NAFTA and environment after 25 years: A retrospective analysis of the US-Mexico border

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ABSTRACT

Twenty-five years after the North American Free Trade Agreement (NAFTA) came into force, what impact has it had on the US-Mexico border environment? This paper asks what lessons NAFTA offers to contemporary debates about trade and environmental governance through analysis of time series data and expert perceptions on the environment of the US-Mexico borderlands. In the early 1990s, scholars and activists argued that NAFTA would have mostly negative impacts on the US-Mexico border, creating water scarcity and increasing air, land and water pollution; degrading ecosystems; and causing health problems. The debate over NAFTA was part of the larger discussion on the environmental impacts of trade and globalization. In response to these concerns, several governance institutions were created to monitor the environment (the Commission for Environmental Cooperation) and to certify and fund improvements to environmental infrastructure along the US-Mexico border (the Border Environment Cooperation Commission and North American Development Bank). NAFTA was recently replaced with a new trade deal (the USMCA). In this paper we review trends in environmental conditions over the past 25 years, mostly on the Mexican side of the border where greater impacts were anticipated, through datasets, institutional reports and scholarly literature. We also present and discuss the results of semi-structured interviews and surveys with 49 experts (researchers, activists, government personnel, and other border institutional actors) to understand the varied legacy of NAFTA on the border environment at 25 years. Although missing data and challenges in attribution complicated our analysis, we found both positive and negative trends in environmental indicators and the literature.

1. Introduction

The North American Free Trade Agreement (NAFTA) came into force on 1 January 1994, with the goal of reducing trade barriers and increasing trade between Mexico, the United States and Canada. At the time, academics and activists raised concerns about the environmental impacts of free trade, especially along the US-Mexico border (Benton, 1996; Krugman, 1993; Mumme, 1993). Others saw NAFTA as a victory for neoliberalism in the Americas, with a pioneering side agreement to protect the environment (Clark, 1994; Fox, 1995). NAFTA’s negative environmental impacts have been employed to oppose almost every new proposal for free trade agreements since, including the Trans Pacific Partnership (TPP) and the renegotiation of NAFTA as the USMCA (United States Mexico Canada Agreement). Some have called NAFTA the greenest trade agreement ever (Deere and Esty, 2002); others see it as a disaster for North American environment and society (Roberts and Thanos, 2013; Sanchez, 2002; Sierra Club, 2014). The debates often use selective evidence and lack careful analysis of trends, research literature, and expert opinion. Can these diverging perspectives be resolved through a more systematic exploration of available data, literature and...
expert judgement on the environmental impacts of NAFTA? Understanding the environmental legacies of trade agreements and institutions can provide a basis for policy discussions and identify areas where governance and practices can be improved.

In this paper, we take a retrospective look at debates and evidence surrounding the environmental impacts of NAFTA on the US-Mexico border 25 years after it came into force. We focus on the Mexican side of the border across northern Mexico as this was the region anticipated to experience the greatest impact because of adjacency to the US, inadequate infrastructure, and the associated potential for rapid industrial and urban growth. Our methods include analysis of trends in available environmental indicators including ecosystem conservation and biodiversity, air quality and water pollution, as well as surveys and interviews with 49 experts about their perceptions of trends in environmental change and attribution of these trends to NAFTA. We also review literature and reports on the environmental impacts of NAFTA and its environmental institutions.

We find a lack of systematic and local level data on environmental conditions over the last 25 years, with available data showing some improvements in water access and air pollution but mixed results on conservation and waste management. We find evidence that growth in mining and agricultural exports with links to NAFTA have caused serious regional water resource depletion and pollution. Informants and case studies in the published literature had mostly negative views of NAFTA’s environmental impacts and institutions, but some positive views of the trade agreement’s associated institutions in terms of their impacts on public participation and infrastructure. Attribution of general environmental changes to NAFTA are difficult to sustain given the pre-existing shifts towards neoliberal policy and environmentalism, as well as confounding factors that have arisen since implementation, including the rise of China, US border security, and energy sector liberalization actions in both countries.

2. Background

The broader theoretical debates and political struggles over NAFTA pitted the disciples of Milton Friedman – the so-called Chicago Boys – who promoted policies of free trade, privatization and smaller government, against the critics of neoliberalism. These critics saw the value of protectionist policies, state ownership, common property, and import substitution in reducing dependency, protecting resources, and decreasing inequality in Latin America and elsewhere (Liverman and Vilas, 2006). Those arguing for NAFTA in the early 1990s believed that the theory of comparative advantage would allow each country to specialize based on the best use of its natural resources and labor costs, and that Mexican salaries would increase. Some analysts drew on the Kuznets hypothesis (Barbier, 1997) to suggest that a strong Mexican economy would increase capacity and interest in environmental regulation and result in innovations in technology and environmental policy that are associated with the theory of ecological modernization (see, e.g., papers in OECD, 2000). Others favoring NAFTA noted that Mexico had already initiated stricter environmental protections and improved environmental institutions leading to environmental standards that harmonized with those in the US and Canada. They believed that industry moving to Mexico would be using newer and cleaner production facilities than older infrastructure in the US and Canada, and that opening up the border trade zone to the whole of Mexico would reduce environmental pressures on the border as industry moved to lower wage regions of Mexico (e.g. Reilly, 1993; Saunders, 1994).

Those opposed to NAFTA were concerned that the border environment was already stressed by the growth of industry, cities, and intensive agriculture and that this would further increase. They drew on the pollution haven hypothesis (Cole, 2004) to argue that dirty factories would move to Mexico because of less and lax environmental regulation and that competition would mean environmental and health standards would decline in a so-called “race to the bottom.” They worried that environmental protection might be seen as a barrier to trade and investment, and that free trade would increase inequality, dispossess the peasantry, and destroy the environment as large corporations took over Mexican agriculture and industry (Barkin, 1993; Barry, 1995; Cleaver, 1994; Liverman et al., 1999; Pena, 1993).

In Mexico, NAFTA was just one of a series of neoliberal policies that transformed Mexican political economy in the late 20th century. These policies included moves to privatize land ownership, water, and resource extraction and the decentralization and withdrawal of state support for small scale agriculture and resource management. Long before NAFTA came into force in 1994, environmental activists and researchers on the border were already focused on air pollution, water scarcity, toxics and shared ecosystems and dramatic increases in manufacturing, urban populations, and agricultural intensification in the border region (Liverman et al., 1999). The in-bond manufacturing plants called maquiladores that produced textiles, electronics, and automotive parts on the Mexican side of the border were established under the 1964 Border Industrialization Program and already employed more than 400,000 workers prior to NAFTA (Espinosa-Torres et al., 1994; Sanchez, 1988). Border cities were already growing rapidly – with resulting environmental problems of air, water and waste. Agriculture was already intensive as a result of irrigation development, new export opportunities and the technology package of hybrid seed, fertilizer and other inputs known as the Green Revolution, with associated problems of pollution, unequal access to new technologies, heavier water use, and loss of employment (Barry, 1995; Hewitt de Alcantara, 1976). Conflicts over shared waters, especially the Rio Grande/Bravo and Colorado River, were already being managed by the International Boundary and Water Commission established in 1944 (Mumme, 1999, 1992; Mumme and Collins, 2014; Wilder et al., 2019).

It is important to note that Mexico adopted environmental policies much earlier in the 20th century, creating national parks beginning in the 1930s and environmental laws and the first federal environmental agencies in the 1970s (Wakild, 2009; Perez Calderon, 2020). Mexicans had increased pressure for environmental regulation of air pollution in Mexico City, water quality, and deforestation in an environmental movement that paralleled those of other countries in the 1970s. In the 1980s, Mexico made extra efforts to implement environmental protections including passing a general environmental law in 1988, establishing SEDUE (the Ministry of Urban Development and Ecology - Secretaría de Desarrollo Urbano y Ecología) and signing the Convention on Trade in Endangered Species in 1991 (Mumme, 1992). In 2000, Mexico renamed its environmental agency to SEMARNAT (Secretaría del Medio Ambiente y Recursos Naturales) which now includes an enforcement branch (Profepa) and the National Institute of Ecology (INE).

There were also earlier agreements on the transboundary environment that still have some impact. For example, the La Paz agreement provided a framework for environmental cooperation that includes regular diplomatic consultation, sub agreements on air quality and sanitation in border cities, and set the stage for strategic planning within the Border 2012 and XXI processes (Mumme and Collins, 2014).

NAFTA can be seen as a continuation of longer-term trends in economic growth, agricultural and industrial intensification, and environmental awareness and policy, especially on the US-Mexico border. This fact raises questions about the extent to which environmental problems and institutions can be specifically associated with the implementation of free trade, and in particular, NAFTA. Environmental degradation and environmental institutions were in place and neoliberal reform was well underway in the 10 years before NAFTA was signed (Varady and Ward, 2009).

However, environmental opposition to NAFTA fed the creation of additional institutions with a focus on the US-Mexico border region. Environmental opposition to NAFTA, especially by some major environmental groups in the US, led to the negotiation of an Environmental Side Agreement – the North American Agreement on Environmental Cooperation (NAAEC)— to mitigate negative environmental impacts
(Liverman et al., 1999; Mumme, 1996). Three environmental institutions were established as part of the NAFTA agreement, the first for the whole NAFTA region and two just for the US-Mexico border. The Commission for Environmental Cooperation (CEC/CCA) was established to conduct research studies and review citizen complaints on lack of environmental enforcement. The Border Environment Cooperation Commission (BECC/COCEP) was to build capacity and certify “environmentally sustainable” projects such as water supply and treatment in US-Mexico border communities. The North American Development Bank (NADBank) would provide loans for environmental infrastructure projects such as those certified by BECC on the border. Several major environmental groups then agreed to support the agreement.

3. Research methods

The methodology of this study was designed to capture the perceptions and observations of academics, activists, and government workers that have researched or worked on border environmental issues, to evaluate drivers and indicators of environmental change in the borderlands through time series data and research literature, and to assess whether and to what degree environmental degradation or improvements are attributable to NAFTA. While NAFTA has had impacts well beyond national borders, we limited our study to the US Mexico border due to the borders-centered activism and institutions that emerged from the NAFTA negotiations, and the significance of the US-Mexico border region in US-Mexico trade. More than 60 percent of US exports to Mexico originate in its border states and estimates of Mexican exports to the US from border states, especially due to maquiladora concentrations— are similarly high (Anderson and Gerber, 2008; Aguilar Barajas et al., 2014).

We chose drivers and indicators of environmental change to evaluate in continuity with a previous assessment by two of the authors (Liverman et al., 1999) and expanded these to include additional areas of interest and concern. As drivers, we considered economic and demographic variables including population, income, industry (maquiladoras), and agriculture. As indicators, we considered air quality, water supply and quality, toxic waste, marine ecosystems, land-use change, conservation and biodiversity, institutions and governance, human health, and climate change. Due to space considerations and limitations related to available data, we have limited specific analysis of indicators in this paper to ecosystem conservation, air quality, water supply and quality, and institutions and governance.

Where possible, we built data trends from government agency data on drivers of environmental change and environmental indicators from at least several years before NAFTA’s implementation (e.g. 1990 as a baseline) and lasting until at least 2010. We focused on counties and cities contiguous to the border and expanded analysis to the level of the watershed or the state, in accordance with available data. Although there are national time series and some state reporting, there is limited local level environmental trend data, and many data collection efforts have been for one or only a few years. For these reasons, long term datasets were a limited method of analysis.

Secondly, we reviewed research literature on NAFTA’s environmental impacts, focusing on the US-Mexico border environment and especially on the Mexican side of the border. We found more publications in the first ten years, with the bulk of the papers focused on case studies and on the associated environmental institutions rather than trends in regional environmental conditions.

Finally, we surveyed and/or interviewed key informants who have been active on environmental issues on the US-Mexico border, about their perceptions of NAFTA and its environmental legacy. Beginning in 2015, we conducted semi-structured exploratory interviews (in-person and by telephone) with individuals known to the researchers to have been engaged in border environmental research, activism and/or management over decades. Results from these 15 interviews influenced our design of an online survey instrument distributed to a broader cast of informants who were self-selecting in their choice to respond to the survey. The interviews were analyzed and notes organized around lists of perceived environmental changes that described the change, the location, whether it was considered good, bad, or ambiguous for the environment (or no opinion given), whether the interviewee had data to back up the observation, and whether it was attributable to NAFTA. (See copy of interview guide in appendix supplementary materials.) For the survey, we recruited participants from the email lists of participants in the Encuentro Fronterizo gatherings of the early 2000s, listservs of organizations active on border environment issues, researchers known to the investigators, and through snowball sampling. The online survey asked participants about their perceptions of NAFTA’s likely effects on the environment when it was being negotiated, how they see it now, and asked them to rate the nature of impacts for various environmental indicators on Likert scales. (See copy of survey in appendix supplementary materials.) We received about 60 responses (in English and Spanish) in 2019, 38 of which were fully completed. Four interviewees also completed the survey. The majority of participants in both the survey and the interviews came from university research settings, with more of USA nationality than Mexican nationality (Table 1). We created visualizations of responses to quantitative questions, and reviewed responses to qualitative questions individually in an aggregated spreadsheet of responses in Spanish and English.

This article has several limitations. Firstly, the limited available time series data, as mentioned above, does not permit a robust and comprehensive assessment of environmental change on the Mexican side of the US-Mexico borderlands. Secondly, the survey and interview data are limited by sample size, self-selection of participants, and a regional and sectoral bias towards U.S. based academics and residents of Arizona and Sonora. The literature review is also somewhat biased towards anglophone scholarship. Finally, the present analysis omits several areas of environmental concern that were included in the original design of the study and have been excluded from this paper due to space considerations.

4. Economy, agriculture, and population after NAFTA

In order to understand NAFTA’s environmental legacy, we first examined the trends in some of the broader and national socio-economic and demographic variables that influence resource use and environmental impacts at the border. Some of these data trends have been used to frame NAFTA as generally beneficial, or to argue that the benefits were greater than the negative impacts on society or environment. U.S. and Mexican government data and reports generally argue that NAFTA

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was positive for the economies of both countries, with imports and exports increasing and the balance of trade shifting in Mexico’s favor (see Fig. 1; Wilson, 2017). For example, the US Congressional Research Service reports that trade grew five times between the US and Mexico, benefiting the economies of both countries (Johnson, 2017; Villareal and Ferguson, 2014). Mexico is now a major supplier of auto parts, oil, fruit and vegetables to the US. Mexico’s overall GDP more than tripled from $35 billion in 1970 to $1220 billion in 2018, and the population has increased from about 50 million to 130 million people (World Bank, 2020). On the US-Mexico border, the population of Mexican border states has increased from 13.2 million in 1990 to 21.3 million in 2015, with the populations of Tijuana and Ciudad Juarez estimated at more than 1.3 million each in 2020 (https://worldpopulationreview.com/countries/mexico-population/cities/). Population has also grown in states on the U.S. side of the border.

Nationally, average incomes in Mexico have increased considerably, but inequality has also increased with continued deprivation in rural areas and for indigenous regions (World Bank, 2020). Poverty levels in Mexico have not decreased significantly since economic liberalization began in 1982 and may have increased slightly since (Tetreault, 2011). Mexico’s 1994 and 2012 poverty rates and real (inflation-adjusted) wages are almost identical while unemployment has increased (Weisbrod et al., 2014). Increases in energy use by industry, households, and the growth of agriculture have increased carbon dioxide and methane emissions by almost 70% from 1990 to 2014 (https://cait.wri.org/profile/Mexico). These changes are much more dramatic than in the United States where US emissions declined from 1990, although they remained more than 10 times the total in Mexico.

Mexican agriculture has restructured as a result of NAFTA, building on long term trends towards export agriculture, especially of vegetables and fruit, with associated environmental impacts (Mares, 1987). There has been a doubling of overall production of fruit and vegetables (Fig. 2) (FAO, 2019) with impacts at the local level that include increased water use and competition, land clearing, and pesticide use (Gallagher, 2011; Puyana, 2012; SOTO, 2012; Weisbrod et al., 2014; Wroth and Kong, 2015; Zahniser et al., 2015). The livestock industry has grown, including a more than 10 times increase in chicken production (FAO, 2019). From 1995–2016 there has been an almost fivefold increase in Mexican fruit and vegetable exports and the same level increase in meat product imports (FAO, 2019). These national trends are generally paralleled in the northern border states. NAFTA has driven increased flows of agricultural commodities (including grains used in the burgeoning livestock industry), snack foods, and foreign direct investment from the United States to Mexico, changes that have brought about a stronger resemblance between the Mexican food system and that of its northern neighbor (Clark et al., 2012). Since the 1980s, US foreign direct investment in Mexico’s food chain has included livestock production estimated in the hundreds of millions of dollars, processed food and beverage industries ($8.2 billion in 2007), fast food restaurants, and supermarkets, where US market share of the five largest firms doubled between 1997 and 2006 (ibid). Mexican food consumption has shifted towards processed foods with negative impacts on health such as increased rates of obesity and diabetes (Flores et al., 2010; Avila Curiel et al., 2011; WHO, 2017; Al-Goblan et al., 2014; DiBonaventura et al., 2018).

Mexican industrial facilities and production have grown and their geography has shifted. The maquiladora manufacturing plants have spread south into Mexico since trade was opened up beyond the border zone (Anderson and Gerber, 2008; Jordaan, 2008). Complicated by changes in definition, Fig. 3 shows the growth in number and total employment in maquiladoras in Mexico since 1965, as well as maquila employment in Mexico’s border states since 2008 (EBRC, 2020; INEGI, 2020). Following long-term trends, toxic wastes produced in maquiladoras have continued to be improperly disposed and prone to accidental spillages that affect local air and water quality for border residents (Grineski and Collins, 2008; Heyman, 2007; Sanchez, 1988).

Some research attributes increases in industrial and agricultural production and pollution to NAFTA. For example, Gallagher (2004) examined the first 10 years after NAFTA and concluded that pollution increased over this period because of increases in the scale of production even though technologies were becoming cleaner. He finds no evidence that increasing incomes were resulting in lower pollution emissions, but also no evidence that Mexico was becoming a pollution haven or that dirty industries were moving to Mexico. He does note that spending on environmental protection and inspections had decreased by 2004. Vilas-Ghiso and Liverman (2007) undertook a similar analysis of agriculture and the environment for the decade after NAFTA and found modest increases in fertilizer use and land use change associated with a rise in agricultural production and shifts to horticulture, as well as weak institutions for pesticide safety. Notably, neither of these studies have been updated.

The legacy of NAFTA has also been complicated by unrelated factors that have impacted both the economies and environments of signatory countries, including in the borderlands. China’s entry into the WTO in 2001 began the increasing dependence of both Mexico and the US on Chinese imports, especially in manufactured goods, and displaced much of Mexican maquila production expected to increase under NAFTA (Gallagher and Peters, 2013; López et al., 2014). The political use of immigration enforcement has led to the creation of border fencing and walls, dirt roads, and increases in patrol activities, with devastating
consequences for the border environment, as described later in this article (Martin, 2011). Securitization of the border after the 9/11 attacks in the US also led to increased northbound delays at ports of entry. Finally, recent legal and policy shifts in both countries have put the priority of environmental protection firmly behind that of the fossil-fuel economy, including Mexico’s 2014 energy sector reforms (Gutiérrez Nájera, 2016; Alfie Cohen, 2016) and the Trump administration’s auctioning off of public lands for extractive investment beginning in 2017.

Fig. 2. Mexican Agricultural Production, 1961-2018.

5. Survey and interview results

This section offers a broad brush summary of the results of our interviews and surveys to illustrate the field of expert perceptions around NAFTA from the early 1990s to the present. We then include quotes from interviewees and survey respondents throughout the thematic sections of the paper.

Interviewees perceived NAFTA’s legacy as more negative than positive, but many articulated that their fears in the early 1990s regarding the trade agreement’s negative environmental impacts had not materialized. A majority of interviewees viewed NAFTA at the time of its passage as negative for the border environment. Interviewees shared several retrospective perceptions regarding both negative and positive environmental impacts of NAFTA in the US Mexico borderlands, and especially in Mexico, after 25 years. Among the positive improvements, they mentioned better wastewater treatment with BECC/NADBANK funding, better wastewater treatment through privatization, improved outcomes in the cooperative governance of the Colorado River, increased mobilization of civil society, and the expansion and strengthening of institutional commitments to environmental issues on the border, at least in an initial post-NAFTA phase of approximately 10 years. They often noted that these positive trends could not definitively be attributed to NAFTA. Perceived negative trends included ground-water pollution and overdraft due to increased capital investment in export agriculture and mining; weak environmental protection and enforcement mechanisms in Mexico; the decline in funding and participation for border environmental remediation and protection after an initial increase associated with NAFTA; loss of the traditional ecological knowledge of small fishermen; and increases in obesity and diabetes in Mexico perceived as linked to the convergence of US and Mexican food systems. Interviewees also mentioned confounding factors, especially the securitization of the border following the World Trade Center attacks on 9/11 and the broader governance shifts towards neoliberalism that were implemented in Mexico before NAFTA came into effect. Many argued that these affected their ability to offer a definitive opinion on the environmental legacy of NAFTA.

Of the 38 fully-completed surveys there was little difference between the views of Mexican and US respondents. A slight majority of respondents told us they had been in favor of NAFTA once the environmental side agreement was added but only five respondents now felt that NAFTA had been good for the environment. Twenty argued it had been negative and the remainder were not sure. In terms of improvements or declines in various aspects, more than half of respondents perceived improvements in public participation, border cooperation, access to information and the activity of NGOs. A large majority perceived that air quality, coastal conditions, clean water access, and waste management had deteriorated. Several respondents highlighted the seriousness of risks associated with increased greenhouse gas emissions and climate change, plastic waste, and the ecological threats posed by border security and the border wall as well as unplanned urban growth on the Mexican side of the border.

In the next section, we turn to our analysis of available time series data, academic literature and government reports, and where applicable, interviewee and survey respondent perceptions on a select number of environmental indicators (air, water, conservation) and on the performance of NAFTA environmental institutions, border securitization, and the implications for the environment in the recently ratified USMCA.

6. Air quality

Air pollution in the border region stems from a variety of sources related to transportation, industry, power generation, agriculture, mining, unpaved roads, drying seawards, brick kilns, and open burning (GNEB, 2017; California Environmental Health Tracking Program, 2015). Of these, the heavy concentration of vehicles and long delays at ports of entry are sources of air pollution clearly linked to expanded trade following NAFTA (Quintana et al., 2015). Air pollution from industrial activity was likewise a concern of environmental activists at the time of NAFTA’s negotiation, including the hypothesis that polluting industries would move across the border to Mexico where environmental standards would not be enforced (Gallagher, 2004).

Air pollution data suggests that in border cities, air quality has generally improved since 1990, including in nitrous oxide, ozone, and particulate matter (EPA, 2018; Figs. 4 and 5). In many cases, air pollution has declined through the most recent decade. Ozone exceedance days declined in San Diego from 38 in 2006 to 12 in 2014 and in the Imperial Valley from 33 in 2006 to 8 in 2014. Though more variable, particulate matter pollution as measured by the number of days when PM10 was exceeded in Ciudad Juarez/El Paso declined from 63 in 2006 to 14 in 2014 (EPA/SEMARNAT, 2016).

Complicating this analysis is the limited monitoring data for the Mexican side of border cities despite the higher concentration of polluting industry there (Grineski and Collins, 2010), the deterioration of air quality in rural areas where border fencing and enforcement has involved opening and patrolling on unpaved roads, and the enhancement of meteorological ozone with warmer temperatures associated with climate change. For example, the Texas Commission on Environmental Quality reports that despite a long-term downward trend, “ozone in El Paso has leveled over the past eight years and is now on the cusp of not meeting the standard” (Texas Commission on Environmental Quality, 2019). Emissions contributing to the leveling of ozone include refinery sources of precursor chemicals and meteorological conditions conducive to ozone formation (ibid). By contrast, NOx concentrations have consistently declined over the long term (Sather, 2019).

Commercial trucking related to cross-border trade remains a persistent source of air pollution in the borderlands, since commercial vehicles produce approximately “11 times the PM2.5 emissions and six times the NOx emissions than privately owned vehicles” (Kear et al., 2012). Formaldehyde is a carcinogen produced by diesel and, in lesser amounts, gasoline vehicles, that has been discovered in elevated levels in the Tijuana area (Zheng et al., 2013). Since NAFTA, policies that address the air pollution caused by commercial trucking have been implemented with some success (Fernandez, 2010). Fernandez and Das (2011) find that implementation of new diesel standards for commercial trucks through the EPA Free and Security Trade (FAST) policy of 2003–2006 during the post NAFTA period of increased trade (1993–2007) was responsible for reductions in air pollutants at select ports of entry and predicted further improvements with the expected inclusion of Mexican fleets during 2008–2011. A pilot project in Nogales to reduce wait times through joint cargo inspection by Mexican and US officials funded by the Border 2020 program was found to substantially reduce crossing times for northbound commercial vehicles and, in combination with the FAST program, reduce emissions of CO2, PM10 and PM2.5 by 85% at the Nogales Mariposa port of entry (North American Research Partnership, 2019).

While air quality in the borderlands remains a persistent danger to the respiratory health of border residents, existing data and literature suggest that it has generally improved since NAFTA’s implementation. Scholars have also used emissions data to retrospectively evaluate the “pollution haven hypothesis” at the national scale and found that none of the more extreme predictions regarding NAFTA’s environmental outcome appear to have materialized (Cui, 2013; Stern, 2007; Ederington, 2007).

1 We analyzed annual mean air quality trends for pollutants NO3, O3, and PM 2.5, from 1990 to 2018, for the following border region cities: Deming, NM; El Centro, CA; El Paso, TX; Las Cruces, NM; Douglas/Sierra Vista, AZ; San Diego-Carlsbad-San Marcos, CA; and Tucson, AZ. Most indicators show an overall trend of stasis or decline despite occasionally dramatic year-to-year increases and declines.
7. Water access, supply and quality

Water access and quality is a core environmental indicator. Potable water access in Mexican states adjacent to the border has increased considerably since 1990, as has the population with sanitation (SEMARNAT, 2018a, Figs. 6 and 7). The EPA and SEMARNAT report that the Border Water Infrastructure program has “provided access to safe drinking water to 70,000 homes and first-time wastewater collection and treatment to 673,000 homes” since 2003 (EPA/SEMARNAT, 2018). However, domestic water access in border cities has become more costly, especially in Baja California (SEMARNAT, 2018b). Water supply and quality was the most outstanding concern of the activists, government officials and scholars surveyed in this study.

Access to clean water has also been a long-standing challenge on the US side of the border, especially in the Texas and New Mexico colonias, and for farmworkers and rural municipalities (Jepson, 2014; Jepson and Vandewalle, 2016; Schur, 2017). While Hargrove et al. (2018) report some improvements since 1990 with 75% of colonias having adequate water and sanitation, they identified more than 600 colonias and 100,000 people with enduring water problems. The colonias have received some infrastructure improvements from BECC/NADBank and state and local government (Federal Reserve Bank of Dallas, 2015). Colonia residents have also found informal ways to access and improve their water supply in the absence of adequate state provisioning (Meehan, 2014).

Survey respondents pointed to out-of-date infrastructure to accommodate stormwater and drainage in the Mexican side of border cities with negative effects on both sides. They complained of binational sewage problems and depletion and pollution of groundwater by agriculture and mining. For example, one survey respondent listed the following issues in the Nogales, Sonora area:

- “Lack of O&M [operation and maintenance] for wastewater infrastructure investments on the Sonoran side
- “Lack of training for investments in wastewater infrastructure on the Sonora side
- “Poor environmental oversight requirements in Nogales, Sonora related to industrial wastewater quality discharges
- “Metals accumulating in the environment from chronic sanitary sewer overflows
- “Chronic sanitary sewer overflows posing microbiological risks to communities on both sides of the border
- “No US stakeholders wishing to take over operation and maintenance of the International Outfall Interceptor which is shared with Mexico
- “Lack of stormwater regulations in Nogales, Sonora resulting in downstream impacts on Nogales, Arizona
- “Chronic dosing of the Nogales Wash with chlorine resulting in US-side impairment and risks for metals migration in an oxidizing environment
- “Developments in the upper watershed with limited consideration given to downstream impacts from increased impervious surfaces
- “Inflow and infiltration of stormwater in wastewater infrastructure resulting in sanitary sewer overflows impacting both communities
“degrading International Outfall Interceptor with new funding tied to someone taking ownership at the local scale (local communities do not want to own something for which they have no upstream control)“
“IBWC always stating ‘why we can’t’ rather than ‘how we can’“

Another frustrated survey respondent in the San-Diego-Tijuana area reported that government agencies “were asleep for the past decade” in keeping infrastructure up to pace with population growth, and complained that bilateral institutions have focused on desalinization plants and water transfers to the detriment of border residents who are experiencing urgent water quality management issues. Issues mentioned include tire and sedimentation flows into southern San Diego County beaches and the Tijuana Estuary protected area as well as untreated sewage flows from inadequate treatment in Tijuana. Raw sewage flows north and causes frequent closures of southern CA beaches with significant ecological and economic ramifications. Three cities in San Diego County and subsequently the California attorney general brought lawsuits against the US federal government (the US section of the International Boundary Water Commission (IBWC)) in 2018 over inadequate management of wastewater treatment infrastructure in violation of the Clean Water Act. These San Diego County cities and the California attorney general all agree that the IBWC has allowed millions of gallons of untreated sewage, pesticides and heavy metals to flow north from Tijuana into the San Diego County coastline (Smith, 2018). These management issues largely predate the implementation of NAFTA (see the history of binational wastewater management in the Tijuana-San Diego area by Fishhendler, 2007, for example). Still, there are some water supply and quality concerns that can be cautiously attributed to economic shifts following NAFTA such as increases in border populations and industry before adequate infrastructure was developed.

Groundwater depletion and salinization related to shifts in scale and composition of agriculture and groundwater depletion and pollution from the mining industry are two problems with clear links to NAFTA. One notable element of shifts in trade following the agreement was the growth in fresh fruit and winter vegetable exports from Mexico to the United States, as can be seen in this long-term data on Mexican agricultural production (Fig. 2). One interviewee described the shift as follows:

“Aside from tariffs for imports, tariffs for exports lowered significantly. This has created the winter produce industry; it has completely eliminated the idea of seasonality. Groundwater pumping and more inputs, pesticides etc. Packing houses tied to Mexican growers, farms in Mexico are co-ventures that NAFTA made possible. You can see it in Michoacán, limones, aguacates, mangos. It’s hard to overstate it. It’s a really significant and under-studied thing. There are two packing houses in the US: McAllen, Texas and Nogales. They have a whole space-time of production tied to these things…”

Some of this production increase is in the border states such as Baja California and Sonora which today report severe overexploitation of water resources: salinization of groundwater is reported in 23 aquifers and saline intrusion is reported in 15 aquifers (CEDRSSA, 2015). One interviewee, an expert on water issues in northwestern Mexico, explained that not only did NAFTA increase overexploitation and saline intrusion of Sonoran aquifers, but it also generated a positive feedback loop whereby an overused aquifer and declining water table means groundwater extraction is more expensive, causing farmers to transition to export crops in order to pay this higher cost.

The broader shifts to neoliberal governance norms, several interviewees argue, have also made more severe the vulnerability of small-scale farmers and fishermen to environmental degradation:

“Large scale water dependent farming was not the thing that should have happened. It’s just so many things happened at the same time. Individuals used to see there was a drought and say I am going to work in the US this year and come back, but then they lost their land because they had put it as collateral, and they lost it. In the rural sector you had BANRURAL, which gave credit at favorable terms which allowed farmers to persist even through drought etc. But without BANRURAL, they turned to private banks for loans. And this expropriation wouldn’t have been possible before 1991. In Sonora the rains are often very localized so access to a lot of different land is important (different sides of the ejido). Social solidarity disbanded. Same thing in the fisheries. A lot has to do with luck, and so since everyone belongs to the cooperative, they help each other… What NAFTA did was take away the flexibility to adapt, not only of farmers but of small-scale fishers. When you are in a fragile environment and you lose that ability to adapt you are out.”

Along with other aspects of neoliberal restructuring, NAFTA facilitated growth in Mexico’s mining sector, with negative consequences for water resources. Under NAFTA, the “liberalization of the mining sector was wide and swift, opening the possibility to export principally to the United States under preferential conditions” (Gutiérrez-Haces, 2016, p. 246). NAFTA eliminated tariffs on mining equipment, leading to a modernization and reinvigoration of the mining sector. The trade agreement was also responsible for FDI flows that were nearly 60 percent higher than they would have otherwise been (Cuevas et al., 2005). Mining accounted for 1% of FDI in the period 1994–2000, 4% in the period 2000–2010 and 10% in 2014 (Guevara González, 2016). (NAFTA’s Chapter 11 also protected foreign investors from any obligation to process the products of their investment in situ, preempting the development of secondary or added-value processes within Mexico (Gutiérrez-Haces, 2016)).

Mining is a water-intensive industry that has also caused catastrophic pollution of above- and below-ground water resources in Mexico’s border states. For example, in 2014, nearly 108 million cubic meters of water were extracted for the mining sector in Sonora, more water for mining than in any other state in the country (Cartografía Crítica 2016, using CONAGUA data). That same year, Grupo Mexico spilled 40,000 cubic meters of copper sulfate acid solution from the Cananea copper mine into the Bacanuchi and Sonora rivers, affecting 22,000 residents and causing the worst ecological disaster of its kind in Mexico (Guevara González, 2016; Gutiérrez-Haces, 2016). To date, Grupo Mexico has not fulfilled promises it made to the communities affected, including for a hospital where the health problems attributed to the water contamination could be treated (Alfie Cohen, 2015). One interviewee described the dynamic of environmental regulation as follows:

“Environmental impact assessments are viewed as utterly meaningless… the assessments that are done have absolutely no bearing on anything. With the Cananea spill the Grupo Mexico funded an investigative group from UNAM that specifically excluded anyone from Sonora that knew the area. And no one believes the accuracy of that final report. It basically destroyed the life in the river between Cananea and the last downstream dam… Basically, they made it clear that their futures would be rosiest if they came up with the favored conclusions. Grupo Mexico had just built a new building for UNAM in Mexico City. You simply can’t take seriously any announcements of industry about environmental assessments. And negative environmental assessments have no impact. The only thing that really stops is mass demonstrations, paros, etc.”

Unfortunately, assessments of environmental policy in Mexico suggest that resource protection laws have been largely unenforced when they come into conflict with powerful economic, political and social interests (Alfie Cohen, 2016). Recent legal reforms to the energy and mining sectors appear poised to continue the protection of such interests over the environment (CECCAM, 2016; Guevara González, 2016;
8. Conservation and protected areas

The border region is home to over 6500 species of flora and fauna, including 148 on the US endangered species list, and to important riparian, desert, and coastal ecosystems (EPA/SEMARNAF, 2010). Many species migrate across the border and this mobility is important to their survival and ecosystems services they provide (López-Hoffman et al., 2010). A Trilateral Committee on Wildlife and Ecosystem Conservation and Management was established in 1996 and has met regularly on cooperative conservation (Mumme, 2015). However, there has been a retrenchment in recent years in bilateral conservation cooperation between the U.S.-and Mexico. The Border Field Coordinating Committee previously in place was abandoned by the end of the Bush Administration and joint projects conducted under the umbrella of the Trilateral Committee appeared to have been scaled down under both Obama and Trump, although concrete expenditures have been elusive.

Since NAFTA, the number and extent of protected areas have continued to increase in Mexico and the networks along the border have had some success in bilateral conservation campaigns. However, the increase in parks and protected areas for some has been ambiguous for conservation, as one interviewee stated:

“I think NAFTA really accelerated the trend towards increased protected areas. NAFTA was both the effect of a shift in thinking but also a driver of change. The parks, they’re not all the same, there have been successes too, but often they are worse than nothing at all. Alamos, for example, is a UNESCO biosphere. I don’t have the evidence for this, but you might actually see that it has accelerated land clearing. It wouldn’t surprise me. And where does the capital come from? It comes from trashing environments in other places.”

Interviewees and survey respondents broadly agreed that the 1990s debate over NAFTA empowered conservationists groups in Mexico and along the border. As one explained, “Right after NAFTA there was a lot of funding and support for the border. It brought needed attention and funding to the region.” Environmental NGOs networked along and across the border to oppose environmentally damaging projects such as the Sierra Blanca nuclear waste site in the US, a proposed salt works in whale habitat in the national security regime in the United States. Then, on top of this, the intervention of narco-trafficers. Two different interviewees had the following comments:

“In Mexico, people are dying fighting infrastructure projects. They will kill you. It’s cheap to kill someone in Mexico right now. So many things have happened. Students working with a professor at [major Mexican university] working on the (resistance to a project in Northern Mexico) received death threats, calls in the middle of the night. The professor … almost lost her job. She got grilled by a panel in the rectory of the university, kangaroo court thing. I don’t know how she survived.”

“An interesting thing happened. The totoaba was endangered because its gall bladder had a huge price in Chinese market. It’s easy to catch. It was put on the endangered list and fisherman were punished for catching it. People stopped catching it for a long time. Then in the 2000s it started resurfacing. Then the narco were paying a thousand dollars for a kilo of the bladder. A huge incentive to catch it. Who was catching it? I don’t know. But putting totoaba on the endangered list was way before NAFTA and it was a good thing.”

Mexico’s terrestrial protected areas have increased from about 2.5% in 1992 to 13.5% in 2018 (Richards, 2018). Still, most of the protected land in the border region lies within the fifteen different protected areas on the US side. This land has come under significant existential threat as the Trump administration rolls back environmental protections, especially to free up public lands for extractive industries, in what two environmental legal scholars describe as “the most substantial rollback in public lands protections in American history” (Blumm and Jamin, 2018).

9. Border enforcement and the border wall

A significant and unforeseen threat to the border environment, especially conservation, at the time of NAFTA’s negotiation has been the expansion of border security and immigration enforcement infrastructure and policing. Increases in access roads, towers, lights and barriers (including walls and fences) affect wildlife habitat, air quality and water resources (Greenwald et al., 2017; Peters et al., 2018).

Increased border enforcement and barriers date to the adoption of a “prevention through deterrence” strategy that relies on increasing infrastructure and policing personnel to deter undocumented migrants (Greenwald et al., 2017; Wilder, 2018). Infrastructure and policing increases in urban port of entries ultimately expanded to more rural areas of the US Mexico border, with negative consequences on wildlife habitat (ibid). During the George W. Bush administration, the US government...
waived 48 environmental protection laws in the name of national security to expand policing and infrastructure at the US-Mexico border, including construction of approximately 700 miles of border fencing and barriers (Mumme, 2006; Sierra Club, 2019; Friends of the Sonoran Desert, 2018). The Center for Biological Diversity reported that “353 miles of border wall, impassable by pedestrians and vehicles, and roughly 300 miles of barriers that block vehicles but not pedestrians, have been constructed” (Greenwald et al., 2017). Most of this construction took place prior to the Obama administration. Subsequently, Trump made the construction of a “secure, contiguous, and impassable physical barrier” between the US and Mexico his central campaign promise, and one of his first executive orders as president (ibid). He pledged 450 additional miles of border fencing by the end of 2020, 100 of which has allegedly been completed with 11 billion dollars in military construction funds (Washington Post 2020).

Border fencing traps migratory wildlife, degrades habitat, increases flooding and water pollution, and harms air and water quality (Mumme, 2006; Cohn, 2007; GNEB, 2017; Peters et al., 2018). Under Trump’s border wall construction plans, an estimated 93 threatened, endangered, and candidate wildlife species could be negatively affected (ibid). A total of 2,134,792 acres of critical habitat for 25 species, including the jaguar, arroyo toad, and bighorn sheep, would be degraded and destroyed (ibid). Steel bollard fencing for Trump’s “wall” is currently under construction in Organ Pipe National Monument, with groundwater from the aquifer that sustains Quitobaquito Springs. The site is home to two native endangered species and is sacred for the Hia-Ced O’odham and Tohono O’odham nations. Indigenous activists have engaged in protests at multiple border wall construction sites. Since June 2020, members of the Kumeyaay nation in the Laguna Mountains east of San Diego have used direct actions to delay border wall construction in desecration of their ancestral burial grounds.

10. NAFTA institutions

The creation of new institutions under the environmental side agreement is one of NAFTA’s enduring environmental legacies. The Commission on Environmental Cooperation, the Border Environment Cooperation Commission, and the North American Development Bank (the latter two merged in 2017) have all received sustained scholarly attention and produce regular reports on their activities. Stephen Mumme has been following environmental governance on the US-Mexico border for more than four decades, with a long term focus on the International Boundary and Water Commission, the La Paz agreement, and Mexican environmental policy; and since NAFTA, on the CEC, BECC, and NADBank (Mumme, 2016, 2003; Mumme and Collins, 2014; Mumme and Lybecker, 2011). For example, he has argued that while the NAFTA institutions have had some success in reducing the adverse impacts of trade along the border, through the projects financed and certified by BECC/NADBank, they have not kept pace with the scale of change or the increasing securitization of the border environment.

Assessments of the CEC (CCA in Spanish, CCE in French) note that it has been underfunded by the three countries: in 1996 its budget was $10.2 million, as compared to $6.8 m in 2011. In recent years the budget has been restored to earlier levels (not adjusted for inflation) with the 2019 budget at $10 million (CEC, 2018).

Positive assessments of the CEC with respect to the US-Mexico border highlight the importance of some of its research studies and monitoring efforts such as the pollutant release and transfer dataset that tracks pollution across borders. In 2009, the CEC also began making grants under the North American Partnership for Environmental Community Action (NAPECA) to NGOs that work with indigenous and other local communities to promote environmental stewardship ranging from $1.2 to $1.4 million annually. Some governance and legal scholars see positive innovation in the citizen submission process by which any resident or non-governmental organization in North America can file a citizen complaint about their country failing to enforce environmental law (Garver, 2015; Jinnah and Lindsay, 2015; Kirton, 2002; Mitchell, 2006; Pacheco-Vega, 2013; Liverman et al., 1999). Complaints have included reports on serious pollution, inadequate environmental review of major projects, and lack of protection of endangered species. The citizen submission process is complex and in many cases the CEC has ruled against considering a complaint, often because the problem predates NAFTA, is not clearly connected to lack of environmental law enforcement, or lacks evidence. Even when the CEC does decide to do a factual record, they may not receive the information they need from governments, and their reports are ignored. In our interviews and the critical literature (e.g., Mumme, 2015), the main value of the process is said to be the opportunity for public complaints and participation, publicity generated and the potential to embarrass a government into action.

As of September 2019, there had been a total of 98 submissions since 1995 and 24 of these had been taken up and ruled on with factual records and responses from the relevant country (http://www.cec.org/sem-submissions/registry-of-submissions). Those relating to the border with factual records included complaints about agricultural waste burning in Sonora, air pollution in Sonora, environmental justice for indigenous communities in the Sierra Tarahumara, molybdenum pollution in Sonora, lead pollution in Tijuana, and a wastewater spill on the Rio Magdalena, Sonora.

The assessments of BECC and, to a lesser degree, NADBank are seen as more successful in terms of governance and material impact on the border environment (Alfie Cohen and Flores Jauregui, 2016; Mumme and Collins, 2014; Rios and Jozwiak, 2008; Varady, 2007). Prior to the merger of the two institutions in 2017, BECC had certified almost 250 projects on both sides of the border. About half have been water supply and wastewater treatment projects including more than 75 plants in Mexico. Other projects include solid waste management and air quality management, including dust control, renewable energy, and energy efficiency. About 80% of these projects have been supported by grants and loans from NADBank with a total of more than $7b invested to serve more than 15 m border residents (North American Development Bank, 2019) (Figs. 8 and 9). The main critiques of BECC and NADBank include that they have been slow to act, subsidized wealthy communities and companies on the US side of the border, and that their focus has been on large-scale infrastructure rather than alternative technologies.

Both the CEC and BECC have included requirements for public participation and capacity building. The CEC is advised by a Joint Public Advisory Committee and also provides voice for citizens through the complaints process. The BECC requires that information on proposed projects is made available for public comment. (For an analysis of civil society perspectives from just two years after implementation, see Varady et al., 1996). However, the BECC was folded into NADBank in 2017, a shift that survey respondents and interviewees view as a major setback to public participation in developing sustainable environmental infrastructure projects along the border. (The long-term process of shrinking the BECC began in 2002 with the Monterrey Commitments and continued through the Boards merger in 2005, followed a decade later by the complete merger initiative.) In 1992, before NAFTA, the US also established the Good Neighbor Environmental Board as a federal advisory committee on the border. Some interviewees and survey respondents suggested that these NAFTA environmental institutions fostered a new culture of public participation on the border, while others were more cynical, viewing the new institutions as offering tokenistic participation and lacking influence on policy or practice.

The positive impact of the border environmental institutions has been greatly limited by the lack of any budgetary mandate for environmental issues and institutions on the border. One interviewee describes:

“The way money is put together in the USA for the border has to do with taking a little bit of money at a number of the sub agencies sub department budgets and then attaching them to the regional offices and the EPA that have something to do with the border. ...And so if you don’t have a strong
lobby at the border through the congressional delegations leaning on EPA to allocate money for the border, then you don’t have money for the border…. And here’s the deal. This has a binational effect. Because Mexico attends to the border only to the degree that the US attends to the border…. all of these binational task forces are supposed to be matched by Mexico. In fact, they have been borne more by the US. But if the US isn’t funding, Mexico isn’t funding.

In the 1990s, civil society was mobilized by the debates surrounding NAFTA. Major environmental groups and local community activists placed pressure on governments and undertook their own investigations of NAFTA’s environmental impacts (Ganster, 2006; Alfie Cohen, 2002). Along the border, more than 100 environmental and community organizations came together in a series of “Encuentros Fronterizos” from 1998 to 2005, which provided an open forum for groups to collaborate and discuss the post-NAFTA border environment with academics and government actors (Dean, 2003; Naumann, 2003). Now, 25 years after NAFTA, it appears that some of these groups have disappeared and lost their connectivity. For example, in the U.S., the Border Ecology Project and the Interhemispheric Resource Center, both active before and after NAFTA, have closed. New rules in 2005 made it more difficult to establish NGOs in Mexico because of audit costs, and philanthropic foundations reduced their funding of groups and researchers along the border. Some groups that organized around specific projects dissolved when they won or lost a battle.

Survey respondents also noted that cross border collaboration is increasingly inhibited by US immigration policy and by cuts in the budgets of federal agencies such as EPA, an observation shared by Coronado (2014) study on the demise of environmental NGOs on the border. Still, some scholars argue that environmental battles won and lost among networks of activists in the border region reveal success and the Interhemispheric Resource Center, both active before and after NAFTA, have closed. New rules in 2005 made it more difficult to establish NGOs in Mexico because of audit costs, and philanthropic foundations reduced their funding of groups and researchers along the border. Some groups that organized around specific projects dissolved when they won or lost a battle.

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tribunal was sympathetic to regulations with bona fide health and environmental objectives, with no other cases ruling against the environment. Moreover, under the USMCA, this threat to environmental protections has been reduced (see below).

11. NAFTA revisited: The US-Mexico-Canada Agreement (USMCA)

In contrast to the original negotiation of NAFTA, little publicity was generated around environmental concerns in the renegotiation of the deal, known as the USMCA, passed by the Senate on January 16, 2020. Negotiation sticking points centered instead on industry and labor issues, for example, origin rules for auto part raw materials (e.g. steel) and improvement of labor laws and enforcement in Mexico.

Among dissenting voices, local border environment concerns took a backseat to frustrations over the absence of climate change prevention or remediation in the deal. Nine environmental organizations condemned the USMCA in a December 13, 2019 letter to lawmakers that references seven areas of environmental failure (350.org, et al. 2019; Sierra Club, 2019). They letter decries that the USMCA omits any mention of climate change, enables toxic pollution, offers attenuated environmental standards and “an ever more effective enforcement mechanism,” “bolsters use of fossil fuels, and gives oil and gas corporations the ability to challenge climate and environmental protections” (350.org, et al. 2019).

The USMCA embeds environmental provisions within a dedicated chapter of the legal agreement, which the US Office of the Trade Representative states makes it “the most comprehensive, highest-standard chapter on the Environment of any trade agreement” (Office of the US Trade Representative, 2020). Under this new structure, signatory countries agree to resolve disputes surrounding environmental issues covered within the agreement under the same dispute settlement that applies to non-environmental provisions of the agreement, which can end up before a panel of ten experts from a pool of 30 chosen by the parties. (Panelists on disputes under the environmental chapter are required to have some expertise in environmental law (USMCA Ch. 31.6 and 31.8). However, such a dispute can only be brought if the violation creates trade benefits for the accused party. For example, if the US were to accuse Mexico of violating the ban on subsidies for illegal, unreported and unregulated fishing activities covered by the USMCA, it would also have to make the case that the violation creates an unfair trade advantage for Mexico.

Moreover, provisions contained in other chapters will likely have a much greater effect on the environment than the environmental chapter (Vaughn, 2018; Tienhaara, 2019). With the exception of an article on fisheries subsidies that contains deadlines and specific demands of signatories, the language in the environmental chapter is vague and non-binding, and lacks new institutional or funding mechanisms to back up commitments. By contrast, a new Chapter on Good Regulatory Practices (28) includes a requirement to share draft regulation and its rationale for public comment as well as an avenue for public comments towards repeal and modification of regulations, opportunities that experts expect industry lobbyists to exploit more than citizens and civil society groups (Tienhaara, 2019). The chapter on agriculture (Chapter 3) makes no reference to sustainability, conservation or environment. Chapter 20 on Intellectual Property mandates Mexico’s revision of laws to comply with the International Union for the Protection of New Varieties of Plants (UPOV 91), which is now facing concerted resistance from campe sino organizations. This supranational convention extends intellectual property law to patented seeds. If adopted as required by the USMCA, the implications for agrobiodiversity in Mexico will be far reaching. The USMCA substantially alters NAFTA’s controversial Chapter 11 investor-state dispute mechanism. It is eliminated altogether between Canada and the US, while Mexico and the US preserve it with significant changes. Claims can only be made based on expropriation or non-discrimination (no longer “fair and equitable treatment,” as under NAFTA). In addition, investors can no longer sidestep domestic courts to bring claims directly to international arbitration. However, the exceptions granted to oil, gas and select public service sectors that have a contract with their host government may prove more significant than the general rule (Tienhaara, 2019; Bernasconi-Osterwalder, 2020).

The USMCA preserves certain NAFTA environmental institutions, including the Commission for Environmental Cooperation and the Submissions on Enforcement Matters process. However, as Vaughn (2018) points out, the subsection discussing SEM contains several pro-industry caveats, including that claims appear “aimed at promoting enforcement rather than harassing industry”; that “private remedies” are considered before examination of citizens’ claims; and that claims are not based solely on “mass media reports” (USMCA Ch. 24.27.2.d and 3.c and d).

Overall, the USMCA reflects significant neglect of border environmental issues that have emerged or worsened as a result of expanded trade between the North American partners to NAFTA, such as groundwater availability and quality.

When asked how the environmental side agreement of NAFTA should have been modified, if at all, survey respondents largely condemned the then-ongoing renegotiations for neglecting the environment. Many suggestions reflect the answer of “more teeth, more funding”—the need for higher standards and enforcement mechanisms, like sanctions, and dedicated funding to support monitoring, analysis and enforcement. Others emphasized the need for community input and social equity, and still others lamented the total absence of the record of environmental impacts of NAFTA in the renegotiation process. They argued for inclusion of new environmental standards, such as addition of new emerging contaminants, standards regarding urban environmental problems, and norms to increase ecosystem services, as well as the need to transition to sustainable economic practices, mentioning solar, wind and diversified agriculture in the US and Mexico.

Meaningful evaluation of the environmental impacts of ongoing regional economic integration will require more and better longitudinal data than is currently being collected, especially in Mexico. As (Khan, 2017) argued, a renewed CEC could dramatically improve monitoring of environmental hazards and pollution, but only if granted dedicated funding and a permanent institution. In addition to its pollutant and hazards transfer dataset, the CEC currently devotes resources to maintaining a North American Environmental Atlas that offers a random assortment of snapshot-in-time visualizations covering terrestrial and marine ecosystems, pollution and waste, climate, and human influence across the continent. Such CEC funding would be better directed towards a concerted longitudinal data collection project that partners with subregional actors, such as universities, environmental NGOs, regional environmental ministry offices, and citizen scientists to produce a body of reliable and accessible data. Such a project could include drivers and indicators of environmental change, signal data collection needs, put pressure on government agencies to meet them, and enable researchers to produce regular updates on the movement of the environmental indicators.

12. Conclusion

The environmental legacy of NAFTA in the US-Mexican borderlands is challenging to define. Our retrospective analysis of NAFTA’s environmental legacy finds both positive and negative impacts for the US-Mexico border environment, some of which that can be reasonably attributed as outcomes of the agreement. We find overwhelming expert perception that the side agreement and environmental institutions of NAFTA increased public participation and engagement in border environmental issues, but that this engagement has since decreased. Available data suggest that urban air quality, potable water access, and access to sanitation have all shown improvements since 1990. Less positively, we conclude that groundwater depletion and degradation has resulted from shifts in the composition of agriculture in the Mexican border states.
related to NAFTA. Also, we see that expansion of the mining sector with foreign direct investment and equipment that NAFTA facilitated has led to poorly remediated water pollution in Mexico’s northern states.

While some argue NAFTA was overall detrimental or beneficial for the environment (see earlier discussion of Sierra Club, 2014 and Van Schoik, 2014), the question of attribution is tremendously challenging. How can an impact be robustly connected to NAFTA rather than to other factors? Only in limited cases – such as the funding and certification of border infrastructure by BECC and NADBank – can an environmental change such as reduced water pollution or access to drinking water and sanitation be interpreted as a direct result of NAFTA. Linking environmental trends change to NAFTA is also challenging because NAFTA was partly a continuation of pre-existing economic liberalization and environmental trends. Processes of economic liberalization and attendant environmental impacts were well underway in the ten years before the trade deal was implemented, and in many instances, it is hard to extract change due to NAFTA from change resulting from the broader structural reforms of which it formed a part, and from the trends of industrialization and population growth that were in place long before the trade deal. As one survey respondent mused:

“I think we overstate the impact of NAFTA vis-a-vis the general progress of the region. The awakening of public consciousness and greater social participation is the key factor. Was it caused by NAFTA?”

Another interviewee summed up his assessment as follows:

“The good news is that NAFTA lifted the institutional—expanded and strengthened the institutional commitment to the environment along the US Mexican border. That it did in a variety of ways. The bad news is that that commitment seems to have peaked. And you don’t have some of the structural elements like a funding base in place to make sure that when public interest falls off, federal priorities change, that you’re still going to be investing in and committing to these programs at the level anticipated.”

Concern over existing conditions and their potential exacerbation under NAFTA galvanized a civil society and research community that put pressure on governments to remedy environmental problems in the borderlands. This activism and attention were key in the inclusion of the environmental side agreement to NAFTA, the formation of new binational institutions dedicated to remedying border environmental issues, and the inclusion of public participation in their mandates. Still, there is little evidence of any concrete impact of the NAFTA environmental governance institutions other than the projects to improve potable water and waste management infrastructure along the border, and these with diminished funding over the years. Efforts to increase protection of ecosystems have been made but are confounded by the expansion of a hard border between the US and Mexico and by the setting aside of environmental regulation in the US to allow for increased border security and immigration enforcement. Since NAFTA, China’s entry into the World Trade Organization in 2001, the ramping up of border security and enforcement following 9/11, and other significant policy shifts on both sides of the border (to name two, the Mexican energy sector and other reforms of 2014 and the Trump Administration’s policy shifts on environmental governance beginning in 2017) confound attribution and pose new challenges to the border environment. One interviewee explained the impacts of 9/11 on funding and attention to environmental issues:

“Militarization of the border, which is one of the consequences of 9/11, the change in political tone, business of building walls and all of that… So whatever interest there was in the border got totally diluted. It coincided with siphoning of funds to the war effort and the decline of the economy after the Clinton era, and a reduction in funding including that OFD [border infrastructure] funding… On the public side, because of 9/11 and the aftermath, there was less money put into all aspects of border work. And you saw that that led to more strain and less ability to promote the kinds of things that would be environmentally sound. I wouldn’t attribute that to neoliberalism per se. So if you had to list other reasons—one is sort of ‘back to business as usual, that was yesterday’s issue’—I mean maybe neoliberalism plays a role in fanning that kind of belief but I think it’s there.”

In sum, sweeping theories of NAFTA causing either generalized environmental degradation or improvement cannot be supported by our findings. We do find some positive improvements, such as those in wastewater treatment supported by investment from NAFTA’s environmental institutions, and data that suggests reductions in air pollution in border cities. But without long-term support for data collection at the local level, with robust baselines and sustained engagement with communities, it is very difficult to identify the local environmental and social impacts of such large-scale structural changes, including those driven by transformations since NAFTA was implemented, such as those in border security and environmental enforcement in each country. More careful monitoring of trade impacts and environmental conditions along the border will require reinvestment from governments and foundations in research and observations and the active participation of border residents.

CRediT authorship contribution statement

Fiona Gladstone: Funding acquisition, Investigation, Visualization, Writing - original draft, Writing - review & editing. Diana Liverman: Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Visualization, Writing - original draft, Writing - review & editing. Roberto Alejandro Sánchez Rodríguez: Conceptualization, Methodology, Funding acquisition. Aaron Eduardo Morales Santos: Investigation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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