

# From guano to green hydrogen: food security and fertilizer disputes in international energy law

Oliver Hailes <sup>\*</sup>

## ABSTRACT

Russia's invasion of Ukraine triggered energy and food crises, driven by demand for natural gas as fuel and fertilizer feedstock. By adopting a recent framework for analysing the diverse ways in which international law regulates energy transactions, I extend the category of end-use energy products to include food for human consumption, given the economic importance of dietary energy and the entangled agendas of energy and food security. To highlight the intermediate roles played by international law in securing resources for conversion into dietary energy, I show how rules allocating entitlements over fossil fuels were inherited from an earlier generation of international disputes over fertilizer resources, including the taxation of nitrate exports, alien entitlements to guano discoveries, and the well-known confiscation of a factory at Chorzów. Many of these disputes between States and commercial actors prefigured the reliance of the modern energy industry on investment arbitration and retain currency in case law. Yet, the fertilizer trade also informed the development of offshore resource entitlements, the local regulation of global externalities, and the belated recognition of the rights of peoples over natural resources. Despite this normative evolution, dispute settlement in the energy sector is still driven by States and commercial actors, although the underlying transactions may have profound implications for food security. By reframing food as energy and integrating fertilizer disputes into a long history of international energy law, the anticipated transition from fossil fuels towards green hydrogen as a dual-use fuel and fertilizer feedstock may generate familiar sites of distributive conflict over resources for the production of dietary energy, calling for closer attention to whether food security may be enhanced by the entitlements of collective subjects (food sovereignty), individuals (right to food), corporations (investment protection), and States (economic regulation).

‘Notwithstanding the extreme inequality of climates and soils, every people ought to be contented with that which has fallen to their share.’<sup>1</sup>

<sup>\*</sup> Assistant Professor of Law, London School of Economics and Political Science, Houghton Street, London WC2A 2AE, UK. Thanks to Susan Marks, Marie-Catherine Petersmann, Margot Salomon, Gerry Simpson, Michael Waibel, and anonymous reviewers for comments on previous versions.

<sup>1</sup> Emer de Vattel, *The Law of Nations: or, Principles of the Law of Nature, Applied to the Conduct and Affairs of Nations and Sovereigns* (Joseph Chitty (ed), 6th edn, Johnson, London 1844) book 2, s 90.

## INTRODUCTION: ALL-CONSUMING CRISES

Russia's invasion of Ukraine triggered two notorious crises for third States, framed in terms of disparate security agendas. An energy crisis, on one hand, threatening the security of European households and industrial consumers of oil and gas. Food crisis, on the other, threatening the security of developing countries that depended on imports of cereals, vegetable oils, and fertilizers to meet nutritional needs. Yet, a clear-cut distinction between food and energy occludes how such crises were driven by lop-sided entitlements over the same resource. In April 2022, 2 months after the war began, the price of natural gas (methane, CH<sub>4</sub>) increased by 139% compared to the previous year.<sup>2</sup> Because gas accounts for up to 80% of the production costs of synthetic nitrogen, the price of critical fertilizers increased by 182% over the same period.<sup>3</sup> By the end of 2023, war-borne restriction of agricultural exports would have increased food prices by a mere 2.6%, whereas a 74% increase was attributable to surging oil, gas, and fertilizer prices.<sup>4</sup> Underlying these crises, in short, was a distributive conflict in securing access to adequate gas supplies, given the demand for electricity and heat, on one hand, and the production of fertilizer and food, on the other.<sup>5</sup>

International lawyers are used to thinking of energy and food as discrete objects, classically treated as problems of investment protection and trade liberalization. Energy disputes have long focused on governmental interference with oil and gas investments. By contrast, food disputes have landed in the laps of trade lawyers, with landmark complaints before the World Trade Organization (WTO) concerning apples, beef, dairy, shrimp, sugar, and so on. This rough division of labour, increasingly blurred by renewable energy disputes, reflects a world economy fuelled by fossils buried somewhere (eliciting limits on the territorial sovereign) and nourished by food grown elsewhere (warranting disciplines on agricultural protectionism). There are good reasons for applying special rules to what we eat. Hence, for example, the Agreement on the Application of Sanitary and Phytosanitary Measures. Whilst the European Union (EU) imposed a price cap on seaborne crude oil and petroleum products from Russia, its sanctions regime did not 'target in any way the trade in agricultural and food products, including wheat and fertilisers, between third countries and Russia'.<sup>6</sup> There may also be sound bases for distinguishing between emissions from electricity, heat, or transportation (mainly carbon dioxide, CO<sub>2</sub>) and agriculture (mainly methane) in the nationally determined contributions of parties to the Paris Agreement.<sup>7</sup> Yet, all these distinctions, however sensible, are drawn among different forms of physical energy.

This article calls for lawyers and policymakers to flex their mindset of what counts as energy from the vantage of international law, to anticipate and perhaps reorganize distributive conflict among consumers of food, fuel, and other forms of energy. I proceed along two main axes—analytical and historical—that sharpen attention to legal links between the concern for food security and the international organization of energy transactions, specifically those that impact fertilizer production as a bridging industry between fuel and food. By adopting a recent framework for international energy law, I extend the category of end-use energy products to include food for human consumption, given the economic importance of dietary energy and the entangled agendas of energy and food security (Food as energy in international law section). To

<sup>2</sup> Peter Alexander and others, 'High Energy and Fertilizer Prices are More Damaging than Food Export Curtailment from Ukraine and Russia for Food Prices, Health and the Environment' (2023) 4 *Nature Food* 84, 85.

<sup>3</sup> *ibid.*

<sup>4</sup> *ibid.*

<sup>5</sup> Not to say that fertilizer prices were the sole driver; the market power of food suppliers allowed them to raise prices well beyond increased fuel costs: 'Interim Report of the Special Rapporteur on the Right to Food, Michael Fakhri' (18 July 2023) UN Doc A/78/202 [Interim Report] para 75.

<sup>6</sup> Para 12 of Council Regulation (EU) 2022/1269 of 21 July 2022 amending Regulation (EU) No. 833/2014 concerning restrictive measures in view of Russia's actions destabilizing the situation in Ukraine [2022] OJ L193/1.

<sup>7</sup> Cf. Alexander Zahar, 'Agricultural Exceptionalism in the Climate Change Treaties' (2023) 12 *Transnational Environmental Law* 42; André Nollkaemper, 'International Law and the Agony of Animals in Industrial Meat Production' (2023) *European Journal of International Law* DOI: 10.1093/ejil/chad049.

highlight the longstanding roles played by international law in securing resources for conversion into energy products, I show how rules allocating entitlements over fossil fuels were inherited from an earlier generation of international disputes over fertilizer resources, including the taxation of nitrate exports, alien entitlements to guano discoveries, and the well-known confiscation of a factory at Chorzów (International disputes over fertilizer resources section). Many of these disputes between States and commercial actors prefigured the reliance of the modern energy industry on investment arbitration and retain currency in case law. Yet, the fertilizer trade also informed the development of offshore resource entitlements, the local regulation of global externalities, and the belated recognition of the rights of peoples over natural resources (Normative evolution through the fertilizer trade section). Despite this normative evolution, dispute settlement in the energy sector is still driven by States and commercial actors, although the underlying transactions may have profound implications for food security. By reframing food as energy and integrating fertilizer disputes into a long history of international energy law, the anticipated transition from fossil fuels towards green hydrogen as a dual-use industrial fuel and fertilizer feedstock may generate familiar sites of distributive conflict, calling for closer attention to the stratified entitlements of different legal subjects and their possible implications for food security (Stratified entitlements in the energy transition section). I conclude by underscoring the importance of securing international entitlements over energy resources for food production (Conclusion: back to the Atacama? section).

## FOOD AS ENERGY IN INTERNATIONAL LAW

This section builds on a recent framework for analysing the diverse ways in which international law regulates energy transactions. Viñuales frames energy as a legal object in terms of four inter-related categories: (i) 'resources' that are converted into (ii) 'products' through a range of (iii) 'activities' relying on particular (iv) 'technologies'.<sup>8</sup> The first two categories are of primary relevance. Energy resources include both stocks (fossil fuels uranium) and flows (watercourses, solar radiation, wind), as well as critical minerals that underpin renewable energy systems and batteries (cobalt, copper, lithium). Notably, Viñuales also refers to bioenergy resources, including crops (corn, wheat, and soy). Already, then, food may be framed as an energy resource, as long as it is never eaten. Such resources are instead converted into end-use products, including electricity, thermal services (heating and cooling), and many types of refined fuels. Again, Viñuales gestures towards the food system, noting how hydrogen (H<sub>2</sub>) may be considered a fuel product, despite its principal use in the production of ammonia (NH<sub>3</sub>) as a chemical feedstock for nitrogen fertilizers such as urea (CO(NH<sub>2</sub>)<sub>2</sub>) and ammonium nitrate (NH<sub>4</sub>NO<sub>3</sub>).

From this vantage, the food system lies at the margins of energy as a legal object. We could, of course, identify other industries that compete for resources with fuel production, such as the use of refined petroleum in petrochemical products. But plastics are not themselves consumed as energy. By contrast, international energy law should not overlook 'that most fundamental of all energy conversions, the production of food'.<sup>9</sup> Hence, this section extends the category of end-use products to include food for human consumption, given the economic importance of dietary energy (Economic importance of dietary energy section) and the entangled agendas of energy and food security (Entangled agendas of energy and food security section B). This extension permits us to reframe the energy and food crises as competition over a resource (natural gas) that can be converted into several uses (food, fuel, heat, electricity) for the benefit of different actors, whose entitlements derive from the allocation of jurisdiction and may be decided in the last resort by international dispute settlement. Other possible frames present a much thicker picture

<sup>8</sup> Jorge Viñuales, *The International Law of Energy* (Cambridge University Press, Cambridge 2022), 14–21.

<sup>9</sup> Vaclav Smil, 'Nitrogen Cycle and World Food Production' (2011) 2 *World Agriculture* 9, 9.

of food as a social practice, underlining its culturally specific dimensions.<sup>10</sup> Yet, framing food as energy in international law reveals a deep continuity in the distribution of entitlements over resources for food and fuel production, which serves to foreground the enduring importance of such entitlements in the legal organization of the energy transition.

### Economic importance of dietary energy

Two reasons appear most salient for framing food as an energy product. The first is physical. Dietary or metabolizable energy is a type of chemical energy that humans consume in the form of macronutrients (carbohydrates, proteins, and fats) in plants and animal products to sustain their metabolism, including their brain and muscular activity. Suppose that food was included in the world energy mix. In that case, it might comprise about 5.6 per cent of total consumption, somewhere between the share of nuclear energy (4 per cent) and the combined share of solar, wind, and other renewable sources excluding hydropower (6.3 per cent).<sup>11</sup> A related reason, therefore, is economic. Historians have tracked transitions away from 'organic' economies, wherein photosynthesis was harnessed as mechanical energy in the form of human and animal muscle.<sup>12</sup> The transition towards a coal-fired 'mineral' economy during the Industrial Revolution was itself fuelled by cheap food for urban factory workers in the form of colonial cash crops, above all sugar,<sup>13</sup> which overcame the ecological limits of European land use by depending on American plantations and the shameful system of chattel slavery.<sup>14</sup> But fossil fuels never supplanted the energy supplied by food. Rather, the organic economy became embedded in the mineral economy, starkly illustrated when a gas supply crunch drives up food prices.

In this light, the massive increase in agricultural productivity during the Green Revolution (the post-war dissemination of high-yielding crop varieties, irrigation technologies, and synthetic fertilizers) may be viewed as an unparalleled injection of dietary energy into the world economy.<sup>15</sup> Agricultural producers are typically viewed as consumers of energy products like any other, albeit major emitters of greenhouse gases in their own right.<sup>16</sup> Yet, just as producers of electricity, thermal services, and fuels are known to provide inputs to all economic sectors, the food system itself employs technologies to convert natural resources into energy products to fuel that most vital factor of production: labour power.

### Entangled agendas of energy and food security

The nexus between food and other energy products is further apparent when we compare the roots of energy security in international discourse with those of food security. Whilst ancillary purposes are pursued through international energy law (equity, safety, and sustainability), the primary pursuit of security (through diversified supply and demand-side management) may be traced to the assertion of sovereignty over petroleum deposits by newly independent States and the weaponization of fuel exports by Arab members of the Organization of the Petroleum

<sup>10</sup> See Food sovereignty section.

<sup>11</sup> In 2021, the world average dietary energy supply was 2960 kilocalories per person per day: *World Food and Agriculture: Statistical Yearbook 2022* (FAO, Rome 2022), 31. With an estimated population of 7.888 billion, the total dietary energy was  $8.522 \times 10^{15}$  kilocalories or 35.66 exajoules, whereas primary energy consumption totalled 597.41 exajoules, comprising oil (184.86), natural gas (146.41), coal (160.43), nuclear (25.33), hydroelectric (40.40), and renewables (39.97): *Statistical Review of World Energy* (72nd edn, Energy Institute, London 2023), 9.

<sup>12</sup> EA Wrigley, *Energy and the English Industrial Revolution* (Cambridge University Press, Cambridge 2010), 14–15.

<sup>13</sup> Michael Fakhrī, *Sugar and the Making of International Trade Law* (Cambridge University Press, Cambridge 2014), 5–9.

<sup>14</sup> Kenneth Pomeranz, *The Great Divergence: China, Europe, and the Making of the Modern World Economy* (Princeton University Press, Princeton 2001), chap 6.

<sup>15</sup> RE Evenson and D Gollin, 'Assessing the Impact of the Green Revolution, 1960 to 2000' (2003) 300 *Science* 758. Cf. Vandana Shiva, *The Violence of the Green Revolution: Third World Agriculture, Ecology, and Politics* (University of Kentucky Press, Lexington 2016).

<sup>16</sup> M Crippa and others, 'Food Systems are Responsible for a Third of Global Anthropogenic GHG Emissions' (2021) 2 *Nature Food* 198.

Exporting Countries (OPEC) in the 1973 Yom Kippur War.<sup>17</sup> This oil shock, amid synchronous crop failures, quadrupled fertilizer prices and worsened a global food crisis.<sup>18</sup> The notion of food security accordingly came to the fore at the 1974 World Food Conference, leading to the creation of the Committee on World Food Security by the UN Food and Agriculture Organization (FAO).<sup>19</sup> This notion is now defined in four dimensions: (i) physical availability, (ii) economic access, (iii) utilization of energy and nutrients, and (iv) stability in those three dimensions.<sup>20</sup> The international agendas of energy and food security thus coalesced in the mid-1970s and shared an emphasis on securing the availability of energy products, whether as fuel or food.

Yet, the pursuit of food security vastly predated its express formulation. The evolution of trade law, for example, was driven by tension between food security and economic liberalization, enabled by land grabs and vulnerable to spikes in fuel and fertilizer prices.<sup>21</sup> Given the commonplace binary of energy and food, however, international law's intermediate roles in securing fertilizer resources for conversion into dietary energy tend to be neglected, despite the prevalence of fertilizer disputes throughout the 19th-century transition from an organic towards a predominantly mineral economy. Akin to fossil fuels, a geographical mismatch between the location of fertilizer resources and their use in food production was imperfectly reconciled through a mix of commerce and conflict, organized by a primitive system of international law. In the next section, I suggest that today's rules allocating entitlements over energy resources were inherited from this earlier generation of fertilizer disputes, which may shed light on how to reorganize the present transition from fossil fuels towards renewable sources in a manner that mitigates the risk of distributive conflict between energy as food and fuel.

## INTERNATIONAL DISPUTES OVER FERTILIZER RESOURCES

Plant growth, and so all dietary energy in the human food web, depends on three main macronutrients: nitrogen (N), phosphorus (P), and potassium (K).<sup>22</sup> These nutrients are recycled through the decay of organic matter and the slow process of fixing atmospheric nitrogen (N<sub>2</sub>) into reactive compounds, performed by a single genus of soil bacteria. Whilst preindustrial farming used manure and nitrogen-fixing legumes to speed up nutrient recycling, two novel fertilizers became known to European commerce during the 19<sup>th</sup> century, promising an escape from limits to growth that were threatened by soil depletion and rising populations amid rapid industrialization.<sup>23</sup> The first was guano, the sun-baked excrement of sea birds (principally the guanay cormorant) found to be rich in macronutrients, derived from an abundant diet of Peruvian anchoveta. The second was sodium nitrate (NaNO<sub>3</sub>), discovered in huge quantities in the nearby Atacama Desert.

<sup>17</sup> Viñuales (n 8) 21–25.

<sup>18</sup> James P Grant, 'Food, Fertilizer, and the New Global Politics of Resource Scarcity' (1975) 420 *Annals of the American Academy of Political and Social Science* 11.

<sup>19</sup> *Report of the World Food Conference, Rome, 5–16 November 1974*, UN Doc E/CONF.65/20.

<sup>20</sup> Agency and sustainability are ancillary dimensions: FAO and others, *The State of Food Security and Nutrition in the World 2023* (FAO, Rome 2023), 246–47.

<sup>21</sup> Anne Orford, 'Food Security, Free Trade, and the Battle for the State' (2015) 11 *Journal of International Law and International Relations* 1; Michael Fakhri, 'A History of Food Security and Agriculture in International Trade Law, 1945–2017' in John D Haskell and Akbar Rasulov (eds), *New Voices and New Perspectives in International Economic Law* (Springer, Cham 2020) 55, 90. See further Surabhi Ranganathan, 'Seasteads, Land-Grabs and International Law' (2019) 32 *Leiden Journal of International Law* 205.

<sup>22</sup> I discuss phosphate in Rights of peoples over natural resources section. I do not examine potassium due to its relative lack of disputes. Before recent sanctions, potash from Belarus and Russia provided two-thirds of EU imports of potassium chloride (KCl): Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Ensuring Availability and Affordability of Fertilisers (9 November 2022) COM(2022) 590 final. Prices doubled, but shortages were mitigated by Canada's stability as the world's largest exporter. Most reserves were nationalized by Saskatchewan in 1976, thereafter owned by PotashCorp, which was privatized in 1990 and is now known as Nutrien.

<sup>23</sup> Vaclav Smil, *Enriching the Earth: Fritz Haber, Carl Bosch, and the Transformation of World Food Production* (MIT Press, Cambridge, MA 2001), chap 3.



The economic criticality of both commodities eroded after the First World War. In 1908, German chemist Haber patented a process of converting atmospheric nitrogen into ammonia through a high-pressure reaction with hydrogen using a metal catalyst, which was brought to commercial scale in 1913 by Bosch of the chemicals giant Badische Anilin- und Sodafabrik (BASF).<sup>24</sup> Because ammonia could be converted into ammonium nitrate for dual use as an explosive or fertilizer, it is unsurprising that BASF's patents for the Haber–Bosch process were immediately subjected to compulsory licensing under the Treaty of Versailles.<sup>25</sup> By 2008, in the wake of the Green Revolution, nitrogen fertilizers fed nearly half the world's population of seven billion.<sup>26</sup> Since hydrogen was predominantly sourced through the reaction of water and natural gas (steam methane reforming), the widespread adoption of the Haber–Bosch process also marked the dependence of food production on fossil fuels, with nitrogen fertilizers now accounting for 2.1% of anthropogenic greenhouse gases.<sup>27</sup>

But before these chemical innovations, when fossil fuels were directly controlled by the British Empire,<sup>28</sup> international law played a socio-technical role in allocating entitlements over fertilizer resources among sovereign equals and commercial actors, prefiguring the legal organization of the modern energy industry. This section offers a potted history of disputes before the Second World War in four steps. First, I introduce the experimental policies adopted by Peru in governing the guano trade and international responses to secure access to fertilizer resources (Geopolitics of guano governance section). Second, I underscore the importance of sodium nitrate, specifically its taxation in contravention of treaty obligations, as the proximate cause of Chile's invasion of Bolivia and Peru (Armed conflict over nitrate taxation section). Third, I examine the pitfalls of international adjudication during this period, focusing on alien entitlements to guano discoveries (Guano claims before mixed commissions section). Finally, I revisit the 20th-century shift towards synthetic fertilizers alongside redistributive agrarian reform, generating landmark cases on compensation that retain currency in international energy law (Interwar roots of compensation principles section).

### Geopolitics of guano governance

In 1804, the Prussian naturalist von Humboldt returned from Peru with samples of a pungent substance that he had seen barged from the Chincha Islands into the port of Callao and laid by locals on coastal fields.<sup>29</sup> Initial attempts to establish an international guano trade were thwarted by decades of political instability. In 1840, however, the Peruvian government granted a 9-year export monopoly to a local businessman, backed by British and French merchants.<sup>30</sup> After a year of rapid sales, Peru had clearly underestimated the profitability of its endowment. In 1841, the government annulled the monopoly, nationalized guano, abolished communal claims, and thereafter charged royalties on consignment contracts.<sup>31</sup> These royalties became the main source of government revenue, but they could not keep pace with military spending. In 1849, the government granted a monopoly on exports to Britain in favour of trading house Antony Gibbs &

<sup>24</sup> *ibid* chaps 4–5.

<sup>25</sup> Art 297 of Treaty of Peace between the Allied and Associated Powers and Germany, adopted 28 June 1919, in force 10 January 1920 [1920] ATS 1 [Treaty of Versailles].

<sup>26</sup> Jan Willam Erisman and others, 'How a Century of Ammonia Synthesis Changed the World' (2008) 1 *Nature Geoscience* 636.

<sup>27</sup> Stefano Menegat and others, 'Greenhouse Gas Emissions from Global Production and Use of Nitrogen Synthetic Fertilisers in Agriculture' (2022) 12 *Scientific Reports* 14490.

<sup>28</sup> British coal accounted for 85% of internationally traded coal in 1900: Bruce Podobnik, *Global Energy Shifts: Fostering Sustainability in a Turbulent Age* (Temple University Press, Philadelphia 2005), 29–33.

<sup>29</sup> Gregory T Cushman, *Guano and the Opening of the Pacific World: A Global Ecological History* (Cambridge University Press, 2013), 23–27.

<sup>30</sup> *ibid* 43–44.

<sup>31</sup> WM Mathew, 'Foreign Contractors and the Peruvian Government at the Outset of the Guano Trade' (1972) 52 *Hispanic American Historical Review* 598, 600–05.

Sons in exchange for a large loan,<sup>32</sup> reflecting an emerging practice of ‘guano-debt contracts’.<sup>33</sup> This snapshot of a nascent guano trade presents several parallels to the post-war nationalization of hydrocarbon assets, renegotiation of investment contracts, and resource-backed loans as a tool of public finance. By the 1850s, ‘guano mania’ had prefigured the 1973 oil shock: rising prices in oligopolistic markets, fears of resource exhaustion, attempts at price controls, threats of armed intervention, and a global rush to explore for new deposits.<sup>34</sup>

The US response to securing fertilizer (following an abortive threat of force<sup>35</sup>) was to legislate the 1856 Guano Islands Act: whenever a citizen ‘discovers a deposit of guano on any island’ that is not claimed or occupied by any other State, the island ‘may, at the discretion of the President, be considered as appertaining’ to the US.<sup>36</sup> By 1900, the US had thereby claimed nearly 100 Caribbean and Pacific islands although their legal status was seldom clear.<sup>37</sup> The US was not alone; nearly every valuable rock in the Pacific was enclosed during this period.<sup>38</sup> So were several islands off the coast of modern Namibia, annexed by the British prior to German colonization of the mainland.<sup>39</sup> Guano islands thus found themselves in a litigious state (‘état litigieux’), observed the Spanish queen as an arbitrator in the *Aves Island* case, who upheld Venezuela’s claim over that of the Netherlands.<sup>40</sup> Venezuela had already granted a guano concession, but not before US nationals began to work the island. Although the State Department declined to apply the Guano Islands Act, it pursued a claim of diplomatic protection against Venezuela for the expulsion and expropriation of its nationals.<sup>41</sup> A settlement agreement was entered in 1857 and, with a little help from gunboat diplomacy, paid in 1864. The same year, the Spanish navy made a play for the resource wealth of its former colony by seizing the Chincha Islands, eventually repelled in 1866 by the underestimated strength of Peru’s guano-funded military.<sup>42</sup> Yet, Peru fared less well in a major conflict that soon emerged over another fertilizer resource that assumed critical importance in the region: sodium nitrate, also known as Chilean saltpetre.

### Armed conflict over nitrate taxation

Once thought to be ancient guano, huge deposits of sodium nitrate were in fact the desiccated residue of prehistoric microorganisms. Also used in the production of explosives and industrial chemicals, the price of nitrate spiked in 1868 following an earthquake that destroyed several Peruvian ports.<sup>43</sup> The government raised taxes on nitrate and proposed to enact an export monopoly, whereby manufacturers would be assigned production quotas and forced to sell at a

<sup>32</sup> Cushman (n 29) 54.

<sup>33</sup> Catalina Vizcarra, ‘Guano, Credible Commitments, and Sovereign Debt Repayment in Nineteenth-Century Peru’ (2009) 69 *Journal of Economic History* 358. See also Vinod K Aggarwal, *Debt Games: Strategic Interaction in International Debt Rescheduling* (Cambridge University Press, Cambridge 1996), chap 6. The largest loan was granted by Dreyfus Frères & Cie in return for a monopoly over the export of two million tonnes to Europe and French colonies: Michael Waibel, *Sovereign Defaults before International Courts and Tribunals* (Cambridge University Press, Cambridge 2011), 138–41. For the last in a string of arbitral proceedings, see *Affaire des réclamations françaises contre le Pérou (France c Pérou)*, PCA, Sentence (11 October 1920) 1 RIAA 215, 218–20.

<sup>34</sup> Smil (n 23) 42.

<sup>35</sup> In 1852, the State Department sent naval protection for guano entrepreneurs, but reversed this decision in view of British support for Peru: Kenneth E Shewmaker, ‘“Untaught Diplomacy”: Daniel Webster and the Lobos Islands Controversy’ (1977) 1 *Diplomatic History* 321.

<sup>36</sup> s 1 of An Act to Authorize Protection to be Given to Citizens of the United States Who May Discover Deposites of Guano 11 Stat 119 (1856).

<sup>37</sup> For an effort to reconcile the Guano Islands Act with principles of international law, see *The Sovereignty of the Islands of Roncador, Quito Sueno, Serrana, and Serranilla* (Legal Adviser, US Department of State, 9 August 1932), 6–39. Cf. Joseph Blocher and Mitu Gulati, ‘Navassa: Property, Sovereignty, and the Law of the Territories’ (2022) 131 *Yale Law Journal* 2390.

<sup>38</sup> Cushman (n 29) 82.

<sup>39</sup> Earle A Parlington, ‘Walvis Bay: South Africa’s Claims to Sovereignty’ (1988) 16 *Denver Journal of International Law and Policy* 247, 254–60.

<sup>40</sup> *Sentence arbitrale relative à la question élevée entre le Venezuela et le Royaume des Pays-Bas, de la domination et de la souveraineté de l’île d’Aves*, Ad hoc, Décision du 30 juin 1865, 28 RIAA 115, 122. See also *Affaire de l’île de Clipperton (Mexique c France)*, Ad hoc, Sentence (28 January 1931) 2 RIAA 1105.

<sup>41</sup> *The Sovereignty of Guano Islands in the Caribbean Sea* (Legal Adviser, US Department of State, 30 September 1932), 45–58.

<sup>42</sup> Cushman (n 29) 56–57.

<sup>43</sup> *ibid* 67–70.

fixed price.<sup>44</sup> British merchants sought diplomatic protection, but the Foreign Office reaffirmed 'the right of the Peruvian Government to regulate the manufacture and export of produce within and from Peruvian territory.'<sup>45</sup> The monopoly was nevertheless shelved due to intense lobbying. By 1875, however, a drop in the price of nitrate and the perceived need to manage competition with guano amid financial crisis led to Peru's nationalization of nitrate, with compensation financed by local banks and Gibbs & Sons appointed as the marketing agent.<sup>46</sup> After extreme flooding in neighbouring Bolivia, moreover, Peru bought up most of Bolivia's beleaguered companies, except the very largest: the Antofagasta Nitrate & Railway Company, owned by British and Chilean interests.<sup>47</sup>

When Bolivia raised taxes on nitrate exports to rebuild infrastructure, Antofagasta refused to pay, citing an 1874 treaty that excluded Chilean companies from such taxation for 25 years to incentivize investment.<sup>48</sup> Once Bolivia began seizing the company's assets, Chilean marines invaded to protect Antofagasta and, in view of Bolivia's defence pact with Peru,<sup>49</sup> launched a pre-emptive strike that resulted in the occupation of Peru's nitrate region and guano islands. The War of the Pacific (1879–83) provided 'a preview of the massive wars fought over phosphate, petroleum, *Lebensraum*, and other resources' in the next century.<sup>50</sup> The International Court of Justice (ICJ) still deals with disputes that stem from Chile's territorial gains.<sup>51</sup> Yet, the war was about 'nothing else' than 'the guano and the nitrates', so testified the US Secretary of State: 'Chile would never have gone into this war one inch but for her backing by English capital,' evident when 'they came to divide the loot and the spoils.'<sup>52</sup> British interests controlled just 13% of the nitrate industry before the war, rising to 70% by 1890.<sup>53</sup> The implementation of the 1883 peace treaty between Chile and Peru, the Treaty of Ancón,<sup>54</sup> was disputed for decades, eventually arbitrated before the US president in 1925.<sup>55</sup> Borchard, who was counsel for Peru, may have had in mind the War of the Pacific when he lamented how weaker States were vulnerable to armed intervention following a 'unilateral determination' that alien property had been injured, proposing that an investor's right of arbitration against its host State may promote the 'reign of law' over the 'danger of war.'<sup>56</sup>

### Guano claims before mixed commissions

The race for fertilizer wealth elicited several experiments in the peaceful settlement of international disputes, prefiguring the reliance of the modern energy industry on investment arbitration.<sup>57</sup> Two disputes over guano discoveries serve to illustrate, each of which not only contributed to the development of international law but also exposed the pitfalls of relying

<sup>44</sup> Robert G Greenhill and Rory M Miller, 'The Peruvian Government and the Nitrate Trade, 1873–1879', (1973) 5 *Journal of Latin American Studies* 107, 112–15.

<sup>45</sup> *Peruvian Monopoly* (1873) in Clive Parry (ed), *A British Digest of International Law* (vol. 6 Stevens & Sons, London 1965), 349.

<sup>46</sup> Greenhill and Miller (n 44) 115–24.

<sup>47</sup> Cushman (n 29) 72.

<sup>48</sup> Art 4 of *Treatado de Límites*, adopted 6 August 1874, in force 22 September 1875.

<sup>49</sup> *Treatado de Alianza Defensiva entre Perú y Bolivia*, adopted and in force 6 February 1873.

<sup>50</sup> Cushman (n 29) 73.

<sup>51</sup> *Maritime Dispute (Peru v Chile)* (Judgment) [2014] ICJ Reports 3; *Obligation to Negotiate Access to the Pacific Ocean (Bolivia v Chile)* (Judgment) [2018] ICJ Reports 507; *Dispute over the Status and Use of the Waters of the Silala (Chile v Bolivia)* (Judgment) [2022] ICJ Reports 614.

<sup>52</sup> HR Report No. 1790: Chile-Peru (1882), 217 (Blaine).

<sup>53</sup> Brett Clark and John Bellamy Foster, 'Ecological Imperialism and the Global Metabolic Rift: Unequal Exchange and the Guano/Nitrates Trade' (2009) 50 *International Journal of Comparative Sociology* 311, 326.

<sup>54</sup> *Treatado de Paz y Amistad entre las Repúblicas de Chile y del Perú*, adopted 20 October 1883, in force 8 March 1884 [*Treaty of Ancón*].

<sup>55</sup> *Tacna-Arica Question (Chile, Peru)*, Ad hoc, Award (4 March 1925) 2 RIAA 921.

<sup>56</sup> Edwin M Borchard, 'Limitations on Coercive Protection' (1927) 21 *American Journal of International Law* 303, 303–06.

<sup>57</sup> See Investment protection section.



on inter-State agreements to establish mixed claims commissions to resolve disputes with commercial actors.

First, the Landreau brothers (born in France but one a naturalized US national) were encouraged by Peruvian legislation to search for guano deposits, expecting to receive one-third of each resource. In truth, this incentive applied only to undiscovered assets of expropriated religious convents.<sup>58</sup> The brothers nevertheless entered a contract with the government in 1865, agreeing to reveal discoveries for a 10% share in their exploitation. Yet, in 1868, the government repudiated the contract as invalid, assuring the brothers that a commission would be appointed to determine a new contract. That never happened. Then came the War of the Pacific. Chile assumed jurisdiction over the deposits under the Treaty of Ancón.<sup>59</sup> The Landreau claim was thereafter submitted to the 1892 Chile–US Claims Commission, established to adjudicate outstanding allegations of injury to alien property. The claim was dismissed by majority, finding that the legislative incentive did not apply to guano discoveries, the 1865 contract was invalid, and the brothers had only personal claims against Peru rather than acquired rights that were actionable against Chile.<sup>60</sup> Because Peru had benefitted from secret information, the dissenting commissioner found that Chile's title was subject to a lien, valued at one-third of the resources.<sup>61</sup> Pursuant to the Treaty of Ancón,<sup>62</sup> however, Chile had deposited half the proceeds from guano with the Bank of England, to be allocated among Peru's creditors by the federal supreme court of Switzerland, which in the majority's view would have been the proper venue to enforce any rights against Peru.<sup>63</sup> The 1895 Franco-Chilean Arbitral Tribunal reached similar conclusions in dismissing parallel claims.<sup>64</sup> Ultimately, Peru and the US established another commission to determine any equitable sum owed to the Landreau heirs, awarding 'a *quantum meruit* for the discoveries which [Peru] appropriated for [its] own benefit.'<sup>65</sup> Later, this finding provided the main authority for the 1981 Iran–US Claims Tribunal to admit the prohibition against unjust enrichment as a general principle of law, providing a residual basis for compensation in the absence of contractual remedies and internationally wrongful acts.<sup>66</sup> But the Landreau claim also displays the risks faced by commercial actors in securing access to resources for food production, coupled with a lack of timely remedies in a legal system controlled by States.

A speedier result was achieved in the case of *Gowen and Copeland*.<sup>67</sup> Two US nationals discovered guano deposits in the uninhabited Los Monjes archipelago, which they began exploiting in 1854. Then, another company obtained a lease from Venezuela, which expelled the US operators and seized their assets. The operators entered a sublease with the rival company to continue working the deposit for 15 months, whereupon they would relinquish their assets to the company. In deciding whether Venezuela had wrongfully dispossessed the original operators, the 1885 US–Venezuela Claims Commission refused to determine whether Venezuela had a right of sovereignty over the islands, given a parallel dispute between Colombia and Venezuela to

<sup>58</sup> *Hodgskin's Case: The Landreau Claim*, 1892 Chile–US Claims Commission, Case Nos. 38 and 39 in John Bassett Moore, *History and Digest of the International Arbitrations to which the United States Has Been a Party* (vol. 4, Government Printing Office, Washington DC 1898), 3571, 3590, 3573–74.

<sup>59</sup> Art 2–3 of Treaty of Ancón.

<sup>60</sup> *Hodgskin's Case* (n 58) 3581–83.

<sup>61</sup> *ibid* 3586–90.

<sup>62</sup> Art 4–12 of Treaty of Ancón.

<sup>63</sup> *Hodgskin's Case* (n 58) 3583–86.

<sup>64</sup> *Affaire du Guano (Chili, France)*, 1895 Franco-Chilean Arbitral Tribunal, Sentence (5 July 1901) 15 RIAA 125, 312–13.

<sup>65</sup> *Landreau Claim (USA v Peru)*, Ad hoc, Award (26 October 1922) 1 RIAA 347, 364.

<sup>66</sup> *Sea-Land Service, Inc. v Government of the Islamic Republic of Iran and Ports and Shipping Organization of Iran*, IUSCT Case No 33, Award No 135-55-1 (20 June 1984) paras 59–63. See further Kathleen Claussen, 'Unjust Enrichment' in Andreas Kulick and Michael Waibel (eds), *General International Law in International Investment Law: A Commentary* (Oxford University Press, Oxford 2024), chap 46.

<sup>67</sup> *John E Gowen and Franklin Copeland v Venezuela*, 1885 US–Venezuela Claims Commission, Case No. 16 in John Bassett Moore, *History and Digest of the International Arbitrations to which the United States Has Been a Party* (vol. 4, Government Printing Office, Washington DC 1898) 3354, 3359 [*Gowen and Copeland*].

determine title.<sup>68</sup> Whatever the result, the claimants could not claim damages for the underlying resource: 'The islands were not theirs, and the guano was a part of the freehold, as much so as gold or coal, or any other valuable deposit.'<sup>69</sup> As to the assets transferred under sublease, the Commission observed that the claimants were 'not compelled to make this bargain', but it was 'difficult to see what other arrangement could have been made without a total loss.'<sup>70</sup> The sublease was deemed to be a 'forced sale', so the Commission awarded damages.<sup>71</sup> This finding is cited as a pioneering authority on State responsibility for coercive transactions.<sup>72</sup> Yet, the Commission was equally prescient in affirming the precedence of territorial sovereignty over natural resources, despite the prior fact of commercial exploitation. This reflects a basic distinction between the presumptive entitlements of States and the derivative entitlements of corporations, which continues to organize energy transactions.<sup>73</sup> Concurrent reports of the Foreign Office accordingly cautioned not to issue 'any lease or licence' over guano islands without 'clear and positive evidence' of effective occupation and 'a formal declaration that the islands are British territory.'<sup>74</sup>

### Interwar roots of compensation principles

In 1898, the pre-eminent British chemist Crookes suggested that the exhaustion of coalfields would be nothing compared with that of fixed nitrogen: 'little short of starvation for the wheat-eaters', 'a lower standard of living for meat-eaters', even the extinction of gunpowder!<sup>75</sup> Guano deposits were fast depleting, whilst the War of the Pacific had resulted in Chilean jurisdiction over nitrate reserves. Later, the First World War drove up prices and threatened supply for munitions. In 1918, therefore, the Allies agreed to prevent their nationals from purchasing nitrate except through the Nitrate of Soda Executive, headed by a representative of Gibbs & Sons, which allocated quotas and fixed prices.<sup>76</sup> Germany faced distinct constraints. As discussed, the Haber–Bosch process of converting atmospheric nitrogen into ammonia was commercialized by BASF in 1913. During the war, however, military demand for ammonium nitrate prevailed over the needs of agriculture, such that Germany relied on another synthetic fertilizer to feed the war effort: cyanamide (CN<sub>2</sub>H<sub>2</sub>). Pioneered in the 1890s, a reaction of atmospheric nitrogen with calcium carbide (CaC<sub>2</sub>) produced this readymade fertilizer, although it required huge amounts of hydropower and caused acidic damage.<sup>77</sup> Nevertheless, in 1915, Germany entered contracts with Bayerische Stickstoffwerke AG (BS) to construct two cyanamide factories, one to be built in the Upper Silesian town of Chorzów.

After the war, the Treaty of Versailles mandated a plebiscite to determine whether the industrial hub of Upper Silesia would form part of Polish or German territory.<sup>78</sup> Before the vote, Germany transferred title in the Chorzów factory to Oberschlesische Stickstoffwerke AG (OS),

<sup>68</sup> The boundary delimitation dispute would drag on for decades: *Affaire des frontières Colombo-vénézuéliennes (Colombie c Vénézuéla)*, Conseil fédéral suisse, Sentence (24 March 1922) 1 RIAA 223.

<sup>69</sup> *Gowen and Copeland* (n 67) 3357.

<sup>70</sup> *ibid.*

<sup>71</sup> *ibid* 3358.

<sup>72</sup> Detlev F Vagts, 'Coercion and Foreign Investment Rearrangements' (1978) 72 *American Journal of International Law* 17, 22; *Desert Line Projects LLC v Republic of Yemen*, ICSID Case No. ARB/05/17, Award (6 February 2008) para 173.

<sup>73</sup> Viñuales (n 8) chap 2. Cf. Stratified entitlements in the energy transition section.

<sup>74</sup> *Laughlan and Purdy Islands* (21 March 1879) in Lord McNair (ed), *International Law Opinions: Selected and Annotated* (vol. 1, Cambridge University Press, Cambridge 1956) 321, 323.

<sup>75</sup> William Crookes, 'Address of the President before the British Association for the Advancement of Science, Bristol, 1898', (1898) 8 *Science* 561, 573.

<sup>76</sup> Jamie Martin, *The Meddlers: Sovereignty, Empire, and the Birth of Global Economic Governance* (Harvard University Press, Cambridge, MA 2022), 36–41.

<sup>77</sup> Christine Strotmann, 'Nitrogenous Fertilisers in Germany – Paths of Distribution from Chile Saltpetre to Haber-Bosch-Ammonia and Cyanamide (ca 1914–1930)' (2021) 62 *Jahrbuch für Wirtschaftsgeschichte* 159, 161–70.

<sup>78</sup> Art 88 of Treaty of Versailles.

with BS retaining the patents.<sup>79</sup> Although Germany won the 1921 plebiscite, a series of armed uprisings and a decision of the League of Nations resulted in Poland securing one-third of the region, encompassing the factory. To maintain economic stability, with a view also to war reparations, the Geneva Convention was signed by Germany and Poland in May 1922.<sup>80</sup> The Convention recognized that ‘Poland may expropriate ... undertakings belonging to the category of major industries’ (including ‘chemical fertilizer factories’) under strict conditions for 15 years, but provided that otherwise ‘the property, rights and interests of German nationals or of companies controlled by German nationals may not be liquidated.’<sup>81</sup> By July, a Polish court had annulled the transfer of the Chorzów factory from Germany to OS, deleting the name of OS from the land register and treating the factory as State property to be transferred to Poland pursuant to Article 256 of the Treaty of Versailles. The government thus assumed control of the factory, also declaring its intention to expropriate protected categories of ‘rural estates.’<sup>82</sup> Germany alleged that these measures breached the Geneva Convention.<sup>83</sup>

In agreeing that the cyanamide factory had been unlawfully confiscated, the Permanent Court of International Justice drew an enduring distinction between a ‘lawful liquidation’, lacking ‘only the payment of fair compensation’, and an ‘illegal act’, requiring reparation in the form of restitution or compensation that must, ‘as far as possible, wipe out all the consequences of the illegal act and re-establish the situation which would, in all probability, have existed if that act had not been committed.’<sup>84</sup> The *Chorzów* principle of full reparation is firmly established in the law of State responsibility, applying equally to compensation for unlawful interference with protected energy transactions and for negative externalities such as damage to environmental goods and services.<sup>85</sup> The standard of fair compensation for lawful expropriation, moreover, was fleshed out a decade later by the US Secretary of State: whilst admitting ‘the right of all countries freely to determine their own social, agrarian and industrial problems’, Hull demanded ‘prompt, adequate, and effective payment’,<sup>86</sup> a formula that shaped post-war debates over resource nationalization and investment treaty practice.<sup>87</sup> It is sometimes overlooked, however, that the Hull formula concerned revolutionary Mexico’s programme of agrarian reform, which redistributed property to landless peasants by expropriating US nationals under its 1917 constitution.<sup>88</sup> Both compensation principles were thus formulated in interwar disputes over fertilizer and farmland as vital resources to produce dietary energy. But the year was 1938: Mexico had just announced the nationalization of its petroleum industry, signalling the ascent of fossil fuels and a shift towards the modern problematics of energy law.

<sup>79</sup> The patents are identified in Alexander Ferguson, ‘A Reply to: *Chorzów Factory* – Intellectual Property and the Continuity of International Law in Investor-State Dispute Settlement’ (2021) 11 *Queen Mary Journal of Intellectual Property* 505, 506–08.

<sup>80</sup> Convention Between Germany and Poland Relating to Upper Silesia, adopted 15 May 1922, in force 3 June 1922, 99 LNTS 465 [Geneva Convention].

<sup>81</sup> Art 6 and 9.1.3.

<sup>82</sup> Art 9.3.2 and 12.

<sup>83</sup> *Certain German Interests in Polish Upper Silesia (Germany v Poland)* (Merits) PCIJ Series A No. 7.

<sup>84</sup> *Factory at Chorzów (Germany v Poland)* (Merits) PCIJ Series A No. 17, 47. Cf. Steven R Ratner, ‘Compensation for Expropriations in a World of Investment Treaties: Beyond the Lawful/Unlawful Distinction’ (2017) 111 *American Journal of International Law* 7.

<sup>85</sup> Oliver Hailes, ‘Valuation of Compensation in Fossil Fuel Phase-Out Disputes’ in Anja Ipp and Annette Magnusson (eds), *Investment Arbitration and Climate Change* (Kluwer Law International, Alphen aan den Rijn 2024), chap 6; *Certain Activities Carried Out by Nicaragua in the Border Area (Costa Rica v Nicaragua)* [2018] ICJ Reports 15 paras 29–35, 41–43.

<sup>86</sup> ‘Mexico—United States: Expropriation by Mexico of Agrarian Properties Owned by American Citizens’ (1938) 32 AJIL Supplement 181, 182–83.

<sup>87</sup> Johanne M Cox, *Expropriation in Investment Treaty Arbitration* (Oxford University Press, Oxford 2019), paras 12.02–12.15.

<sup>88</sup> Lorenzo Cotula, ‘The New Enclosures? Polanyi, International Investment Law and the Global Land Rush’ (2013) 34 *Third World Quarterly* 1605, 1613.

## NORMATIVE EVOLUTION THROUGH THE FERTILIZER TRADE

We have seen how distributive conflict over access to fertilizer resources triggered many episodes of international dispute settlement that provide an overlooked backcloth to the modern allocation of entitlements over energy among States and commercial actors, also prefiguring the settlement of investor–State disputes by arbitration. Yet, the fertilizer trade also informed a spatial expansion of entitlements under the law of the sea (Offshore resource entitlements section) and a functional shift from merely enabling energy transactions towards regulating their negative externalities (Local regulation of global externalities section). I end this section by recalling the dispossession of colonized peoples endowed with phosphate rock (Rights of peoples over natural resources section), underlining the importance of integrating the rights of collective subjects and individual humans, not just States and corporations, in the international organization of energy transactions affecting food production.

### Offshore resource entitlements

The guano industry cast a long shadow on the law of the sea, providing a precedent of transboundary cooperation and informing debates regarding the assertion of jurisdiction over resources in a State's continental shelf and exclusive economic zone (EEZ).<sup>89</sup> An 1866 boundary treaty between Bolivia and Chile created a special economic zone, in modern parlance, wherein the parties shared the proceeds of guano exploitation, with the regulation and taxation of exports to be mutually agreed and then collected by a single customs house.<sup>90</sup> In the *North Sea Continental Shelf*, Judge Jessup recalled this treaty as his earliest example of 'international cooperation in the exploitation of a natural resource',<sup>91</sup> which preceded the use of joint development agreements in the offshore oil and gas sector by nearly a century.<sup>92</sup> Although US president Truman's 1945 proclamation of jurisdiction over the continental shelf was justified by a 'world-wide need for new sources of petroleum',<sup>93</sup> its unilateral character was compared by jurists to the Guano Islands Act.<sup>94</sup> Waldock deemed it inconsistent to have wrested the guano resources of unoccupied islands from coastal States by denying their title of contiguity, only later to claim the resources of the seabed by relying on such a title.<sup>95</sup> In 1947, moreover, Peru's declaration of an EEZ emphasized 'food production' and specifically 'the value of the fertilizer left by the guano birds on islands', which required 'for its safeguard the protection, maintenance and establishment of a control of the fisheries which serve to nourish these birds'.<sup>96</sup> These examples illustrate how entitlements to undertake energy activities in the continental shelf and EEZ were forged against the backdrop of earlier practice regarding access to fertilizer resources.

### Local regulation of global externalities

The guano industry's demise in the 1960s is attributed to a collapse in the cormorant population caused by extreme El Niño years and commercial overfishing, driven by Peru's support for fishmeal exports to high-income countries as livestock feed.<sup>97</sup> The fishmeal industry thereby mirrored the Victorian era of 'high farming' until the 1870s, wherein guano was mostly used to

<sup>89</sup> On salient differences between territorial sovereignty and sovereign rights under the UN Convention on the Law of the Sea (UNCLOS), see Viñuales (n 8) 45–48.

<sup>90</sup> Art 2–3 and 5 of *Treatado de límites entre la República de Chile i la de Bolivia*, adopted 10 August 1866, in force 9 December 1866.

<sup>91</sup> *North Sea Continental Shelf* (Separate Opinion of Judge Jessup) [1969] ICJ Reports 67, 82–83.

<sup>92</sup> Viñuales (n 8) chap 4.

<sup>93</sup> *Laws and Regulations on the Regime of the High Seas* (vol. 1, United Nations, New York, NY 1951) 38.

<sup>94</sup> Richard Young, 'Recent Developments with Respect to the Continental Shelf' (1948) 42 *American Journal of International Law* 849, 850.

<sup>95</sup> CHM Waldock, 'The Legal Basis of Claims to the Continental Shelf' (1950) 36 *Transactions of the Grotius Society* 115, 120–21.

<sup>96</sup> *Laws and Regulations on the Regime of the High Seas* (n 93) 16.

<sup>97</sup> Cushman (n 29) chap 9.

fertilize root crops as cattle feed for luxury consumption rather than agricultural staples.<sup>98</sup> This era was followed by British dependence on colonial grain imports, notwithstanding the mass starvation of Indian subjects.<sup>99</sup> The 19th-century trades in fertilizer and food have thus been described as ‘ecologically unequal exchange’ of energy resources, manifesting in labour exploitation and environmental degradation.<sup>100</sup> The negative externalities of the modern energy industry are somewhat mitigated by human rights and environmental obligations, which matured in the latter half of the 20th century.<sup>101</sup> Yet, the guano industry also triggered an early episode of international law addressing such externalities, albeit by presuming the competence of States to regulate deleterious activities.

Demand for Peruvian guano drove the transpacific passage of indentured labourers, viewed by many as tantamount to slavery or piracy.<sup>102</sup> In 1872, the *María Luz* docked in Yokohama en route from Macao to Callao, where the Japanese authorities were alerted by the British consulate to the vessel’s abused passengers. Several Chinese labourers refused to reboard the vessel to perform their contracts, so the ship’s master launched an unsuccessful civil suit for specific performance or damages. The Peruvian government took up the master’s claim, quick to remind Japan that ‘Peru alone exports in very great quantities that indispensable article for the improvement of lands, and here so necessary, the guano’.<sup>103</sup> The dispute was submitted to arbitration before the Russian tsar, who affirmed that Japan had ‘acted in good faith in virtue of her own laws and customs, without infringing the general prescriptions of the law of nations, or the stipulations of particular treaties’.<sup>104</sup> The presumption of Japan’s exclusive jurisdiction, in the absence of a treaty granting extraterritorial privileges to Peruvian subjects, was consistent with concurrent practice: Peru’s right to regulate its nitrate trade was no ground for diplomatic protection, whereas Bolivia’s seizure of Antofagasta’s assets contravened treaty commitments and thus warranted intervention. The *María Luz* incident is also recognized as a steppingstone towards universal human rights, the principle of sovereign equality, and the premise that public policy may override private contracts in international arbitration.<sup>105</sup>

### Rights of peoples over natural resources

Whilst the high point of fertilizer disputes preceded the prohibition on the use of force, it is important to note the relative autonomy of Latin American States in governing the guano and nitrate trades compared to colonized peoples endowed with rock containing phosphorus pentoxide (P<sub>2</sub>O<sub>5</sub>). Major sources included French North Africa and two Pacific Islands, Nauru and Banaba, which left several impressions on the law of self-determination.

In 1920, the French protectorate of Morocco established the Office Chérifien des Phosphates (OCP) as a State monopoly, abandoning its open door policy towards foreign participation in phosphate mining.<sup>106</sup> Along with deposits in Algeria and Tunisia, the distribution of Moroccan

<sup>98</sup> *ibid* 47–48.

<sup>99</sup> Mike Davis, *Late Victorian Holocausts: El Niño Famines and the Making of the Third World* (Verso, London 2000).

<sup>100</sup> Clark and Foster (n 53) 313.

<sup>101</sup> Viñuales (n 8) chap 3. My framing of food as energy underscores how international law enables energy transactions that have disrupted not only the carbon cycle but also the nitrogen and phosphorus cycles: Johan Rockström and others, ‘Safe and Just Earth System Boundaries’ (2023) 619 *Nature* 102, 107–08.

<sup>102</sup> Ginevra Le Moli, ‘“Parity with All Nations”: The “Coolie” Trade and the Quest for Recognition by China and Japan’ (2021) 34 *Leiden Journal of International Law* 879, 887–90.

<sup>103</sup> ‘No. 259: Mr De Long to Mr Fish’ in *Papers Relating to the Foreign Relations of the United States* (vol. 1, Government Printing Office, Washington DC 1873) 586, 602, 587 (Inclosure 1: Minister of Peru to Minister of Foreign Affairs).

<sup>104</sup> *Japan and Peru: Case of the ‘Maria Luz’*, Ad hoc, Award (29 May 1875) in John Bassett Moore, *History and Digest of the International Arbitrations to which the United States Has Been a Party* (vol. 5, Government Printing Office, Washington DC 1898) 5034, 5035.

<sup>105</sup> Pierre Lalive, ‘Ordre Public Transnational (ou Réellement International) et Arbitrage International’ (1986) 3 *Revue de L’Arbitrage* 329, 335–36.

<sup>106</sup> This shift is narrated in *Phosphates in Morocco (Italy v France)* (Preliminary Objections) (Judgment) PCIJ Series A/B No. 74.



phosphates was determined by colonial officials, being traded for British coal and Italian labour whilst providing fertilizer to French farmers at submarket prices.<sup>107</sup> Upon independence in 1956, Morocco assumed control of OCP, which remains the world's largest producer of phosphate fertilizers. In 1976, OCP acquired a majority stake in Phosboucrac SA, formerly a State-owned mining company in the colony of Spanish Sahara. The UN renamed this colony the non-self-governing territory of Western Sahara, subject to the right of the colonized people to self-determination since the ICJ found no historical ties of territorial sovereignty with Morocco or Mauritania.<sup>108</sup> Western Sahara is nevertheless occupied by Morocco, such that OCP's exports are allegedly breaching the self-determination of the Sahrawi people and their permanent sovereignty over natural resources (PSNR).<sup>109</sup> As Judge Weeramantry explained in *East Timor*, the principle of PSNR protects the resources of non-self-governing peoples until they achieve self-determination.<sup>110</sup>

Another alleged breach of PSNR was one of the several causes of action in *Certain Phosphate Lands*, wherein Nauru sought the environmental rehabilitation of lands that were strip-mined prior to independence in 1968.<sup>111</sup> Alongside Banaba and Christmas Island, Nauru had been administered by the British Phosphate Commission (BPC) since 1919, entrusting the resource to British, Australian, and New Zealand commissioners for the benefit of the islanders. Yet, the commissioners exploited their tripartite monopoly to deliver cost-price phosphate to their home agricultural sectors amid soaring interwar food prices.<sup>112</sup> Whilst Nauru settled its ICJ case against Australia, Banabans had been relocated by the BPC to Fiji in 1945 and their island became part of Kiribati,<sup>113</sup> forcing them to litigate their claims (without success) before the English courts.<sup>114</sup> This disparity underscores the international litigation opportunities entailed by sovereign equality, as compared to peoples who never obtained postcolonial statehood as a vehicle for their sovereignty over natural resources. However, the phosphate industry had earlier informed the drafting of common Article 1(2) of the international human rights covenants, which reaffirms the free disposal of 'natural wealth and resources' as an expression of self-determination and provides that '[i]n no case may a people be deprived of its own means of subsistence.'<sup>115</sup> Only two examples regarding this subsistence proviso were discussed in the travaux préparatoires: forced resettlement from ancestral lands in Tanzania and the case of Nauru, where 'the only source of national wealth, phosphates, was being unwisely over-exploited by a British company'.<sup>116</sup> In this light, the proviso protects the subsistence of peoples from deleterious disposal of their endowment, which includes any resources or wealth that provides means of producing or otherwise obtaining food.<sup>117</sup>

<sup>107</sup> Rebecca Gruskin, 'The Value Within Multiform Commodities: North African Phosphates and Global Markets in the Interwar Period' (2021) 16 *Journal of Global History* 315.

<sup>108</sup> *Western Sahara* (Advisory Opinion) [1975] ICJ Reports 12.

<sup>109</sup> For creative litigation in domestic and regional courts, see *Mohamed v Guardians of NZ Superannuation* [2021] NZHC 512; Jed Odermatt, 'International Law as Challenge to EU Acts: *Front Polisario II*' (2023) 60 *Common Market Law Review* 217.

<sup>110</sup> *East Timor (Portugal v Australia)* (Dissenting Opinion of Judge Weeramantry) [1995] ICJ Reports 139 [Weeramantry], 197–99.

<sup>111</sup> *Certain Phosphate Lands in Nauru (Nauru v Australia)* (Preliminary Objections) (Judgment) [1992] ICJ Reports 240.

<sup>112</sup> Cait Storr, *International Status in the Shadow of Empire: Nauru and the Histories of International Law* (Cambridge University Press, Cambridge 2020), chap 4.

<sup>113</sup> Katerina Martina Teaiwa, *Consuming Ocean Island: Stories of People and Phosphate from Banaba* (Indiana University Press, Bloomington 2015).

<sup>114</sup> *Tito v Waddell (No. 2)* [1977] Ch 106 (concluding that the Crown's undertaking to hold royalties 'in trust' for the Banaban community gave rise to a non-justiciable governmental obligation rather than a fiduciary duty).

<sup>115</sup> International Covenant on Civil and Political Rights, adopted 16 December 1966, in force 23 March 1976, 999 UNTS 171 [ICCPR]; International Covenant on Economic, Social and Cultural Rights, adopted 16 December 1966, in force 3 January 1976, 993 UNTS 3 [ICESCR].

<sup>116</sup> UNGA 10th Session, 3rd Committee, 674th Meeting (28 November 1955) UN Doc A/C.3/SR.674 para 8 (Urquia).

<sup>117</sup> Philip Alston, 'International Law and the Human Right to Food' in Katarina Tomaševski and Philip Alston (eds), *The Right to Food* (Martinus Nijhoff, Leiden 1984) 9, 67, 23–24; Ben Saul and others, *The International Covenant on Economic, Social and Cultural Rights: Commentary, Cases, and Materials* (Oxford University Press, Oxford 2014), 116–21.

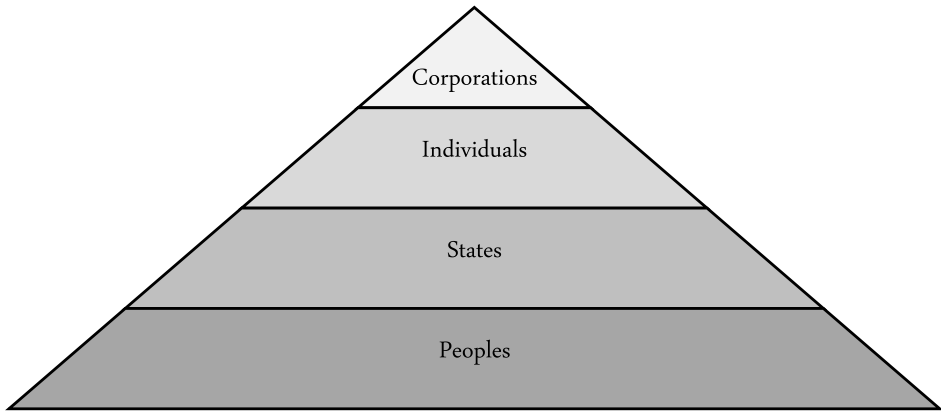


Figure 1. *De jure* hierarchy of entitlements.

### STRATIFIED ENTITLEMENTS IN THE ENERGY TRANSITION

I have emphasized the roles played by international law in allocating entitlements over fertilizer resources, whether secured by coercive or peaceful dispute settlement, which prefigured the organization of the modern energy industry. The global adoption of the Haber–Bosch process, driven by the Green Revolution, embedded the production of dietary energy in the fossil economy, manifesting in today’s conflict among European fuel consumers and developing countries that depend on fertilizers to meet nutritional needs. This transition towards fossil-fuelled food is difficult to isolate from economic regulation, itself shaped by post-war international law. For example, the first report adopted by the contracting parties to the General Agreement on Tariffs and Trade found no breach in Chile’s complaint that Australia was subsidizing synthetic fertilizers to the ‘competitive inequality’ of mineral nitrate and affirmed Australia’s ‘policy of stabilizing the cost of production of certain crops.’<sup>118</sup> As discussed, international law has since recognized the principle of PSNR as an economic expression of the right of peoples to self-determination, undergirding the rights of States freely to dispose of natural resources and to regulate economic activities,<sup>119</sup> whilst human rights protect against the negative externalities of energy transactions and investment treaties constrain the arbitrary exercise of governmental authority.<sup>120</sup> This normative hierarchy is simplified in Fig. 1, wherein the entitlements of peoples are located at the base and those of individuals and corporations impose limits on the presumptive rights of States (with human rights understood as weightier constraints than investment treaties).<sup>121</sup>

As in the age of guano, however, international dispute settlement surrounding the Ukraine war has been driven by States and corporations, although the underlying transactions may have profound implications for food security.<sup>122</sup> The energy transition does not promise any escape from such asymmetries without strategically strengthening other subjects’ entitlements

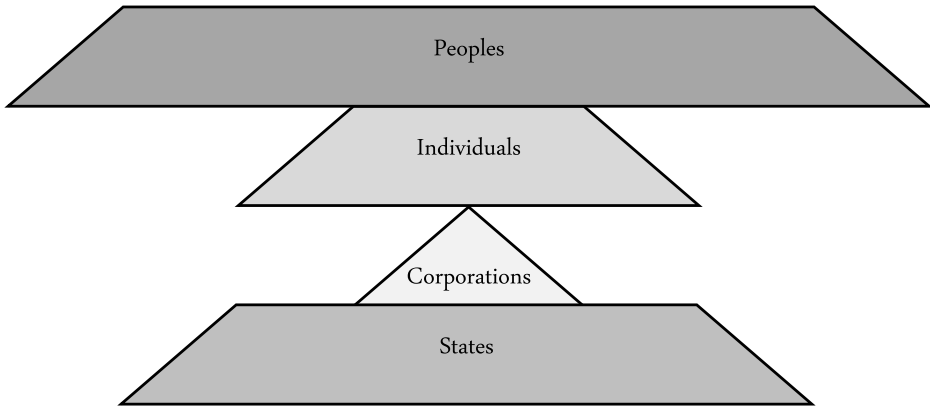
<sup>118</sup> Working Party Report, *Australian Subsidy on Ammonium Sulphate*, GATT/CP.4/39, adopted 3 April 1950, BISD II/188.

<sup>119</sup> Georges Abi-Saab, ‘Permanent Sovereignty over Natural Resources and Economic Activities’ in Mohammed Bedjaoui (ed), *International Law: Achievements and Prospects* (UNESCO, Paris 1991), chap 27. See further Danae Azaria, ‘Community Interest Obligations in International Energy Law’ in Eyal Benvenisti and Georg Nolte (eds), *Community Interest Obligations Across International Law* (Oxford University Press, Oxford 2018), chap 15.

<sup>120</sup> Viñuales (n 8) chaps 2 and 3.

<sup>121</sup> Cf. Ginevra Le Moli, ‘Beyond Externalities: Human Rights as a Foundation of Entitlements over Energy Resources’ (2023) 26 *Journal of International Economic Law* DOI: 10.1093/jiel/jgad031.

<sup>122</sup> For example, WTO Appellate Body Report, *Ukraine—Anti-Dumping Measures on Ammonium Nitrate (Ukraine—Ammonium Nitrate (Russia))*, WT/DS493/AB/R, adopted 30 September 2019; *NJSC Naftogaz of Ukraine and others v Russian Federation*, PCA Case No. 2017–16, Final Award (12 April 2023).



**Figure 2.** *De facto* hierarchy of entitlements.

in anticipation of future disputes. In this section, I focus on a shift towards green hydrogen (produced from electrolysis powered by renewable energy) as low-carbon fuel to replace oil, coal, or gas in energy storage, long-distance transportation, and hard-to-abate industrial processes such as steel production (From gas to green hydrogen? section). Because these industries would be competing for hydrogen against the fertilizer sector, I sketch the entitlements of four subjects and their possible implications for food security: peoples and other collective subjects (Food sovereignty section), individual humans (Right to food section), corporations (Investment protection section), and States (Economic regulation section). A more accurate hierarchy of entitlements over energy resources is represented in Fig. 2, reflecting the *de facto* dominance of States and the unique access of foreign investors to arbitral remedies. Nevertheless, this house of cards is undergoing several developments towards a more stable pyramid of entitlements, including the regional strengthening of the rights of collective subjects in support of food sovereignty. Amid a capital-intensive transition away from fossil fuels, however, a more promising nexus for food security in the energy transition should be strengthened between economic regulation and the right to food in harnessing private investment.

### From gas to green hydrogen?

Hydrogen is mainly used to produce ammonia, around 70% of which is used for fertilizer. In 2021, green hydrogen represented 1 per cent of the market, with production costs (>\$4/kg) being approximately four times those of grey hydrogen from steam methane reforming.<sup>123</sup> Yet, reputable pathways towards net zero emissions require the combined production of green and blue hydrogen (produced from gas with carbon capture) to increase from 1 MT in 2021 to 100 MT by 2030.<sup>124</sup> The US has accordingly introduced a tax credit of up to \$3/kg, depending on carbon intensity.<sup>125</sup> Many developing countries with high potential for low-cost renewable energy also seek to attract investment.<sup>126</sup> For example, Namibia's Environmental Investment

<sup>123</sup> *Global Hydrogen Review 2022* (International Energy Agency, 2022), 93.

<sup>124</sup> *ibid* 5–6.

<sup>125</sup> s 13204 of Inflation Reduction Act, 136 Stat 1818 (2022).

<sup>126</sup> Joseph Cordonnier and Deger Saygin, 'Green Hydrogen Opportunities for Emerging and Developing Economies: Identifying Success Factors for Market Development and Building Enabling Conditions' (OECD Environment Working Papers No. 205, 4 November 2022).

Fund has partnered with Dutch development organizations and concessional lenders to mobilize private capital.<sup>127</sup> A switch to locally produced green ammonia could reduce developing countries' reliance on fuel or fertilizer imports and help to decarbonize food production. However, such projects are largely export-oriented, so industrialized countries may produce high value-added goods with low emissions.

A transition towards hydrogen is therefore bound to create new sites of distributive conflict among food and fuel consumers, prefigured by a long history of international disputes over access to resources to produce dietary energy. Yet, the dependence of fertilizer and food production on ammonia supply is routinely ignored in a burgeoning literature on hydrogen geopolitics.<sup>128</sup> Adding fire to the fuel, 'synchronized crop failures due to simultaneous weather extremes across multiple breadbasket regions pose a risk to global food security', with 'disproportional impacts for import-dependent regions'.<sup>129</sup> So, which entitlements over energy resources could enhance food security at this critical juncture? A comprehensive map goes beyond this article, but the contours may be identified by reference to food sovereignty, the right to food, investment protection, and economic regulation, corresponding to entitlements of peoples, individuals, corporations, and States.

### Food sovereignty

The movement for food sovereignty seeks to decentre the rights of States,<sup>130</sup> focusing instead on the rights of collective subjects (peasants, Indigenous peoples) 'to determine their own food and agriculture systems', 'to participate in decision-making processes on food and agriculture policy', and 'to healthy and adequate food produced through ecologically sound and sustainable methods that respect their cultures'.<sup>131</sup> The movement finds its juridical roots in the right of peoples not to be deprived of the means of their subsistence, linked above to the dispossession of Nauruan phosphate. However, the Human Rights Council (HRC) has long been reluctant either to (i) recognize Article 1 of the International Covenant on Civil and Political Rights (ICCPR) as a justiciable right under its procedure of individual communications or (ii) decide whether collective subjects, such as First Nations in North America, even constitute a people under international law.<sup>132</sup> On both counts, the African and Inter-American human rights systems are more advanced.<sup>133</sup> In a case concerning the Ogiek community, whom the Kenyan government evicted from the Mau Forest, the African Court on Human and Peoples' Rights interpreted the right of peoples to 'freely dispose of their wealth and natural resources' as protecting their use and enjoyment of 'the abundance of food produced by their ancestral lands'.<sup>134</sup> Although the Ogiek were not a people in the sense required by the general law of self-determination, the applicable right was enjoyed by 'ethnic groups and communities that constitute the population of a State'.<sup>135</sup>

<sup>127</sup> Daniela Gabor and Ndongo Samba Sylla, 'Derisking Developmentalism: A Tale of Green Hydrogen' (2023) 54 *Development and Change* 1169.

<sup>128</sup> Thijs Van de Graaf and others, 'The New Oil? The Geopolitics and International Governance of Hydrogen' (2020) 70 *Energy Research & Social Science* 101667.

<sup>129</sup> Kai Kornhuber and others, 'Risks of Synchronized Low Yields are Underestimated in Climate and Crop Model Projections' (2023) 14 *Nature Communications* 3528.

<sup>130</sup> Michael Fakhri, 'Third World Sovereignty, Indigenous Sovereignty, and Food Sovereignty: Living with Sovereignty Despite the Map' (2018) 9 *Transnational Legal Theory* 218, 239–50.

<sup>131</sup> Art 15(4) of United Nations Declaration on the Rights of Peasants and Other People Working in Rural Areas (17 December 2018) UN Doc A/RES/73/165.

<sup>132</sup> *Chief Bernard Ominayak and Lubicon Lake Band v Canada*, HRC Communication No. 167/1984 (26 March 1990) para 32.1. Cf. Le Moli, 'Beyond Externalities' (n 121) (noting how the HRC has recharacterized communications under Art 1 of ICCPR as relating to the justiciable right of minorities to enjoy their own culture under Art 27); Saul and others (n 117) 22–25 (comparing ICESCR).

<sup>133</sup> Margot Salomon, 'Emancipating Human Rights: Capitalism and the Common Good' (2023) 36 *Leiden Journal of International Law* 857, 870–73.

<sup>134</sup> *African Commission on Human and Peoples' Rights v Republic of Kenya*, ACHPR, Application No. 006/2012, Judgment of 26 May 2017 paras 200–201.

<sup>135</sup> *ibid* paras 195–199.

Alongside financial reparation, the Court ordered Kenya to grant collective title over ancestral lands and to establish a fund to support ‘food security, natural resource management and any other causes beneficial to the well-being of the Ogiek’.<sup>136</sup> In *Sawhoyamaxa*, moreover, the Inter-American Court of Human Rights suggested that Paraguay may be obliged even to expropriate investors to make land restitution to Indigenous peoples.<sup>137</sup>

Such decisions signal a judicial reorganization of the *de facto* hierarchy of entitlements over natural resources (Fig. 2) towards the normative hierarchy contemplated by post-war international law (Fig. 1), giving procedural teeth to the rights of collective subjects and supporting the bottom-up movement for food sovereignty. Yet, there are at least two material limits on the movement’s potential in securing access to resources for food production amid the energy transition. First, whether any entitlement of collective subjects must inform a State’s disposal of renewable resources that could be used in green hydrogen production without ‘permanent deprivation’, such as wind or solar radiation, remains an open question.<sup>138</sup> The consultation of Indigenous peoples before conducting energy projects is nevertheless mandated under several instruments, which may provide a framework for securing demands against both States and corporations.<sup>139</sup> Second, as a radical response to the model of corporate control that motored the Green Revolution, the food sovereignty movement is focused on local control, albeit knitted together by solidarity networks.<sup>140</sup> As it stands, however, less than a third of the world’s population could satisfy their demand through locally sourced staple crops.<sup>141</sup> The rights of collective subjects thus have limited utility in securing food for urban masses in their dependence on industrial agriculture and world trade.<sup>142</sup>

### Right to food

The rights to ‘adequate food’ and ‘to be free from hunger’ are components of the human right to an adequate standard of living.<sup>143</sup> The Committee on Economic, Social and Cultural Rights has long recommended that States adopt national strategies to address ‘critical issues and measures in regard to all aspects of the food system’ and ‘take appropriate steps to ensure that activities of the private business sector and civil society are in conformity with the right to food’.<sup>144</sup> The principal obligation of States is ‘to achieve progressively the full realization’ of ‘physical and economic access at all times to adequate food or means for its procurement’, imposing an obligation ‘to move as expeditiously as possible towards that goal’.<sup>145</sup> The Committee also recognized that States should ‘ensure coordination between ministries and regional and local authorities in order to reconcile related policies (economics, agriculture, environment, energy, etc.) with the obligations under article 11 of the Covenant’.<sup>146</sup> There is strong evidence that rights-based domestic policies positively influence food security.<sup>147</sup>

<sup>136</sup> *African Commission on Human and Peoples’ Rights v Republic of Kenya*, ACtHPR, Application No. 006/2012, Judgment (Reparations) of 23 June 2022 paras 155, 160.

<sup>137</sup> *Case of the Sawhoyamaxa Indigenous Community v Paraguay*, IACtHR, Judgment of 29 March 2006 (Merits, Reparations and Costs) paras 135–140.

<sup>138</sup> Weeramantry (n 110) 199.

<sup>139</sup> Art 15 of Convention (No 169) Concerning Indigenous and Tribal Peoples in Independent Countries, adopted 27 June 1989, in force 5 September 1991, 1650 UNTS 383; Art 32 of United Nations Declaration on the Rights of Indigenous Peoples (2 October 2007) UN Doc A/RES/61/295.

<sup>140</sup> Cf. Interim Report (n 5) paras 96–100 (calling for ‘multilateralism anchored in food sovereignty’).

<sup>141</sup> Pekka Kinnunen and others, ‘Local Food Crop Production Can Fulfil Demand for Less Than One-Third of the Population’ (2020) 1 *Nature Food* 229.

<sup>142</sup> George Monbiot, *Regenesis: Feeding the World Without Devouring the Planet* (Allen Lane, London 2022), 143–46.

<sup>143</sup> Art 11 of ICESCR.

<sup>144</sup> Committee on Economic, Social and Cultural Rights, General Comment No. 12: The Right to Adequate Food (Art 11) (12 May 1999) UN Doc E/C.12/1999/5, paras 21–28.

<sup>145</sup> *ibid* paras 6–20.

<sup>146</sup> Committee on Economic, Social and Cultural Rights, General Comment No. 4: The Right to Adequate Housing (Art 11 (1) of the Covenant) (13 December 1991) UN Doc E/1992/23, para 12.

<sup>147</sup> Devon Sampson and others, ‘Food Sovereignty and Rights-Based Approaches Strengthen Food Security and Nutrition Across the Globe: A Systematic Review’ (2021) 5 *Frontiers in Sustainable Food Systems* 686492.



However, a global food crisis in 2008 (attributed to oil prices, biofuel demand, and land speculation) led to greater focus on how the right to food may be realized at the international level.<sup>148</sup> According to the current UN Special Rapporteur on the Right to Food, States must not only ‘respond to the food crisis with national plans’ but also ‘develop an international coordinated response’ (with the Committee on World Food Security providing the ‘most inclusive platform’) and ‘transform their food systems to make them more resilient to climate change and prevent biodiversity loss’ (by shifting from ‘industrial agriculture towards agroecology’).<sup>149</sup> In the Rapporteur’s view, ‘structural constraints’ arise from ‘corporate-dominated food systems’, observing that dependence on food and fertilizer imports has generated high levels of debt whilst ‘investment law has long privileged foreign investor interests over human rights.’<sup>150</sup> Shortly, I suggest that public incentives for private investment may be coupled with regulatory requirements that secure access to green hydrogen for food production. Yet, investment protection itself could have salutary side effects.

### Investment protection

Prefigured by guano claims before mixed commissions, the pursuit of compensation through investment treaty arbitration (according to the *Chorzów* principle of full reparation or the Hull formula of prompt, adequate, and effective payment) may discipline governmental measures that undermine access to energy resources, including measures that purport to secure food. Several claims were brought against Venezuela following its nationalization or arbitrary treatment of fertilizer plants,<sup>151</sup> farmland,<sup>152</sup> and flour mills,<sup>153</sup> implementing its 2008 legislation on food security.<sup>154</sup> Although these tribunals deferred to the respondent’s ‘policies on food security and domestic food production for the people of Venezuela,’<sup>155</sup> the tribunal in *Vestey* found it difficult to discern any nexus between the avowed purpose and the decision to expropriate a highly productive farm that was already selling at regulated prices to the domestic market.<sup>156</sup> The ongoing case of *Odyssey v Mexico*, moreover, illustrates a tension with both local subsistence and environmental protection: whilst the claimant framed its plans to mine seabed phosphate as a boon for food security, the respondent denied the necessary permits due to the impact on fishing activities and marine ecosystems.<sup>157</sup> Investment treaty arbitration may nevertheless provide a bulwark for food security by ensuring that a host State does not unreasonably abolish the regulatory and fiscal incentives emerging for green hydrogen and ammonia production, akin to the case law on subsidized renewable energy,<sup>158</sup> whilst allowing States to regulate prices in times of crisis.<sup>159</sup> In

<sup>148</sup> ‘Report of the Special Rapporteur on the Right to Food, Olivier De Schutter: Crisis into Opportunity: Reinforcing Multilateralism’ (21 July 2009) UN Doc A/HRC/12/31.

<sup>149</sup> Interim Report (n 5) 101–11.

<sup>150</sup> *ibid* 59–65.

<sup>151</sup> *Gambrinus, Corp. v Bolivarian Republic of Venezuela*, ICSID Case No. ARB/11/31, Award (15 June 2015) (declining jurisdiction); *Koch Minerals Sàrl and Koch Nitrogen International Sàrl v Bolivarian Republic of Venezuela*, ICSID Case No. ARB/11/19, Award (30 October 2017) (awarding over \$300 million).

<sup>152</sup> *Vestey Group Ltd v Bolivarian Republic of Venezuela*, ICSID Case No. ARB/06/4, Award (15 April 2016) (awarding \$98 million).

<sup>153</sup> *Valores Mundiales, S.L. and Consorcio Andino S.L. v Bolivarian Republic of Venezuela*, ICSID Case No. ARB/13/11, Award (25 July 2017) (awarding \$430 million).

<sup>154</sup> Decreto Ley No. 6.071/08: Ley Orgánica de Seguridad y Soberanía Agroalimentaria.

<sup>155</sup> *Koch* (n 151) para 7.17.

<sup>156</sup> *Vestey* (n 152) paras 293–300.

<sup>157</sup> *Odyssey Marine Exploration, Inc. v United Mexican States*, ICSID Case No. UNCT/20/1, Claimant’s Memorial (4 September 2020) paras 25–38. Cf. *AsiaPhos Limited and Norwest Chemicals Pte Ltd v People’s Republic of China*, ICSID Case No. ADM/21/1, Award (16 February 2023) paras 25–34 (prohibition of phosphate mining near a panda conservation park).

<sup>158</sup> Cf. *Kruck and others v Kingdom of Spain*, ICSID Case No. ARB/15/23, Partial Dissenting Opinion, Prof. Zachary Douglas KC (13 September 2022) paras 47–53.

<sup>159</sup> Anatole Boute, ‘Energy Justice in Times of Crisis: Protection of Consumers and Market-Based Renewable Energy Investments’ (2023) 26 *Journal of International Economic Law* DOI: 10.1093/jiel/jgad030.

the event of breach, the right of peoples not to be deprived of their means of subsistence may impose a limit on compensation awards.<sup>160</sup>

### Economic regulation

A State's right of reasonable regulation under customary international law (wherein the negative impact is not 'manifestly excessive'<sup>161</sup>) does not include any obligation to pay compensation, making it a flexible vehicle for incentivizing investment, maintaining access to fertilizer resources, and mitigating negative externalities of food production. Following Russia's invasion of Ukraine, however, many WTO members resorted to restrictions on fertilizer and food exports, which are prohibited unless 'temporarily applied to prevent or relieve critical shortages of foodstuffs or other products essential to the exporting contracting party.'<sup>162</sup> The history of fertilizer disputes underlined how ex-post measures, particularly those contrary to treaty commitments, may aggravate conflict over energy resources. Economists have recommended that States upgrade their *ex ante* capacity to monitor 'systematically significant prices', including food, utilities, and chemical products such as fertilizer, to implement a range of stabilization measures before crises manifest.<sup>163</sup> Demand-side targets have also been adopted by the EU, aiming for a 20% reduction in fertilizer use by 2030 as part of the European Green Deal,<sup>164</sup> whilst a proposed directive on soil fertility would safeguard food security alongside climate and biodiversity goals.<sup>165</sup>

Such regulations may prevent opportunistic price hikes or reduce import dependence. But they would not secure access to green ammonia as a fertilizer feedstock in the face of demand for industrial heat and transportation fuel. However, the trend of public incentives for private investment in export-oriented hydrogen projects may present an opportunity for developing countries to secure fertilizer inputs and thereby reduce their vulnerability to volatile commodity prices. By analogy, Indonesia has long required coal exporters to sell a percentage of output to the price-controlled domestic market, securing an affordable supply for electricity production.<sup>166</sup> These requirements are typically prohibited as quantitative restrictions under WTO law or performance requirements under investment treaties.<sup>167</sup> However, Chile's development agency also includes domestic sales requirements in its contracts with lithium producers to support local industry in scaling the value chain, carving out these non-conforming measures from the scope of its trade and investment obligations.<sup>168</sup> This offers an example of what de Lacharrière called foreign legal policy, whereby States strategically secure their geopolitical and economic interests through international law and organization.<sup>169</sup> Such policies have long been pursued collectively by both producers (e.g. OPEC) and consumers (e.g. Nitrate of Soda Executive) to secure either high prices or low-cost resources. Yet, unlike the historical organization of food systems based

<sup>160</sup> *Final Award, Eritrea's Damages Claims*, 2000 Eritrea-Ethiopia Claims Commission, Decision of 17 August 2009, 26 RIAA 505 paras 19–22. See further Martins Paparinskis, 'Crippling Compensation in the International Law Commission and Investor-State Arbitration' (2022) 37 ICSID Review 289.

<sup>161</sup> *Certain Iranian Assets (Iran v USA)* (Judgment) 2023 ICJ <<https://www.icj-cij.org/sites/default/files/case-related/164/164-20230330-JUD-01-00-EN.pdf>> (accessed 1 August 2023) [147]–[149], [185]–[187].

<sup>162</sup> Art XI:2(a) of General Agreement on Tariffs and Trade, adopted 15 April 1994, in force 1 January 1995 [GATT] 33 ILM 1153 (1994).

<sup>163</sup> Isabella M Weber and others, 'Inflation in Times of Overlapping Emergencies: Systemically Significant Prices from an Input-Output Perspective' (UMass Amherst Economics Department Working Paper Series, 340, 2022).

<sup>164</sup> European Commission, *Farm to Fork Strategy: For a Fair, Healthy and Environmentally-Friendly Food System* (EU, 2020), 9.

<sup>165</sup> Proposal for a Directive of the European Parliament and of the Council on Soil Monitoring and Resilience (Soil Monitoring Law) (5 July 2023) COM(2023) 416 final.

<sup>166</sup> Riza Noer Arfani and Poppy Sulistyaning Winanti, 'Value Chain Governance in Export Commodities: The Case of Indonesia' in Marion Jansen and others (eds), *Connecting to Global Markets: Challenges and Opportunities* (WTO Publication, Geneva 2014) 25–40, 29–30.

<sup>167</sup> Alexandre Genest, *Performance Requirement Prohibitions in International Investment Law* (Brill, Leiden 2019), chap 4.

<sup>168</sup> Oliver Hailes, 'Lithium in International Law: Trade, Investment, and the Pursuit of Supply Chain Justice' (2022) 25 Journal of International Economic Law 148, 157–59, 169–70.

<sup>169</sup> Guy de Lacharrière, *La politique juridique extérieure* (Economica, Paris 1983).

on guano or gas, the foreign legal policies of States in the energy transition must be informed by their obligations to peoples and individuals. A pillar of food security in the energy transition could be the obligation of States to fulfil the human right to adequate food, both individually and through international cooperation, in the *ex ante* regulation of renewable energy transactions that impact access to dietary energy, specifically by securing green hydrogen for low-carbon fertilizer production.

### CONCLUSION: BACK TO THE ATACAMA?

In approaching energy as a regulatory object of international law, I extended the category of end-use products to include food for human consumption, given the economic importance of dietary energy and the entangled agendas of energy and food security. The commonplace distinction between energy and food crises may thus be reframed as competing entitlements over resources (natural gas, green hydrogen) that can be converted into several products (food, fuel, heat, electricity) for the benefit of different actors. I focused on fertilizer disputes before the Second World War to highlight the neglected roles played by international law in securing resources for conversion into dietary energy. My argument, put at its highest, was that rules allocating entitlements over fossil fuels were inherited from this earlier generation of disputes over the taxation of nitrate exports, alien entitlements to guano discoveries, and the notorious confiscation of an Upper Silesian cyanamide factory. Many of these disputes between States and commercial actors prefigured the reliance of the modern energy industry on investment arbitration and retain currency in case law. Yet, the fertilizer trade also informed the development of offshore resource entitlements, the local regulation of global externalities, and the belated recognition of the rights of peoples affected by the phosphate industry. Despite this normative evolution, dispute settlement in the energy sector is still driven by States and commercial actors, although the underlying transactions may have profound implications for food security. Finally, I considered which entitlements of collective subjects, individuals, corporations, and States may enhance food security, in view of possible distributive conflict over green hydrogen as a dual-use industrial fuel and fertilizer feedstock. My endpoint was not to argue that domestic sales requirements or price controls would necessarily fulfil the human right to adequate food but to highlight how Chile, for example, has adopted a foreign legal policy in the lithium industry that reinforces its international entitlements amid the energy transition. Similar policies could be adopted in the nascent industry for green hydrogen. Indeed, Chile obtained the World Bank's first loan to accelerate green hydrogen projects from pilot to industrial scale, with expectations to become a top three exporter by 2030 and to 'strengthen food security by using green hydrogen to produce green ammonia, which can be used as an input for fertilizers'.<sup>170</sup> This foresight is unsurprising when we consider how the pendulum of international energy law has swung from fertilizer to fossils, perhaps back to the Atacama.

<sup>170</sup> World Bank, 'Chile to Accelerate its Green Hydrogen Industry with World Bank Support' (29 June 2023). A much larger loan to India was approved for a wider range of projects, also aligned with the Hydrogen for Development Partnership (H4D) initiative: World Bank, 'World Bank Approves \$1.5 Billion in Financing to Support India's Low-Carbon Transition' (29 June 2023).