) nexus. By conducting an analysis of the media framing of FEW nexus interactions and collective action framing, our findings provide some insight into the local socio-political process, as media frames are representations of reality. Our media framing findings suggest there is a greater focus on two-way nexus interactions over the three-way nexus and suggest that problems and solutions may be discussed simultaneously. Media framing may be useful for identifying changes from diagnostic to prognostic over time, which could benefit cross-sectoral FEW nexus collaboration and resource management. Our findings suggest

that media framing provides insight into complex socio-political environmental processes by showing increases in event-driven shocks through changes in nexus and collective action framing and by showing changes in environmental conflict through media-reported shifts from problem to solution framing. These findings suggest that interdependencies are tightly coupled and deserve attention when setting plans for the RNB in the face of climate uncertainty and that event-driven analysis can provide a window of opportunity for implementing the FEW nexus approach in policy and practice. With calls for empirical, governance-focus, and qualitative research within the FEW nexus (Albrecht, Crootof, and Scott 2018; Cai et al. 2018; Liu et al. 2018; Newell, Goldstein, and Foster 2019), this empirical case provides insights into the importance of governance responses for FEW system interactions and suggests that present actions alone may be insufficient due to the urgency of the action required to address problems. Future studies should focus on action-oriented research for the FEW nexus in the RNB that considers Uruguay's aims to double agricultural production by 2050 and related climate impacts.

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Data Availability Statement

The data analysis supporting this study's findings is available on request from the corresponding author. The data was derived from the Nexis Uni® database (formerly LexisNexis Academic).

References

Albrecht, T. R., A. Crootof, and C. A. Scott. 2018. The water-energy-food nexus: A systematic review of methods for nexus assessment. *Environmental Research Letters* 13 (4):043002. doi: 10.1088/1748-9326/aaa9c6.

Bazilian, M., H. Rogner, M. Howells, S. Hermann, D. Arent, D. Gielen, P. Steduto, A. Mueller, P. Komor, R. S. J. Tol, et al. 2011. Considering the energy, water and food nexus: Towards an integrated modelling approach. *Energy Policy* 39 (12):7896–906. doi: 10.1016/j.enpol.2011.09.039.

Bellfield, H. 2015. Water, energy and food security nexus in Latin America and the Caribbean. Accessed November 6, 2023. https://cdkn.org/sites/default/files/files/The-Water-Energy-Food-Nexus-in-LAC-April-2015.pdf

Benford, R. D., and D. A. Snow. 2000. Framing processes and social movements: An overview and assessment. *Annual Review of Sociology* 26 (1):611–39. doi: 10.1146/annurev.soc.26.1.611.

Bernard, H. R., A. Y. Wutich, and G. W. Ryan. 2017. *Analyzing qualitative data: Systematic approaches*. 2nd ed. Los Angeles: SAGE Publications.

Birnbaum, A., J. Lamontagne, T. Wild, F. Dolan, and B. Yarlagadda. 2022. Drivers of future physical water scarcity and its economic impacts in latin america and the caribbean. *Earth's Future*. 10 (8):e2022EF002764. doi: 10.1029/2022EF002764.

Cai, X., K. Wallington, M. Shafiee-Jood, and L. Marston. 2018. Understanding and managing the food-energy-water nexus – opportunities for water resources research. *Advances in Water Resources* 111:259–73. doi: 10.1016/j.advwatres.2017.11.014.

Curran, J. 2002. *Media and power*. London: Routledge.

Daher, B., B. Hannibal, K. E. Portney, and R. H. Mohtar. 2019. Toward creating an environment of cooperation between water, energy, and food stakeholders in San Antonio. *The Science of the Total Environment* 651 (Pt 2):2913–26. doi: 10.1016/j.scitotenv.2018.09.395.

Dewulf, A., M. Mancero, G. Cárdenas, and D. Sucozhañay. 2011. Fragmentation and connection of frames in collaborative water governance: A case study of river catchment management in southern ecuador. *International Review of Administrative Sciences* 77 (1):50–75. doi: 10.1177/0020852310390108.

Estoque, R. C. 2022. Complexity and diversity of nexuses: A review of the nexus approach in the sustainability context. *The Science of the Total Environment* 854:158612. doi: 10.1016/j.scitotenv.2022.158612.

Garcia, M., E. Koebele, A. Deslatte, K. Ernst, K. F. Manago, and G. Treuer. 2019. Towards urban water sustainability: Analyzing management transitions in Miami, Las Vegas, and Los Angeles. *Global Environmental Change* 58:101967. doi: 10.1016/j.gloenvcha.2019.101967.

Hall, T. E., and D. D. White. 2008. Representing recovery: Science and local control in the framing of U.S. pacific Northwest salmon policy. *Human Ecology Review* 15 (1):32–45.

Hurlimann, A., and S. Dolnicar. 2012. Newspaper coverage of water issues in Australia. *Water Research* 46 (19):6497–507. doi: 10.1016/j.watres.2012.09.028.

Inter-American Development Bank, Sustainable Development Solutions Network (IBD & SDSN). 2021. Uruguay sustainable development report 2021. Accessed November 6, 2023. https://www.sdgindex.org/reports/uruguay-sustainable-development-report-2021/

Jones, J. L., and D. D. White. 2021. A social network analysis of collaborative governance for the food-energy-water nexus in Phoenix, AZ, USA. *Journal of Environmental Studies and Sciences* 11 (4):671–81. doi: 10.1007/s13412-021-00676-3.

Jones, J. L., D. D. White, and D. Thiam. 2022. Media framing of the cape town water crisis: Perspectives on the food-energy-water nexus. *Regional Environmental Change* 22 (2):79. doi: 10.1007/s10113-022-01932-0.

Khan, Z., T. B. Wild, M. E. Silva Carrazzone, R. Gaudioso, M. P. Mascari, F. Bianchi, F. Weinstein, F. Pérez, W. Pérez, F. Miralles-Wilhelm, et al. 2020. Integrated energy-water-land nexus planning to guide national policy: An example from uruguay. *Environmental Research Letters* 15 (9):094014. doi: 10.1088/1748-9326/ab9389.

Kurian, M., C. Scott, V. R. Reddy, G. Alabaster, A. Nardocci, K. Portney, R. Boer, and B. Hannibal. 2019. One swallow does not make a summer: Siloes, trade-offs and synergies in the water-energy-food nexus. *Frontiers in Environmental Science* 7:32. doi: 10.3389/fenvs.2019.00032.

Lebel, L., A. Haefner, C. Pahl-Wostl, and A. Baduri. 2020. Governance of the water-energy-food nexus: insights from four infrastructure projects in the lower Mekong basin. *Sustainability Science* 15 (3):885–900. doi: 10.1007/s11625-019-00779-5.

Lee, K. C. L., J. P. Newell, J. Wolch, N. Schneider, and P. Joassart-Marcelli. 2014. Story-Networks" of Livestock and Climate Change: Actors, Their Artifacts, and the Shaping of Urban Print Media. *Society & Natural Resources* 27 (9):948–63. 10.1080/08941920.2014.918227.

Lele, U., M. Klousia-Marquis, and S. Goswami. 2013. Good governance for food, water and energy security. *Aquatic Procedia* 1:44–63. doi: 10.1016/j.aqpro.2013.07.005.

Liu, J., V. Hull, H. C. J. Godfray, D. Tilman, P. Gleick, H. Hoff, C. Pahl-Wostl, Z. Xu, M. G. Chung, J. Sun, et al. 2018. Nexus approaches to global sustainable development. *Nature Sustainability* 1 (9):466–76. doi: 10.1038/s41893-018-0135-8.

Lombard, M., J. Snyder-Duch, and C. C. Bracken. 2006. Content analysis in mass communication: Assessment and reporting of intercoder reliability. *Human Communication Research* 28 (4):587–604. doi: 10.1111/j.1468-2958.2002.tb00826.x.

Macnamara, J. 2005. Media content analysis: its uses, benefits, and best practice methodology. *Asia Pacific Public Relations Journal* 6 (1):1–34.

MacQueen, K. M., E. McLellan, K. Kay, and B. Milstein. 1998. Codebook development for team-based qualitative analysis. *CAM Journal* 10 (2):31–6. doi: 10.1177/1525822X980100020301.

McDonald, N., S. Schoenebeck, and A. Forte. 2019. Reliability and inter-rater reliability in qualitative research: Norms and guidelines for CSCW and HCI practice. *Proceedings of the ACM on Human-Computer Interaction* 3:1–23. doi: 10.1145/3359174.

Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente (MVOTMA) [Ministry of Housing, Territorial Planning and Environment]. 2018. Calidad Ambiental de la Cuenca del Río Negro 2009 -2017 [Environmental quality of the Rio Negro Basin 2009 – 2017]. Accessed November 6, 2023. https://www.gub.uy/ministerio-ambiente/sites/ministerio-ambiente/files/documentos/publicaciones/Informe_calidad_ambiental_cuenca_Rio_Negro_2009_-_2017.pdf

Mohtar, R. H, and B. Daher. 2016. Water-Energy-Food Nexus Framework for facilitating multi-stakeholder dialogue. *Water International* 41 (5):655–61. 10.1080/02508060.2016.1149759.

Mohtar, R., and B. Daher. 2012. Water, energy, and food: The ultimate nexus. In *Encyclopedia of agricultural, food, and biological engineering*, ed. Dennis R. Heldman and Carmen I. Moraru, 2nd ed., 3. Taylor & Francis. doi: 10.1081/E-EAFE2-120048376.

Neff, R. A., I. L. Chan, and K. C. Smith. 2009. Yesterday's dinner, tomorrow's weather, today's news? US newspaper coverage of food system contributions to climate change. *Public Health Nutrition* 12 (7):1006–14. 10.1017/S1368980008003480. 18702838

Newell, J. P., B. Goldstein, and A. Foster. 2019. A 40-year review of food–energy–water nexus literature and its application to the urban scale. *Environmental Research Letters* 14 (7):073003. doi: 10.1088/1748-9326/ab0767.

O'Connor, C., and H. Joffe. 2020. Intercoder reliability in qualitative research: Debates and practical guidelines. *International Journal of Qualitative Methods* 19:160940691989922. doi: 10.1177/1609406919899220.

Opejin, A. K., R. M. Aggarwal, D. D. White, J. Leah Jones, R. Maciejewski, G. Mascaro, and H. S. Sarjoughian. 2020. A bibliometric analysis of food-energy-water nexus literature. *Sustainability* 12 (3):1112. doi: 10.3390/su12031112.

Perrone, D., and G. M. Hornberger. 2014. Water, food, and energy security: Scrambling for resources or solutions? *WIREs Water*. 1 (1):49–68. doi: 10.1002/wat2.1004.

Redo, D. J., T. M. Aide, M. L. Clark, and M. J. Andrade-Núñez. 2012. Impacts of internal and external policies on land change in Uruguay, 2001–2009. *Environmental Conservation* 39 (2): 122–31. doi: 10.1017/S0376892911000658.

Ringler, C., A. Bhaduri, and R. Lawford. 2013. The nexus across water, energy, land and food (WELF): Potential for improved resource use efficiency? *Current Opinion in Environmental Sustainability* 5 (6):617–24. doi: 10.1016/j.cosust.2013.11.002.

Schmid, A. N., J. R. Thompson, and D. N. Bengston. 2007. The public discourse about land use and water quality: Themes in newspapers in the upper Mississippi River basin. *Applied Environmental Education & Communication* 6 (2):187–96. doi: 10.1080/15330150701598270.

Stauffacher, M., N. Muggli, A. Scolobig, and C. Moser. 2015. Framing deep geothermal energy in mass media: The case of Switzerland. *Technological Forecasting and Social Change* 98:60–70. doi: 10.1016/j.techfore.2015.05.018.

Stephan, R. M., R. H. Mohtar, B. Daher, A. Embid Irujo, A. Hillers, J. Carl Ganter, L. Karlberg, L. Martin, S. Nairizi, D. J. Rodriguez, et al. 2018. Water–energy–food nexus: A platform for implementing the sustainable development goals. *Water International* 43 (3):472–9. doi: 10.1080/02508060.2018.1446581.

Sternlieb, F., R. P. Bixler, H. Huber-Stearns, and C. Huayhuaca. 2013. A question of fit: Reflections on boundaries, organizations and social-ecological systems. *Journal of Environmental Management* 130:117–25. doi: 10.1016/j.jenvman.2013.08.053.

Stoddart, M. C. J., R. Haluza-DeLay, and D. B. Tindall. 2016. Canadian news media coverage of climate change: Historical trajectories, dominant frames, and international comparisons. *Society & Natural Resources* 29 (2):218–32. doi: 10.1080/08941920.2015.1054569.

Van den Bulck, H. 2002. Tools for studying the media. In *The media book*, ed. Chris Newbold, Oliver Boyd-Barrett, and Hilde Van den Bulck, 55–89. London: Oxford University Press.

Wei, J., Y. Wei, F. Tian, N. Nott, C. de Wit, L. Guo, and Y. Lu. 2021. News media coverage of conflict and cooperation dynamics of water events in the Lancang–Mekong river basin. *Hydrology and Earth System Sciences* 25 (3):1603–15. doi: 10.5194/hess-25-1603-2021.

Wild, T., Z. Khan, M. Zhao, M. Suriano, J. L. Bereslawski, P. Roberts, J. Casado, M. Gaviño-Novillo, L. Clarke, M. Hejazi, et al. 2021. The implications of global change for the co-evolution of Argentina's integrated energy-water-land systems. *Earth's Future* 9 (8):e2020EF001970. doi: 10.1029/2020EF001970.