



NATURAL RESOURCES DEFENSE COUNCIL

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Hearing on the U.S. Agricultural Sector Relief Act of 2012

**Subcommittee on Energy and Power
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Summary

- Protection of the ozone layer is a huge bi-partisan public health success story. The phase-out of ozone-destroying chemicals, including methyl bromide, is saving literally millions of Americans, and tens of millions of people around the world, from death and disease, from skin cancer, cataracts, and immune diseases. It is also saving farmers billions of dollars in UV-related crop losses.
- Now is not the time to tamper with the Montreal Protocol and the Clean Air Act. By slowing or even reversing the transition away from methyl bromide, “The U.S. Agricultural Sector Relief Act” will lead to more skin cancers, more cataracts, more immunological disease. It will benefit strawberry growers and others who have profited by abusing the “critical use exemption” for almost a decade. Thousands of other farmers growing other crops will suffer more UV-related crop losses as a result.
- Methyl bromide suppliers and users have dragged their feet on replacing this dangerous compound for two decades. No other industry has had more time and more leeway to transition from dangerous ozone-destroying chemicals.
- The United States is responsible for more than 90 percent of all methyl bromide exemptions. Every other strawberry- and tomato-growing country with California-like growing conditions – including Italy, Spain, Greece, and Australia – has ended use of methyl bromide. Mexican growers use less methyl bromide per acre than their California counterparts, and Mexico will end methyl bromide use entirely this year.
- California strawberry growers have done very well during the whole experience, according to a recent peer-reviewed economic study. Strawberry acreage is up 16% and yields are up 14% since 2004 despite significant reductions in methyl bromide allocations. So are U.S. grower prices and total crop values.
- U.S. critical use exemptions have been coming down. California strawberries are now the only field use for which the U.S. is still seeking critical use exemptions. Together with several structural and commodity uses, the total U.S. exemption request for 2014 is down to slightly more than 400 tons.
- The bill would do reckless damage in three major ways: First, it would permanently define as “critical uses” all of the uses that were labeled critical in 2005, even though the vast majority no longer even use methyl bromide. Absurdly, the bill would make even golf course turf grass a “critical use.” It makes no sense to freeze into law an utterly out-dated list of “critical uses.”
- Second, the bill relieves applicants of the need to show why they need exemptions. They could just submit their exemption wish lists without any supporting data. EPA then would bear the burden of gathering the data to support any reduction. Absent resources and data, EPA would have little choice but to forward the applicants’ unsupported wish lists to the parties. This would be foolish even from the growers’ perspective. It actually helps the U.S. government win approval for exemptions to have shown that it has exercised judgment and discipline in framing its requests, and has is not mechanically asked for everything its domestic applicants may have wanted.
- Third, the bill would blast an enormous new loophole into the Clean Air Act and our pesticide safety laws, by allowing any individual user to write his own ticket for up to 20 tons of methyl bromide

simply by asserting the existence of an “emergency.” There could be a hundreds of emergency exemptions per year, totaling up to 2,000 tons per year (the 2011 critical use amount).

- This is a bad and unneeded bill. It would harm public health, harm other farmers, and indeed even harm the farmers it is intended to help. The process is working. This Committee should let well enough alone.

Thank you Chairman Whitfield and Ranking Member Rush for the opportunity to testify on behalf of the Natural Resources Defense Council on the proposed “U.S. Agricultural Sector Relief Act of 2012.” Founded in 1970, NRDC is a national nonprofit environmental organization of scientist, lawyers, and environmental specialists with more than 1.3 million members and online activists, served from offices in New York, Washington, Chicago, San Francisco, Los Angeles, and Beijing. I am policy director of NRDC’s Climate and Clean Air Program. I have been with NRDC twice, from 1978 through 1992 and from 2001 to the present. In the 1990’s I served as director of climate change policy in the EPA Office of Air and Radiation. Relevant to the topic of today’s hearing, I have worked on the phase-out of ozone-destroying chemicals for more than a quarter century.

There are few greater success stories than the global effort to phase out the ozone-damaging chemicals. Every American, and every citizen on this Earth, relies on the ozone layer to block dangerous ultraviolet radiation that causes skin cancer, cataracts, immune disorders and other diseases. The treaty to protect the ozone layer, known as the Montreal Protocol, has enjoyed bipartisan support from five presidents beginning with Ronald Reagan. So have the ozone layer protection provisions of the Clean Air Act. They are saving literally millions of Americans, and tens of millions of people around the world, from death and disease. They are also preventing billions of dollars in UV-related crop losses and other economic damages.

Yet the ozone shield is still being weakened by ozone-depleting chemicals that increase our exposure to dangerous UV radiation. Millions of Americans – including farmers – must work everyday in the sun. Millions more – from school children to seniors – spend hours of their days out of doors. Millions of concerned parents check the UV Index and cover their kids with sunscreen before letting them go out in the sun.

That brings us to methyl bromide. Methyl bromide is the most powerful ozone-depleter still in widespread use. All of the other more potent ozone-destroying chemicals have been successfully

eliminated – worldwide. Methyl bromide is also highly toxic, with inhalation or dermal exposure causing a wide range of acute and chronic effects, including death.

Mr. Chairman, I will not mince words. You are considering a bill to further slow the snail-like pace of the transition from this dangerous chemical – a bill that will lead to more skin cancers, more cataracts, more immunological disease, and more crop losses due to ozone-destruction and UV radiation, as well as more illness from direct exposure. Contrary to the bill’s grandiose title, this bill will not broadly benefit “the U.S. agricultural sector.” Indeed, thousands of farmers growing other crops will suffer more UV-related crop losses as a result. Instead, this bill will benefit only a small sliver of strawberry growers and few others who have profited handsomely by abusing the “critical use exemption” for the better part of a decade.

No industry has had more time and more leeway to transition from dangerous ozone-destroying chemicals than this one. The auto industry replaced CFCs in car air conditioners in less than four years. The electronics industry replaced ozone-depleting solvents in circuit board manufacture in less time than that. The air conditioning and refrigeration industry and the fire protection industry got rid of their potent ozone-depleters in well under a decade. Indeed, some of these industries have gone through two rounds of transitions to safer chemicals in the last 20 years. And all of these industries have been able to produce better, more energy-efficient, and more profitable products.

But methyl bromide stands apart. The producer and the users of this chemical have dragged their feet on replacing this dangerous compound for two decades. Let’s review:

The phase-out of methyl bromide was supposed to be completed by 2001 pursuant to the 1990 Clean Air Act Amendments. With a decade of lead-time, growers and other users should have invested in developing and field testing other agents and other agricultural practices, like every other industry did. Their effort was minimal. And their minimal effort was rewarded by pushing the deadline back to 2005, in conjunction with amendments to the Montreal Protocol to phase out methyl bromide world-

wide. An post-2005 exemption was allowed for so-called “critical uses,” but all observers then thought this would be just a small percentage of historical (“baseline”) methyl bromide use, just as the “essential use” exemptions for other ozone-destroying chemicals had been only a small fraction of their baselines.

Indeed, other countries with comparable agricultural conditions played by those rules, submitting critical use exemption requests, if any at all, that reflected small fractions of their historical methyl bromide use levels. Only the U.S. took a different tack. In 2003, U.S. growers and others sought exemptions totaling some 15,000 tons, more than 60 percent of country’s baseline use in the early 1990s. The U.S. government requested more than 10,000 tons of exemptions, and nearly broke the back of the Montreal Protocol. For the first time in its history, the parties were unable to come to a consensus decision. For the first time, there was an impasse that could not be resolved without calling an extraordinary meeting of the parties.

For eight years running, the United States alone has requested more than 90 percent of all exemptions. Over this period, nearly every other developed nation has eliminated its need for methyl bromide. Specifically, every other strawberry- and tomato-growing country with Mediterranean-like growing conditions – including Italy, Spain, Greece, and Australia – has moved beyond use of methyl bromide. Even Mexico – the California strawberry growers’ only competitor – is committed to end its use of methyl bromide this year.¹

Throughout this period, and here again today, the California strawberry growers have led the pack in coming to Congress playing the hardship violin. In fact, however, California strawberry growers have done very well during the whole experience, according to a recent peer-reviewed economic study by Erin N. Mayfield and Catherine Shelley Norman, published in the *Journal of Environmental*

¹ “The Government of Mexico has committed to achieve the complete phase-out of MB by the end of 2012.” United Nations Environment Programme, Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol, Sixty-sixth Meeting, Montreal, 16-20 April 2012, “Project Proposal: Mexico, National methyl bromide phase-out plan (third tranche), ¶19, <http://www.multilateralfund.org/66/English/1/6641.pdf>.

Management.² They have expanded their strawberry acreage and increased their yields dramatically despite significant reductions in methyl bromide allocations: California strawberry acreage in 2010 had increased 83 percent over 1991 levels and 16 percent over 2004. Yields per acre in 2010 increased 29 percent over 1991 levels and 14 percent over 2004. California's share of U.S. production also increased during this period, from about 80 percent in 1991 to more than 90 percent in 2010. U.S. grower prices and total crop values adjusted for inflation also increased during the exemption years.

The expansion of the strawberry acreage treated with methyl bromide is extremely troubling because it breaks a commitment made by the U.S. government not to allow such expansion. For instance, the "National Management Strategy for Methyl Bromide, United States of America, December 2005" states: "An important way that the United States addresses the issue of avoiding increases in MeBr use is our policy to disallow any increases in acreage or throughput that CUE applicants might include in their CUE request."³ This turns out to have been a hollow promise.

The growers' complaints often center on the claim of unfair competition from Mexico. Throughout this period, however, Mexican growers used less methyl bromide per acre than their California counterparts, and Mexico, as I mentioned, has committed to stop using methyl bromide this year. Mayfield and Norman note that although strawberry imports from Mexico increased as the overall U.S. strawberry market grew, Mexico's share of total U.S. consumption did not increase significantly, and U.S. growers' strawberry exports to Canada rose by almost as much as imports from Mexico.

Mayfield and Norman also note that the economic analysis supporting the critical use nomination for 2014 – an analysis prepared by the strawberry growers – indicates that a range of alternatives to methyl bromide are effective and available at comparable cost and without yield losses.

² E. Mayfield & C. Norman, *Moving away from methyl bromide: Political economy of pesticide transition for California strawberries since 2004*, *Journal of Environmental Management*, Vol. 106, Pp. 93-101 (2012), available at <http://www.sciencedirect.com/science/article/pii/S0301479712001909>, and attached to this testimony.

³ <http://www.epa.gov/ozone/mbr/downloads/MeBrNatMgmtStrat.pdf>, p. 4.

Notably, these results do not depend on methyl iodide, which was withdrawn from the market by its manufacturer earlier this year.

As it turns out, the industry is still sitting on a stockpile of methyl bromide made before 2005 and stored in railroad cars in various communities around the country. Believe me, tank cars of highly toxic methyl bromide baking in the sun on rail sidings are not something I'd want in my community, or rolling through my Congressional district, yet few people know if they enjoy that privilege. As of today, the stockpile still exceeds 1,200 tons – three time the U.S. critical use nomination for 2014.

Why is the stockpile important? Because the rules of the road under the treaty are that a country may request permission to manufacture new methyl bromide to serve critical use needs only if it has exhausted its stockpiles. The industry attempted to conceal that stockpile from both the public and the government, and this led to the U.S. government's initially misrepresenting to the other Montreal Protocol parties in 2003 that there would be no stockpile left in 2005. But the true stockpile, divulged only later in response to an NRDC lawsuit, was nearly 13,000 tons – more than the entire amount the U.S. claimed to need for 2005. The methyl bromide stockpile has been used – illegally, in our view – for crops that no longer qualify as critical uses, such as golf course turf grass, and to exceed the critical use limits on crops such as strawberries. Each year since 2004, the stockpile has been larger than the next year's total critical use request. That is true for 2013 and 2014. The deception over the stockpile, once revealed, almost caused the breakdown of the treaty process, and the existence of a continuing stockpile is still a major irritant between the parties today.

NRDC acknowledges that the amounts of U.S. critical use exemptions have been coming down, however belatedly. Many growers and other users have finally taken up alternative chemicals and alternative pest management practices, so that we have now come to the point where the only field use for which a critical use nomination is still being made in 2014 is California strawberries. Together with several structural and commodity uses, the total U.S. exemption request is down to slightly more than

400 tons, as compared to nearly 10,000 tons in 2005. This progress, though long delayed, is noteworthy and must continue. Further progress is possible even in the short run, through practices such as greater use of impermeable films (something other countries have already adopted) and by continued adoption of alternatives.

In short, the process is working. Now is not the time to tamper with the methyl bromide phase-out requirements under Montreal Protocol and the Clean Air Act. Mr. Chairman, the bill before you would pointlessly weaken curbs on this dangerous ozone-destroying chemical, threaten the recovery of the ozone layer, and further strain our relations with other countries that are already experienced with U.S. abuse of critical use exemptions. The bill does reckless damage in at least three major ways:

First, the bill would permanently define as “critical uses” all of the uses that were labeled critical in 2005, regardless of the fact that the vast majority of those crops and applications have successfully transitioned to alternatives and no longer even use methyl bromide. Absurdly, the bill would make golf course turf grass a “critical use,” even though the Bush administration’s agriculture department dropped it from the list in 2006. Why in the world does it make sense to revive and freeze into law an utterly out-dated list of “critical uses”?

Second, since growers and other applicants are seeking exemptions for a chemical that is otherwise already banned under both domestic and international law, and since they are in the best position to innovate and test alternatives, they quite properly now bear the burden of showing the need for methyl bromide and the absence of economically practical alternatives. But the bill would turn that burden around. It would allow applicants to submit their wish lists for exemptions without providing any data in support. Even though this chemical is already supposed to be banned, the bill would then require EPA to shoulder the burden of developing the data to support any reduction from the growers’ or other applicants’ requests. As the growers would be quick to point out, EPA does not run farms, and EPA does not run alternatives testing programs.

Absent the resources and access to data, EPA would have little choice but to forward the applicants' wish lists to the parties for consideration. Even from the growers' perspective, this would be a fool's errand. It is difficult enough for the U.S. to gain approval for its out-sized exemption requests when it can bring a reasonably robust case forward for technical scrutiny by the other parties. It actually helps the U.S. win approval for exemptions to have shown that the government has exercised some judgment and discipline in framing its requests, and that the U.S. is not asking for everything its domestic applicants may have wanted.

Third, the bill would blast an enormous new loophole into the Clean Air Act and our pesticide safety laws, by allowing any individual user to write his own ticket for up to 20 tons of methyl bromide simply by asserting the existence of an emergency. "Emergency" is conveniently defined to mean any situation where someone wants to use more methyl bromide than is available under a critical use exemption, and where he declares that there is no alternative. The bill would allow a hundred 20-ton emergency exemptions per year, up to a total of 2,000 tons per year (the amount of critical use exemptions in 2011). This would be a massive abuse of the emergency exemption provision under the Montreal Protocol, which has been invoked only twice so far (once by Australia and once by Canada) in genuine emergencies.

Imagine, Mr. Chairman, how cool it would be to be able to withdraw more cash from the bank than you have in your account, just by calling it an emergency. There's another name for that: bank robbery.

This is a bad bill, and an unneeded bill. It would harm public health, harm other farmers, and indeed even harm the farmers it is intended to help. The process is working. This Committee should let well enough alone.



Moving away from methyl bromide: Political economy of pesticide transition for California strawberries since 2004

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ABSTRACT

We examine the progress of the phaseout of the use of the pesticide methyl bromide in the production of California field strawberries. This phaseout is required under the Montreal Protocol and has been contentious in this sector, which receives exemptions from the schedule initially agreed under the treaty, and in international negotiations over the future of the Protocol. We examine the various ex-ante predictions of the impacts on growers, consumers and trade patterns in light of several years of declining allocations under the Critical Use provisions of the Protocol and the 2010 approval of iodomethane for use in California and subsequent 2012 withdrawal of this alternative from the US market. We find that, contrary to ex-ante industry claims, the years of declining methyl bromide use have been years of rising yields, acreage, exports, revenues and market share for California growers, even when faced with a global recession and increased imports from Mexican growers who retain the right to use the chemical under the Protocol. This has implications for the Protocol as a whole and for the remainder of the US phaseout of this chemical in particular.

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1. Introduction and background

US fruit and vegetable growers using the fumigant methyl bromide (MeBr), scheduled for phaseout under the Montreal Protocol on Substances that Deplete the Ozone Layer, faced uncertainty about the cost and effectiveness of alternative chemicals and practices, and many of them applied for exemptions allowing continued use after the planned elimination of MeBr. This process was controversial – so much so that the United States suggested that they might withdraw from the Montreal Protocol, up to that point considered a model of successful international environmental policy, if their nominations for exemptions were not granted (Gareau and DuPuis, 2009). In the exemption process, which allowed exceptions to the scheduled 2005 complete phaseout date, one of the most contested uses was for strawberry farming, especially in California where many alternatives are strictly regulated or disallowed. Growers argued that none of the alternatives met the ‘economic and technical feasibility’ conditions of the Critical Use Exemption (CUE) rules. DeCanio and Norman

(2005) discuss possible interpretations of the feasibility criteria at length, emphasizing that it cannot mean that no changes in costs or agricultural practices are required of methyl bromide users, but there is not a consensus definition of precisely what standard must be met.

Currently, the majority of CUEs for methyl bromide are allocated to the United States.¹ The share of field (rather than nursery) strawberries in total exemption requests has also grown; the 2014 US field strawberries nomination was for over 93% of the total US allocation, and was exclusively for use in California, which produces 90% of US strawberries (ERS, 2011c). In 2007 the same share was only 13% and more geographically dispersed, including uses in the southeastern US as well as California (USDoS, 2010, 2005, ozone.unep.org). Substitutes have been slower to develop in California,

¹ For the last seven years reported, 2007–2013, approved US CUEs have been more than 75% of non-Article 5 exemptions approved globally, so US strawberry uses are a significant amount of remaining global use of MeBr. In the first year of the exemption process, US allowances were a bit over 40% of total non-Article 5 allocations. For 2013, the United States has received over 90% of approved CUE allowances. Article 5 parties, which are, roughly speaking, less developed countries, do not have to complete phaseout until 2015, but their total use peaked in 1998, and by 2010 total consumption in Article 5 and non-Article 5 countries were approximately equal (exclusive of quarantine and pre-shipment uses, which are regulated separately and excluded from the discussion throughout this paper) (ozone.unep.org).

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due to different farming practices and a relatively stringent regulatory climate that has slowed the approval of some MeBr alternatives. The California strawberry crop is worth more than \$2 billion annually and is the 6th highest-valued fruit crop in the state, so while the industry is small at the national level it is economically significant in the region.²

California growers and those negotiating the CUE process on their behalf were deeply concerned that the main source of US imports of fresh strawberries, Mexico, would not be required to eliminate the use of MeBr at the same time that California growers were scheduled to. The Montreal Protocol allows delays in the elimination of ozone depleting substances for less developed countries, and growers feared that lowered trade barriers under NAFTA would combine with a technological advantage to Mexican growers using the fumigant, leading to dramatically increased imports of fresh strawberries and reduced sales of and/or prices for domestic berries.

This work investigates how the process of phaseout has affected the California field strawberry industry and finds that management and regulatory decisions at the international, national, and state levels have allowed California growers to maintain and enhance their dominance in the domestic and North American market as the phaseout has progressed. The period between the beginning of the methyl bromide phaseout and the availability of iodomethane, the closest thing to a 'drop-in' substitute yet developed, for use in the state has been characterized by slow elimination of MeBr, rising acreage, yields and consumption, improved balance of trade, increasing domestic market share, and rising or relatively stable prices. Iodomethane itself has recently been voluntarily withdrawn from the US market, and we consider how this might affect our assessment of the phaseout process to date.

2. Ex-ante analyses of economic effects and political factors influencing phaseout

Economic analyses earlier in the process did not reach a consensus regarding the likely impacts of phaseout. Norman (2005) relied heavily on data from nominations for CUEs and found that trends in demand growth for fresh strawberries³ and significant pass-through of cost increases to consumers were expected to outweigh the stated negative effects of production cost increases associated with use of alternative fumigants, even in the absence of direct government support, under fairly conservative assumptions, and that increased consumer costs per household would be minimal, even if they were substantial in aggregate.

Carpenter et al. (2000) simulated production, consumption, and crop prices for methyl bromide users (e.g., California) and direct competitors (e.g., Mexico) – prior to and after the 2005 MeBr ban using a spatial partial-equilibrium model. To simulate post-ban conditions, shifts in production technology and corresponding changes in production costs and monthly yields were assumed.⁴ Model results suggested that following a ban, US consumers would pay higher prices for strawberries and consume fewer of them. The increased price of strawberries would outweigh

increases in CA production costs for growers and, when coupled with increased acreage devoted to CA strawberry production, CA strawberry growers' gross and net revenues would increase and remain stable, respectively.

Goodhue et al. (2005) and Carter et al. (2005), on the other hand, suggested that MeBr phaseout could cause significant problems for US or California growers. The former included field trials to estimate weed control costs using MeBr and various available alternatives but were unable to estimate yield losses from the use of MeBr alternatives directly, and concluded that acreage and thus supply would have to decline significantly to raise market prices enough to eliminate the net losses to remaining growers. The latter note that a single annual demand elasticity parameterization obscures important variation in seasonal demand and supply functions and can bias estimates of losses downward, with the most significant losses accruing between mid-May and early July. Their simulation results suggest full-season losses of between 4 and 20% of revenue, with a point estimate of around 12%, excluding revenue realized from lower valued crops as acreage in strawberries decline. Neither study considered longer-term trends in the fresh strawberry market.

The design of these studies reflected concerns that Mexico, which provided (and continues to provide) more than 99% of imported fresh strawberries to the US (ERS, 2010, Table 14), was an Article 5 country under the Montreal Protocol and thus not required to eliminate MeBr until 2015, at which point their MeBr use would also have to comply with CUE standards to be permitted. NAFTA rules would make it hard to shield US growers from Mexican competition. Rising costs to US producers forced to transition away from their preferred fumigant could make Mexican imports more competitive over more of the year, reducing market share and revenues to domestic growers. Carpenter, Gianessi, and Lynch (2000) projected that after the 2005 ban – exemptions notwithstanding – increased acreage in Mexico devoted to strawberry production would be observed, and in the absence of land and water constraints, Mexico would continue to increase acreage and displace acreage in California.

On the regulators side, there was concern that significant exemptions would slow the phaseout and increase lobbying efforts at the expense of efforts to develop and implement alternate fumigation strategies. Using even the lowest estimate of the cost burden of the elimination of MeBr for California strawberries growers from Norman (2005) of \$51⁵ ha/year suggests that diversion of funds to directly unproductive rent seeking around CUE rights could be significant; the 2011 industry survey indicates that 15,145 ha are planted in strawberries in California, and less than 5% of that land is devoted to organic production (CSC, 2011). This implies that delays in phaseout for conventionally grown berries could be worth more than \$700,000 annually ($15,145 \times .95 \times \$51 = \$733,775$), and any successful efforts to secure delays that cost less than this amount are profit maximizing for the industry as a whole.

The California Strawberry Commission (CSC), the most active industry group, doubled (nominal) federal lobbying expenditures from \$40,000 in each of 2001–2007 to \$80,000 in 2008, and expenditures have remained at that level through 2010 (Center for Responsive Politics, 2011). State nominal lobbying expenditures were about \$30,000 for the 2001–2002 legislative session, as decisions about initial CUE applications were being made, and then dropped to around \$3000 for the next session, rising for each subsequent legislature to a level of about \$20,000 in 2009–2010 (CalAccess, 2011). It is likely, of course, that only some of these

² <http://www.californiastrawberries.com>.

³ We focus on fresh berries throughout; in the US, frozen berries are largely a residual crop (ERS, 2011c), and as they are not perishable this market operates quite differently. Large increases in the share of production going for frozen or otherwise processed berries might suggest quality issues associated with various changes to fumigation processes, but we do not observe this in the data.

⁴ The model assumes that the best alternative technology – which is assumed to be the technology resulting in the highest yield per acre for the lowest cost per acre – is selected. Given that the study was completed in 2000, the best technologies projected at the time do not entirely correspond to the alternatives actually employed during the phaseout.

⁵ All figures converted to 2010 dollars using the CPI unless otherwise noted.

efforts were focused on preserving MeBr phaseout exemptions for growers. We were not able to find evidence of significant lobbying expenditures for strawberry growers in other regions. While lobbying expenditures are one indicator of lobbying efforts, the rapidity of regulatory movement – in this case, the reduction timeline – may also be suggestive. The reduction timeline in California has been much less aggressive than in other US regions, which no longer use MeBr for field strawberries, and more broadly, the reduction timeline in the US has been much less aggressive than other non-Article 5 parties. Taken together, the lobbying expenditures and reduction timeline suggest that if lobbying has slowed the phaseout of methyl bromide for strawberries in CA, it has been a rational investment for the industry, even if the costs of using alternative pesticides are a relatively small fraction of revenues and profits.

The Critical Use Exemption process involves stakeholders who use the regulated chemical, national nominations, and recommendations or analysis by the Technology and Economic Assessment Panel (TEAP) of the Montreal Protocol, leading to final amounts which must be approved by the Parties to the Protocol at their annual meeting. In the US, the Environmental Protection Agency (EPA) solicits yearly applications with supporting information on use patterns and economic impacts from growers, and then the Department of State submits these as Critical Use Nominations (CUNs). For the last year for which data are available – the nominations and final decisions for 2012 exemptions – the CSC requested permits to treat 4454 ha, which were passed on to the Parties to the Montreal Protocol, who approved 4421 of those hectares, albeit at a lower application rate than was originally requested.⁶ If this smaller amount receives the low estimate of value from continued use of MeBr, CA growers have gained about \$225,000 in 2012 by securing the 2012 exemptions, as well as slowing further phaseout and broader price impacts until their chief competitor in the North American fresh strawberry industry completes their phaseout. At this point Mexican growers presumably lose any price advantage gained by ongoing MeBr use, and alternative pest control practices will be more established in California.

Interestingly, this approved MeBr fumigation allowance for about 30% of California acreage annually could mean use over the majority of the growing region on an intermittent basis. The CSC notes that “[m]ethyl bromide is often being used in rotation with alternative fumigants. Many growers will use alternative fumigants for 2–3 years then rotate back to methyl bromide to clean up emerging weed and disease problems” (California Strawberry Commission, 2008. *Request for a critical use exemption for methyl bromide on strawberries for the 2011 use season*. Cited in 2013 US Field Strawberries CUN). While a move towards using MeBr every 2–3 years rather than annually is certainly a substantial reduction in MeBr applications, it is not a reduction in the geographic area reliant on MeBr as part of strawberry production, and thus reflects less progress towards achieving a permanent phaseout than the reported reductions in acreage needing treatment would suggest. Unobserved cooperation within the industry to produce this

outcome would undermine the intent of the Parties to the Protocol, particularly as it could allow the use of MeBr on fields put into production after the beginning of phaseout. In California, 2009 acreage represented an increase of 89%, or 7600 ha, over the 1991 ‘baseline’ year established for MeBr under the Protocol (ERS, 2010, Table 4). It is not possible to determine if new acreage is using MeBr on the basis of allocations currently in use, as these are not broken out by sector or sub-state geographic regions by the US EPA once exemptions are granted (Federal Register, 2011). While the United States did articulate a policy of not allowing growth in CUNs due to new acreage (UNEP, 2005), they did not specify that new acreage reliant on MeBr was not allowed even if it did not drive increasing total amounts of requested MeBr, and so the continued decline in CUNs for this sector seems to satisfy this domestic policy.

While lobbying efforts are ongoing, the CSC and other industry groups also work closely with farmers and researchers developing and testing MeBr-free growing methods. CSC reports research expenditures of over ten million dollars to date toward this end, presumably beginning in the early to mid-1990s, which suggests that research expenditures are a substantial part of the CSC budget (calstrawberry.com). Additionally, within regional nomination applications, research expenditures and funding resources have historically been reported and used to substantiate nominations.⁷ Sufficient data to elicit trends in those expenditures is not available. Overall, it seems reasonable to deduce that investment in new technology hedged by investment in lobbying for continued exemptions represents an effective risk management strategy for growers and has been an influential driver of industry and regulator decision-making.

The political-economic and sociological issues around agricultural exemptions to the MeBr phaseout have been studied extensively. Clark (2001) offers an early analysis of the relationship between growers, the state of California, and the Federal EPA. Badulescu and Baylis (2006) consider the harmonization of pesticide rules under NAFTA and the possibility that that process has favored US strawberry producers. Kent-Monning (2007) raises concerns about the environmental justice implications of the use of the CUE process in California.

More recently, DuPuis and Gareau (2008); Gareau (2008, 2010, 2012) and Gareau and DuPuis (2009) argue in a series of papers that increasing pressure to provide market solutions rather than command and control ones – as evinced partly by the economic justification for exemptions to agreed phaseout schedules, which was not allowed for the previously established ‘Essential Use Exemptions’ granted for other ozone depleting substances in earlier stages of the Protocol – undermined the later stages of the Montreal Protocol. They further suggest that an emphasis on the credibility of estimates of private costs over estimates of public benefits will drive decision-making about exemptions in the future, while in the past a precautionary principle approach to the human and environmental risks associated with ozone depleting substances was more important. Stakeholder processes have been ‘captured’ to a significant degree by industry groups rather than involving a broader group more focused on the welfare of civil society as a whole. That this mode of discourse is so dominant in US policymaking is thus offered as an explanation for the ongoing use of significant amounts of MeBr in the US when other countries granted early exemptions have completed phaseout.

⁶ The 2013 nominations proved very contentious in 2011; additional bilateral (including with the CSC as well as with representatives of affected nations) and TEAP meetings were added to the schedule and multiple submissions were revised and new research offered during the process (UNEP, 2011a). The decision in the advance draft report of the 23rd Meeting of the Parties reflects the MBTOC (the Methyl Bromide Technical Options Committee, part of the TEAP) recommendation (a 2013 exemption of 461.186 metric tons for field strawberries) but not that of the minority report offered by several members of the MBTOC (UNEP, 2011a,b), which recommended granting the full nomination amount (531.737 metric tons). Application rates used to calculate CUNs and CUEs and the availability of alternative pesticides in specific California growing regions were disputed within the TEAP and among governmental and nongovernmental stakeholders.

⁷ Publicly reported research expenditure information is incomplete – CSC has reported research expenditures as Confidential Business Information, and detailed expenditure data are not typically reported in regional nominations.

3. Progress and barriers in eliminating MeBr under the Montreal Protocol

For the first year of CUNs, 2005, 28 countries nominated critical uses. This number has declined steadily and most recently, four nominating parties (the US, Japan, Australia, and Canada) requested CUEs for 2013 (UNEP, 2011). Global CUEs for non-Article 5 countries have decreased by 94% since 2005. Use in Article 5 countries has also declined, falling below total non-Article 5 use for the first time in 2007. This decline is partly due to the support of phaseout programs paid for by the Protocol's Multilateral Fund, which is not available to non-Article 5 countries. 2010 MeBr use in Article 5 countries was 5.2% of the 1991 baseline.

Nominations by the US and requests for nominations from the California Strawberry Commission between 2005 and 2014 are shown in Fig. 1. The US, which has had the slowest average annual rate of decrease in MeBr usage of non-Article 5 countries using the CUE process, had nonetheless reduced CUN amounts by 78% from 2003 to 2013. Although the US has been accelerating the MeBr phaseout in recent years, with a large drop in the 2014 nomination, a complete phaseout has not been planned and it remains unclear when complete phaseout will be achieved.

Within the US, California is now the only state still requesting critical use exemptions for field strawberries. Porter et al. (2006) conducted a global meta-analysis of strawberry yields based on hundreds of studies and found that many alternatives produce “statistically equivalent yields” to MeBr, and thus worked to undermine arguments for exemptions related to technical feasibility. The resistance to phaseout of MeBr in California has centered on technical issues but also on economic feasibility and uncertainties associated with the availability of alternative fumigants – namely iodomethane. Approval of iodomethane for use in California was predicted for 2003, and then 2005 (Carter et al., 2005), but it was not actually available for use until December 2010. The failure of California to permit the use of iodomethane was a key rationale for the ongoing exemption request in that state (UNEP, 2011); this is consistent with the US not decreasing its CUN request between the nominating years 2010 and 2011. Since the registration of iodomethane in the 2011 growing season, however, only one California strawberry grower has used it, and that usage was small in scale (Wozniacka et al., 2012).

The registration of iodomethane by the US Environmental Protection Agency and the California Department of Pesticide Regulation was controversial due to potential public and occupational health hazards resulting from its use in pre-plant soil applications. After first denying registration of iodomethane in April 2006, the US EPA granted a one-year registration in October 2007 and, by 2008, licensed iodomethane for sale and use in the US with some restrictions on its application. Most states – with California the most notable exception – quickly followed suit by

registering the fumigant. California eventually did approve the sale and use of iodomethane, but with restrictions more stringent than those imposed by the US EPA and other states. Legal challenges to the approval of this fumigant are ongoing, and an ongoing dialogue with respect to concerns about the registration of iodomethane persists between the general public, the US EPA, the California state legislature, and the risk assessment community, including government scientists involved in assessing the risk of iodomethane, a neurotoxin and possible carcinogen (Urevich, 2011). In early 2012, while no legal ruling against the use of iodomethane was made, the manufacturer announced that, based on an internal review of the fumigant and its economic viability in the U.S. marketplace, they would no longer sell this alternative fumigant in the United States and withdrew its registration in California (Chawkins and Marcum, 2012; ALC, 2012).

4. California strawberries today

US strawberries had record production levels in 2009; production, real value per unit and the total real value of the fresh strawberry crop have risen every year since 2004 according to the USDA (ERS, 2010, Table 1). Real US cash receipts have risen in every year from 2005 to 2010, the last year reported (ERS, 2011a, Table A-8). As noted above, acreage in California has also increased according to each of several data series (California Agricultural Resource Directory, 2010–2011, CSC, 2011; ERS, 2010), contrary to the predictions of declining acreage in the Carter et al. (2005) work and consistent with Carpenter et al. (2000). The ERS data go back the farthest and show that harvested acres of California strawberries have increased steadily since 1970. An OLS linear regression of acreage on time for 2001–2009 data fits well and yields an estimated increase of 650 ha/year; regressions including the earlier decades also show positive and significant trends but do not fit the data as well, suggesting that the time trend alone is not as explanatory over longer periods. These data show acreage increases in every year since 1997, with the exception of 2007, when they declined by less than 1%. Additionally, the ERS data show that the share of California acres in US strawberry acreage has grown steadily over time, from less than a third of the total in the early eighties, to more than half by the mid-90s and rising over two-thirds in 2006, where it remains.

Productivity of planted acres has also risen during this time period. ERS data on California yields from 1970 to 2009 show steadily increasing output per acre (ERS, 2010 Table 4). This trend continues for years subsequent to the onset of efforts to eliminate MeBr, though yields are, predictably, subject to weather and other conditions and thus more volatile than acreage. The share of California production in total domestic production has also grown over the time period covered, and has hovered around record highs of 88–89% since 2003. More recently, the Fruit and Tree Nuts report notes of 2010 that “last year, the increase in average yields per acre

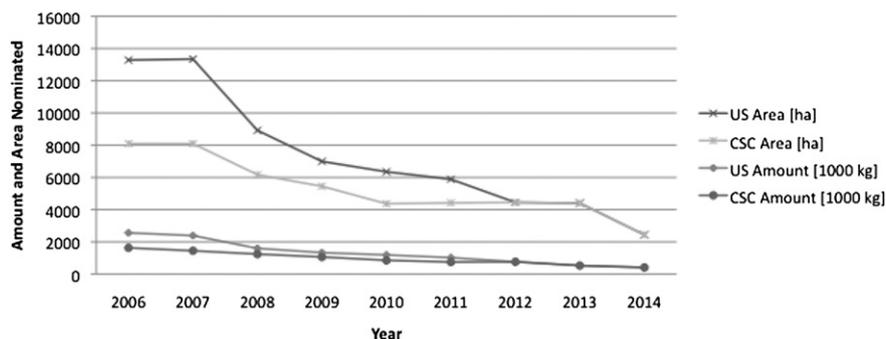


Fig. 1. US and California Critical Use Nominations, with MeBr requests and acreage.

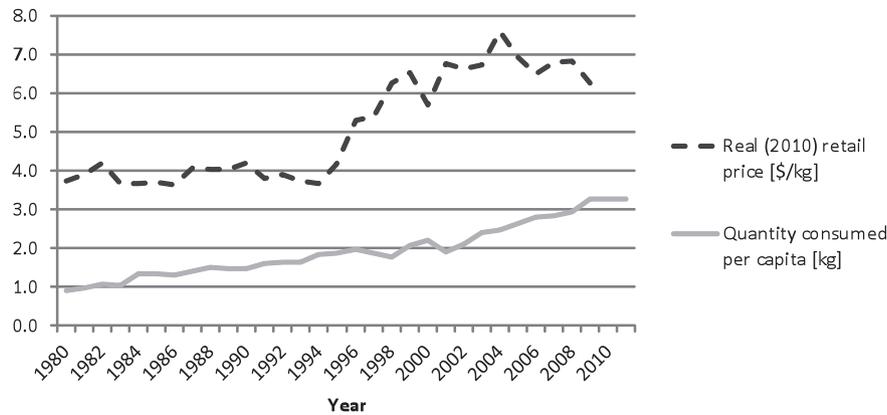


Fig. 2. US fresh strawberry prices and consumption.

in California (up 7 percent from 2009) more than made up for the decline in harvested acres (down 3 percent), resulting in a larger crop” (ERS, 2011c).

On the consumption side, we see that per capita consumption and total consumption of fresh and frozen strawberries continues to rise. In fact, per capita annual consumption of fresh strawberries has broken record levels in each year from 2003 to 2009 (ERS, 2011c; ERS, 2010, Table 12) even as real retail prices have stayed relatively stable or declined slightly. The most recent figures suggest an increase of 48% in per capita consumption of fresh berries since 2002, the last year covered in Norman (2005); with population growth that has amounted to a 67% increase in total US consumption over the same period. The continuing increase in per capita consumption as well as trends in real retail prices can be seen in Fig. 2.

We examine seasonal patterns in retail prices to evaluate hypotheses about patterns of trade raised in some of the ex-ante studies discussed above. Real retail prices in June, the period identified by Carter et al. (2005) as most vulnerable to losses in a MeBr phaseout, rose in 5 of the 10 most recent years for which data are available (2000–2009). The average of real June retail prices from 2005 to 2009 was 1% higher than for 2000–2004, suggesting no significant change in the trend over time as a driver of this observation. Looking more closely, however, and in contrast with all but 3 of the preceding 24 years of available data, we note that for 2004–2008 May retail prices were higher than April prices, reversing again in 2009. Grower prices confirm this trend; for 2005–2011, May prices to growers for fresh berries were higher than April prices in 5 years and lower in two years (<http://quickstats.nass.usda.gov>).

While farming is subject to significant variability from year to year, both in the various growing regions domestically and abroad, this is suggestive of an increasingly competitive market in North America. Norman (2005) predicted that the pre-2005 gap between higher April prices and lower May prices was likely to decrease in size in the absence of methyl bromide. Ex-post, we see that the gap has not just diminished but has reversed, while significant MeBr use continues. In the past, imports from Mexico peaked in April and domestic deliveries peaked in May or June. The historic drop in prices as domestic berries hit the markets in bulk suggested that exporting costs were high enough for Mexican growers that expanding exports during this period was relatively unattractive. In recent years, we have not observed a significant shift in strawberry acreage away from northern California growing areas, which deliver strawberries later in the season, and towards southern regions, where strawberries come in earlier (CSC, 2011), which might offer a domestic explanation for this shift in the pattern of relative prices throughout the year, so the currently observed

pattern of relatively lower April prices is consistent with the US market becoming more attractive for Mexican growers wishing to export for more of the season or US growers facing rising costs in their peak production periods. It could also be that unobserved changes in crop timing associated with the use of MeBr alternatives have shifted the timing of peak deliveries in some parts of the state.

Investigating trends in imports and exports of fresh strawberries in more detail, however, does not provide strong supporting evidence for the hypothesis that increased Mexican imports are driving intra-year changes in relative prices. Imports of fresh strawberries to the United States, almost exclusively from Mexico, have indeed grown substantially, continuing a trend observed well before MeBr restrictions began. They have more than doubled since 2004 (ERS, 2011b and Table G-1, ERS, 2011a). The share of Mexican imports in domestic consumption has changed less, however, trending slowly upward since the mid-1980s and now around 8%.⁸ This may reflect increasing retail availability and consumption in the off seasons for domestic strawberries as well as increased April exports from Mexico.

United States exports also grew during this time, rising more than 50% from 2004 to 2010 (Table G-2, ERS, 2011a). The bulk of these exports go to Canada, which consumes considerably more strawberries than are produced there. The increase in tonnage of exports to Canada is very similar to the increase in imports from Mexico, suggesting that changing price patterns over time cannot be cleanly ascribed to trade advantages for Mexican growers selling in the United States. Domestic exports could well increase the scarcity of domestic berries at peak periods, driving domestic prices up. Strawberry exports do peak in May (ERS, 2011a, Tables G6–G8). Unfortunately, import and export data by month are only available for a few years, making it difficult to discern trends over time with confidence.

Also affecting trade patterns in North America may be the promulgation of Country of Origin Labeling (COOL) regulations in the United States (<http://www.ams.usda.gov/AMSV1.0/COOL>). For the 2009 and subsequent seasons all fresh strawberries sold in the United States were required to carry labels indicating where they were grown and packed. One expectation of supporters of this policy was that consumers would prefer domestic products over imports, and this may have reduced the vulnerability of California growers to cheaper imports from Mexico in particular. Carter and Zwane (2003) argue that this was in essence a (costly) protectionist policy. Van Ittersum et al. (2007) note that consumers may prefer domestic or local region products both because they believe them to be better or safer, or because they have a preference for

⁸ Calculations based on ERS (2011b) yield slightly different shares than those given in ERS (October 2010, Table F-14).

supporting growers in geographic regions that they identify with. Either of these would help California growers and hurt Mexican exporters in the domestic market. While we cannot isolate any impact of this over the short period since the rules have been established, it remains clear that the majority of the US market continues to be served by domestic growers.

The MeBr alternative iodomethane has been approved for use in Mexico and a commercial launch there is planned for 2012 (ALC, 2010). As an Article 5 country, Mexico has until 2015 to phaseout MeBr under the Montreal Protocol; however, the government of Mexico has committed to completely phaseout methyl bromide by 2012 (UNEP, 2010),⁹ by which point it seems likely that growers there will be able to use iodomethane and California growers will use continuing allocations of MeBr and any of several alternatives which show little to no yield changes in current research (summarized in USDoS, 2012). Costs for various production inputs and growing conditions will of course vary and be drivers of comparative advantage in international trade as with any commodity. It is unlikely that changes in land use in California or Mexico have been driven by an expectation of continued MeBr use in Mexico after it is curtailed in the United States.

Additionally, increases in imports may reflect changing trade advantages unrelated to MeBr phaseout in the United States. From 2002 to 2009, imports of Mexican lemons increased from negligible to a major trade commodity, increasing to 54 times initial levels. Avocados increased eleven fold, raspberries increased eight fold, pineapples were up 250%, and pecans and coconut meat also increased more rapidly than fresh strawberries. Tangerine, lime, and mango imports grew more slowly than strawberries but still rose significantly (ERS, 2011a, Table G-1). Trade changes driven by NAFTA or other drivers of increased globalization should not be ascribed to the ongoing MeBr phaseout without more substantial evidence than we are able to find.

5. California strawberry production cost estimates

Looking at the various sample budgets available from Cooperative Extension in California (UC Cooperative Extension, 2001a–c, 2004a–d, 2006, 2010, 2011a–b), we do not observe clear links between decreasing availability of MeBr and costs or profits. 2010 and earlier reports note that alternatives to MeBr are available and in use, but the sample budgets assume fumigation with MeBr and chloropicrin (or 'Pic'); Pic allows for significantly lower rates of MeBr application in areas where MeBr had previously been used alone. Of the two 2011 reports one notes that methyl bromide availability is limited and does not specify a fumigant in the line-item budgets and the other uses Pic alone.

In the geographically central of the three largest growing regions, fumigation costs as a share of total costs were 2.4% in the 2001 sample budget, 3.7% in 2004, 3.5% in 2006 and 2.9% in 2011. For the same 3 years estimated net returns were 1.6, 14.2, 7.6, and 3.2% of total costs. In the main growing region to the south we have budgets for 2001, 2004, and 2011 which show a decline in fumigation costs as a share of the total, from 6.0 to 5.7 to 3.1%, while net returns increased from 9.5 to 13.4% and then dropped to 2.2%. In the

northernmost growing region, budgets for 2001, 2004 and 2010 show increasing fumigation costs (5.2, 5.4 and 6.9% of total costs, respectively) and fluctuating net returns (6.6, 9.4 and 4.0%). These numbers offer some insights into input and production costs, in particular suggesting weakly declining fumigation costs and yielding some evidence of declining net revenues in the most recent years, but we note that the sample budgets are designed to offer a general understanding of costs and revenues using current methods rather than to support rigorous economic analysis.

Critical Use Nominations themselves are another source of data on trends in production costs and revenues. The nominations through 2013 give a baseline yield rate for fumigation with 100% methyl bromide and discount it by some fraction for each alternative pest control regime. While detailed budgets are not provided, annual CUNs for CUEs also include estimates of the economic impacts of MeBr as compared to alternatives.¹⁰ These estimates are developed to support the case that additional exemptions to use MeBr in California are needed to avoid 'significant market disruption,' which is a key part of the standard established in Decision IX/6 of the Montreal Protocol to define a use as critical. Alternatives are shown with associated yield estimates and implied costs to producers facing changed yields and other practices. For 2006–2013 CUNs, the baseline MeBr yield estimates fluctuate a bit, dropping by around 15% from 2006 to 2008 levels in 2009–2010 and then rising again for 2011–2013 nominations. Reported yields per hectare are well below those reported in the sample budgets referenced above, typically around 40–50,000 kg/ha in recent CUNs, with some alternatives in the 30–40,000 range in earlier nominations, while first year strawberry yields in the sample budgets are around 60–80,000 kg/ha and the most recent second year yield reported is over 50,000 kg/ha (UC Cooperative Extension, 2011c). The yield loss associated with moving from MeBr to a mixture of 1,3-dichloropropene (1,3-D) and chloropicrin is steady at 14% throughout, suggesting that the loss rate estimate was not revised over time but simply applied to the MeBr number for a given year. This alternative is the only one included in every nomination¹¹; metam sodium (MS) and a mixture of Pic and MS were excluded from 2010 to 2009, respectively, and a mixture of Pic and MeBr was not added until the 2010 nomination. Iodomethane is included for the first time in the 2013 nomination.

Projected strawberry prices drop by about 30% from 2010 to the 2011 nomination estimates, and they remain at this low level through the 2013 nomination. This price, \$1.37/kilogram,¹² is well below current and recent reported grower receipts (ERS, 2010); it is not clear why recent nominations have used such a low baseline price. This price drop helps explain why the estimated value of MeBr use as opposed to 1,3-D+Pic can be relatively stable, ranging between \$43–68 per kilogram for 2006–2013 nominations, while the figure for "percentage loss in net revenues" swings up to 1269% in 2011 and subsequent years, after previously being estimated at 55 and 87%. While the loss to net revenue is appealing as a proxy for disruption suffered by growers, the nominations note that the

¹⁰ These figures are all reported in nominal dollars, as the requests are filed a few years in advance of the proposed use, and do not specify nominal or real figures. Additionally, many of the numbers do not change from year to year, suggesting that the precision of the estimates is not such that deflating them should drive conclusions.

¹¹ It is worth noting that the 1,3-D mix is not available to all growers, as many California townships restrict 1,3-D use (Carpenter et al., 2001) and some counties restrict Pic application. This may be why the extension service budgets above exclude it, and this may also make it difficult to draw statewide conclusions on the basis of variation in yield estimates between 1,3-D alone and in combination and MeBr.

¹² The CUN itself reports 'units'; we believe these to be kilograms based on matching with previous California nominations.

⁹ In 2008, Mexico's MeBr consumption was below consumption allowed under the Montreal Protocol. As of 2010, those implementing the National Methyl Bromide Phase-Out Plan for Mexico (the United Nations Industrial Development Organization (UNIDO) along with the governments of Italy, Spain, and Canada) intended to eliminate the remaining MeBr (approximately 900 ODP tonnes) by 2012, provided requested monies from the Multilateral Fund were received. The plan initially proposed that the strawberry sector convert near the end of the phaseout because "strawberry growers were reluctant to reduce MB consumption" (UNEP, 2010, p. 5). However, Mexico's strawberry growers have since requested immediate assistance in order to accelerate completion of the phaseout.

required gross revenues less operating costs are “difficult to measure and verify” (USDoS, 2004–2011). Net revenues are sensitive to the implied change in gross revenues of much lower strawberry prices even in the absence of significant cost shifts, and smaller net revenues produce bigger percentage changes for a given nominal cost increase or yield decrease.

As this article was being finalized for publication, the 2014 Critical Use Nomination for field strawberries in California was made public. It requests 415 metric tonnes of MeBr for field strawberries, a bit over a 20% decline from the request for 2013. The drop in requested acreage to be treated is about 50%, suggesting decreasing use of MeBr in combination with other chemicals and thus at higher rates, while the baseline fumigant in the economic impact table is now a mixture of MeBr and Pic rather than MeBr alone. The economic impact analysis shows no yield losses for any alternative, a substantially higher output price for growers of \$2.51 per unit, a roughly 60% increase in reported yields to nearly 80,000 kg/ha, and greatly reduced or even negative loss measures. The estimated loss or gain as a percentage of net revenue ranges from –9% (for an alternative using iodomethane) to 5% across all reported alternatives (USDoS, 2012). Chloropicrin alone yields an increase in net revenue of 2% relative to the baseline. Thus the key driver of the request is now the limited access in some specific areas to use of some of the alternative fumigants, or the requirement for buffer zones around schools and residential areas. However, the township caps that limit 1,3-D are being reached in regions where strawberry acreage has grown substantially since the US agreement to phaseout methyl bromide. It is difficult to argue that a sub-state regulatory decision that limits the amount of acreage in all crops that can be treated with certain pesticides represents a substantial disruption of the California strawberry market due to the elimination of methyl bromide.

It is interesting to note that with the exception of the 2006–2008 nominations the economic impact estimates in the CUNs assume no price gap per unit produced using MeBr and using alternatives. Wolverson (2012) indicates that in 2006–2008 the change in prices was used to reflect anticipated planting delays and subsequent later deliveries of crops to market for growers using alternative fumigation practices rather than broader market impacts. Constant output prices across alternatives with significantly differing yields suggest that these economic impact estimates assume no market price responses to significant supply swings (including projected yield losses of up to 30% for California growers, which would certainly affect the domestic and North American markets), and thus do not account for the significant amount of any cost increase that will be passed along to consumers as the market reaches a new equilibrium price (see Norman, 2005 for detailed discussion of the impact of relatively inelastic

consumer demand for fresh strawberries on market prices and the distribution of the burden of rising production costs). If all acres not receiving exemptions were using alternatives with substantially lower yields and similar or increased costs, we would expect market prices to rise and moderate reductions in profits.

While we do not observe profits directly in the way that we do acreage and revenues, it is difficult to reconcile the history of CUN figures for California yields and costs using alternatives with the increasing use of alternatives and the increasing yields per acre and increases in total acreage noted above. The continued expansion in acres noted above is not consistent with an industry facing large losses as the phaseout continues; basic economics tells us that rising profits attract entry into an industry and falling profits drive exit, as more remunerative investments are sought for the land and capital previously employed in the failing sector. It seems likely that modifications of farming practices in concert with the use of non-iodomethane MeBr alternatives have been increasingly successful at preserving yields in those areas that are doing without MeBr either altogether or at least in some years. Input substitution as the price of fumigation relative to other inputs into the strawberry growing process rises – altered weeding practices or schedules, perhaps, or alternate cultivars or crop rotations – would be expected to lower the costs of compliance with the phaseout process. We have found no evidence suggesting zero input substitution characterizes this industry, and any substitutability across inputs will reduce cost burdens on growers. Learning by doing should also lower costs and gaps in yields across different pest control strategies over time, as growers and fumigation contractors become accustomed to using alternatives. Further and perhaps most significantly, it seems that the calculations used to support the granting of CUEs in this sector do not allow for the ability of growers to share cost increases with consumers, who may by their numbers and relatively inelastic demand bear the majority of any remaining burden without individually experiencing price increases as economically disruptive.

6. Additional drivers of change and trends

While per capita consumption of fresh berries by Americans has continued to rise since 2004, it is not obvious that this is driven by rising per capita incomes as earlier data suggested to Norman (2005). Mean and median household and per capita income trends were disrupted by the global recession, with US median household income falling in 2008, 2009 and 2010, mean household income falling in 2007, 2008, 2009 and 2010, and per capita income falling in 2009 and 2010 (Historical income tables, www.census.gov). With a relatively short data period to contend with and a lack of detailed information about changes in income distribution

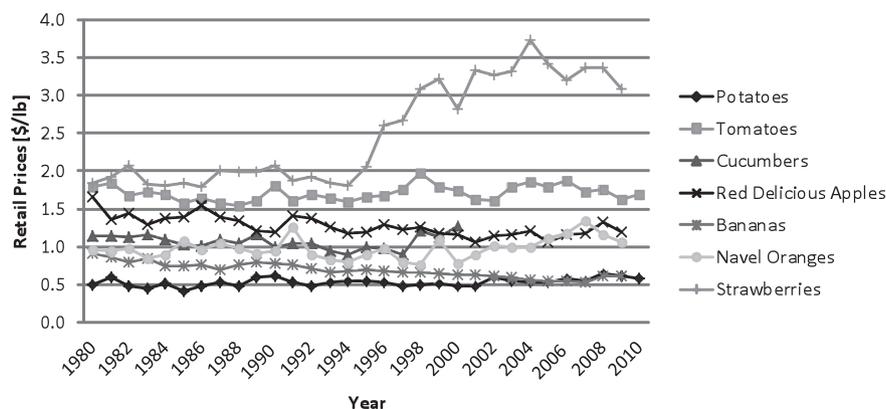


Fig. 3. US fruit and vegetable real retail prices.

and the relationship between income and strawberry consumption, disentangling trends in prices, consumption, and income to estimate relationships is imprecise.

One thing we do note in this market is that while prices of many fresh fruits and vegetables, including strawberries, have trended slightly downwards since 2008 (ERS, 2010 Table 12 and October 2011 Table A-7), over a longer time horizon, we observe a marked difference in fresh strawberry prices, which have increased by 85% from 1994 to 2008, compared to the prices of some other fruits and vegetables, which have largely been stable or increased to a much lesser extent (Fig. 3). Per capita consumption of fruits overall remained constant from 1994 to 2008, while per capita vegetable consumption initially increased from the mid-90s to 2000 but declined subsequently. This suggests that significantly increased strawberry consumption in the face of rising or stable prices in recent years is not likely to be driven by a decline in the price of strawberries relative to substitute fruits and vegetables. Changes in income, tastes, and preferences as well as the increased availability of strawberries at all times of the year are combining to support increased per capita and total strawberry consumption.

7. Conclusion

We offer an ex-post analysis of the impact of the mandated phaseout process for methyl bromide on California strawberry growers to date. Ex-ante estimates of the economic impact of the elimination of MeBr were required by and influential in the CUN and CUE processes, in contrast with either a benefit-cost approach including public health and environmental protection gains, as required by many of the domestic environmental policies of Parties to the Montreal Protocol, or with the Essential Use Exemption process used for other ozone depleting substances eliminated earlier in the ozone protection regime. While this is not an ex-post analysis of the originally expected complete phaseout, and thus cannot be directly compared with ex-ante predictions based on the complete elimination of MeBr use, it does offer insight into the gap between predictions and outcomes of a strawberry industry moving away from this ozone depleting pesticide while facing import competition from a major trading partner with a more lenient phaseout schedule.

Contrary to many ex-ante predictions and concerns expressed by stakeholders, California strawberry growers have thrived in recent years relative to both domestic and foreign competitors. They have successfully worked to ensure that MeBr has been available for significant fractions of their significantly expanded acreage, increased exports, and continued to enjoy rising yields and revenues as well as increased demand from consumers. The interim years between the planned elimination of MeBr and the increasing success of alternatives as detailed in the 2014 CUN and other reports have been years of expansion in the face of global recession and increased imports from Mexico, and successful navigation of technical and regulatory changes. Industry data suggests that the real burdens associated with changing agricultural practices have not kept this sector from profitability and growth in a challenging economic environment, though we cannot know how much faster growth might have been if MeBr use had continued unabated.

Alarming numbers in the CUNs sent to the Parties to the Montreal Protocol are not consistent with the success of California strawberry growers in aggregate as use of MeBr has been reduced. Nor are they consistent with basic economics. The 'economic disruption' standard of the CUE process was not intended to require the Parties to permit application of MeBr on new acreage to allow limitless expansion of a given industry using MeBr, and it is difficult to justify ongoing exemptions to support expansion rather than

protect existing growers and growing regions. If all the new acres in production since 2005 are being managed profitably without MeBr, and existing acres are using less MeBr less often while overall and per acre yields and revenues rise steadily, it seems we have reached a point where alternatives are demonstrating successes for field strawberries in California.

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