Title: The construction of a regulatory style for genetically modified crops in Chile

Key words: transgenic crops, socio-scientific controversy, regulatory styles, Chile

Abstract:

After several decades of commercialization, genetically modified crops continue to generate controversy with adoption rates and public acceptance varying amongst countries. To make sense of the technology nations have developed regulatory styles based on their particular framings of risk, institutional arrangements and public participation modes. Our objective is to understand the development of Chile's regulatory style and explain why, after several years, the controversy ensues. We reconstructed the technology's use and regulatory evolution, identified key actors in the controversy and compared Chile's regulatory style with that of the United States and Europe. Chile aligns more closely with the US approach yet unlike the latter it restricts the technology's use to a specific sector, the seed-export industry. This apparent ambiguity results from the concerted action of government, private and social actors. Global market forces and the nation's export-based economy have shaped its regulatory style. Civil society organizations have framed their opposition around a basic demand for public information and transparency, raising the issue of public trust. Thus Chile's particular civic epistemology appears to respond to a technocratic culture that limits crucial public debate. Chile's existing regulatory style raises the issue of the need to strengthen and broaden the accountability of technological applications.

Author:
Maite Salazar López
Escuela de Biotecnología, Universidad Santo Tomás. Assistant Professor
Núcleo Milenio en Genómica Funcional de Plantas. Associated Junior Researcher

Co-authors:
Manuel Tironi Rodó
Instituto de Sociología, Pontificia Universidad Católica de Chile
Assistant Professor

Daniel Valenzuela Galarce
Núcleo Milenio en Genómica Funcional de Plantas.
Research Assistant

I. Introduction: Regulatory styles and the controversy over genetically modified crops

Almost twenty years after the introduction of the first genetically modified food into the market, the debate over genetically modified organisms (GMOs) remains contentious (Levidow and Carr, 2007). Far from having reached a consensual stage, the discussion seems to be ever more polarized, intense and conflictive (Bonneuil et al 2008; Bonneuil and Levidow 2012; Levidow and Carr, 2007). As with other iconic technological innovations (Bauer, 1995), there is no public consensus about the risks and benefits involved in the use of GMOs. Pro- and anti-GM arguments have multiplied, and are often framed as a mix of economic, agricultural, ethical, environmental, political, ecological and cultural issues. Indeed, consumers, farmers, NGOs, national governments, international regulatory bodies, scientists, retailers and the biotech industry are some of the parties involved in the controversy –and each of them has assembled a complex web of positions, arguments and facts.

To make sense of the technology nations have developed regulatory styles based on their particular framings of risk, institutional arrangements and public participation modes (Jasanoff 2005a, 2005b, Benauer 2002, Hindmarsh 2008, Vogel 2002). Thus for example the policy response of the United States (US) framed the risks of biotechnology as a *stream of products* and the technology itself as familiar. In contrast in the European Community (EC), biotechnology and GMOs have been framed as a *process* in some ways not yet well understood and which requires "precaution" (Dunlop 2000, Jasanoff 2005). Thus while the US is a top world producer of GM crops, the EC restricts commercial cultivation and field trials. Worlwide commercial cultivation continues to increase in acreage, with some developing nations among top produces (James, 2011). At the same time, public responses to the technology – while varied - are embedded and consistent with their political culture, rather than irrational and unpredictable expressions of concern (Jasanoff 2005a). Furthermore, the collective action of the public has influenced regulatory policy in different ways depending on the context-specific institutional arrangements. In the US low public outrage in the context of centralized decision-making allowed for greater influence by the biotechnology industry. In the EU higher public outrage, coupled with multi-layer decision-making and low industry organization, generated greater influence by opposition groups (Bernauer 2002). But perhaps most importantly these comparisons highlight how different actors within and across nations construct common narratives to make sense of the uncertainties associated with new technologies such as GMOs.

In Chile the debate over GMOs, particularly over GM crops has grown and made more visible in the last few years. Various actors have intervened in the debate and questions about the appropriateness of Chile regulatory situation have emerged from all sides of the controversy. Issues of public participation in particular are emerging, as opposition groups seek to define the public arena. While there has extensive research on the GMO controversy in the developing world, less has been said of emerging countries far from the technology's development center. Our goal is to understand the development of Chile's regulatory style and explain why, after several years, the controversy ensues. We reconstructed the technology's use using primary data on GM crop production and its regulatory history, identified key actors and compared Chile regulatory style to that if USA and the EU.

II. Methodology

We used a qualitative case study approach to analyze the emerging GM controversy in Chile. Our main data sources were interviews with key actors and content analysis of various public documents. Our design was emergent but focused, i.e. initial questions and key actors were identified based on content analysis of public documents and participant observation of selected events. Initial interviews generated information about other key informants that were later interviewed. This iterative process is currently underway and interviews will be conducted until data saturation.

For the interviews, we initially identified key organizations participating in or party to the debate and contacted members or representatives. These included producers, government officials, members of NGOs, scientists and biotech industry representatives. Interviews were conducted in a semi-structured manner and covered the following topics: definitions or framing of key issues, organization and strategies, and decision-making and participation. They were taped and then transcribed. The analysis presented in this paper is based on results from interviews with 12 key informants.

We complemented our analysis with production data for GM crops in Chile from government records. We obtained this data via Chile's the new Transparency Law enacted in 2009 which seeks to ensure access to public information. To our knowledge this will be the first time this data is analyzed and published. Based on this data we reconstructed the tecnology's use and its regulatory evolution, identified key actors and their perspectives and compared the case with the United States and European Union.

We analyzed interview and document data using the software for qualitative analysis Nvivo. An initial set of codes were created using the software NVivo reflecting themes that emerged from the data and/or were found in the literature. These were categorized according three main groups: "setting-context", "definition of the situation" and "framings or perspectives held" (Bogdan and Biklen 1998). Sub-codes emerged, were categorized and further refined the analysis. On-going data analysis from documents, production data and interviews was used to reformulate and further focus the research questions and the interview guide.

III. Transgenic crop adoption in Chile: use and regulatory evolution

According to public records, the first adoption of GM technology for crop use in Chile dates back to 1992, with very small areas of production. Adoption grew slowly until 2000 when GM cultivation areas increased in magnitude with onset of commercial GM seed production. Since then, production has grown steadily. The main GM crops grown in Chile are maize, soy and canola (table 1). Maize is clearly the predominant crop with 90% of total production, followed by soy and canola. Commercial GM production has been restricted to the seed-export industry. Non-seed cultivation is permitted only for research purposes.

Table 1: Surface area of GM crops in hectare, per crop and production year

Crop	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
canola or raps	203	36	110	139	746	628	445	1188	4012	1862	2648
maize	1517	6193	10931	8436	7614	12118	17982	21831	20977	17389	13614
soy	6506	279	215	128	273	166	250	1398	5389	5474	3514
Other crops*	2	16	12	4	51	18	163	47	4	44	22
Total/year	**8228**	**6524**	**11269**	**8707**	**8684**	**12929**	**18839**	**24464**	**30382**	**24769**	**19798**

*other crops include: others: rice, safflower, alfalfa, *B juncea*, barley, eucalyptus, flax, pumpkin, sunflower, melon, potato, pine, sugar beet, tobacco, tomato, wheat and grapes

Currently Chile is the 6th world seed producer (international seed federation http://www.worldseed.org/isf/seed_statistics.html) and GM crops represent an important part of the growing seed industry. Chile's value as a seed producer stems from its phytosanitary isolation and seasonal difference with the northern hemisphere where key markets are located. This seasonal difference – known as "counter-season" - allows companies to test products or increase seed in the south during the northern hemisphere's winter, cutting down product development time. Thus new commercial lines may be harvested in the north, "tested" or increased in the south, and be ready for sale in time for the North's growing season. The counter-season is also important for products under review for commercial authorization in the north, as key data can be generated one season ahead of time or seed increased for field trials. The seed industry, in general, is characterized as a highly innovative and technological sector. While its overall volume of production is small compared with other agricultural sectors in Chile, the seed industry's growth and progressive approach makes it a strategic sector for agricultural production. In this context, transnational biotech companies are key players.

GM crop adoption in Chile occurs in the context of an economic development strategy highly supportive of innovation, free markets and global market integration. At the same time, global market integration requires that legal and regulatory frameworks align with international standards, particularly in regards to private property rights. In the case of agriculture, World Trade Organization agreements via the UPOV establish standards for property rights which must be followed by countries engaging in bi and multi-lateral commercial agreements.

Main GM crops and events present in Chile

The main traits present in GM crops grown in Chile are herbicide tolerance and insect resistance. The specific events – or genetic modifications – that confer these traits to the crops grown in Chile have increased over time as GM surface areas have grown. In the case of maize for example, GM lines grown since 2007 include the presence of

more than 250 different events[1]. Table 2 illustrates the importance of different GM traits grown in Chile, with production data from 2010. For maize the most frequent modification is the stacked trait herbicide tolerance and insect resistance. Stacked traits – defined as the presence of more than one genetic modification in a crop are increasing in importance worlwide (Stein and Cerezo 2010). Chile reproduces two main world trends for GM crops: 1) the main traits present are herbicide tolerance and insect resistance 2) increased production of GM seed with various stacked traits (the case of maize in Chile). These trends are consistent with Chile's role as a main seed exporter for the world.

Table 2: Number of events and traits types in GM crops in Chile

crops	Number of events present per crop							Total events
	one trait			two traits			three traits	
	TH	RI	other	TH-RI	TH-X	RI-X	TH-RI-X	
canola or raps	19	0	12	0	4	0	0	**35**
maize	34	37	26	224	3	8	24	**356**
soy	38	3	5	0	4	0	0	**50**
Other crops	4	3	6	0	0	0	0	**13**
Total	**95**	**43**	**49**	**224**	**11**	**8**	**24**	**454**

HT: herbicide tolerance; **IR**: insect resistance; **HT-IR**: combination of herbicide tolerance and insect resistance; **HT-X**: combination of herbicide tolerance and another modification; **IR-X**: combination of insect resistance and another modification. **Other modifications**: yield increase, modification of fatty acid content, modification of oleic acid content, drought resistance, altered fertility, expression of alpha amylase, expression of pro insulin 2, expression of gamma linoleic acid. **Other crops**: zucchini, sugar beet, tomato y safflower

Chile as a "word laboratory"

A more in-depth look at GM production data suggests a nuanced reality. GM crops grown in Chile include a range of non-production traits such as modifications for industrial, processing and pharmacological uses, as well as nutritional quality. Less frequent production traits grown include drought resistance, increased yield and various types of virus resistance. Thus, while production is limited in acreage and concentrated on herbicide tolerance and insect resistance, the range of traits grown in Chile is in fact quite heterogeneous (see table 3 for more details).

[1] Our analysis considers the combination of previously developed traits as a "new event" . This of course increases the number of events, since many of these are in fact different combinations of previously developed or authorized traits. Nevertheless, even if we only focus on single traits, the number of events has clearly increased over time.

Table 3: Non-production trait present GM crops in Chile

crop	modification
maize	alpha amylase expression
soya	Modification of oil content
soya	oleic acid content
safflower	expression of proinsulin2
safflower	gamma linoleic acid content
rice	expression human albumin
canola	phytase production
safflower	bovine enzyme production
rice	lactoferrin production
safflower	insulin production
maize	monoclonal antibody production

Furthermore, at the onset of GM development in the early 90s Chile provided a place in which to carry out field trials or increase GM seed for these trials in the north. The case of GM tomato, the first GM product commercialized worldwide, illustrates Chile's role in these early years. Various seed companies grew GM tomatoes in Chile before its approval for commercialization in the US and EU at a time when national regulation was non-existent or precarious. There are reports of field trials conducted in Chile as early as 1989 for the delayed ripening tomato developed by Zeneca Seeds in collaboration with the University of Nottingham[2], though no public records exist about the event (cited in http://www.ncbe.reading.ac.uk/NCBE/GMFOOD/tomato.html).

Besides Zeneca's GM tomato, our analysis of public records indicates that a variety[3] of GM delayed ripening tomatoes were grown in Chile from 1992 onwards and that at least several of these years represent field trials. Seed companies in Chile also grew Monsanto's insect resistant GM tomato prior to its commercial approval in the US. Since commercial production is prohibited in Chile, we can presume this limited production was intended for field trials or seed increase. Interestingly, a local seed company continues to grow this GM tomato in Chile for commercial seed export, although it is no longer sold commercially in the US or EU. The GM tomato seeds are produced in Chile's on of tomato seed growing region, the central valley.

More interestingly, our analysis of public records (obtained via the new transparency laws in Chile) indicate that since the late 90s, farmers in Chile have been cultivating pharma and industrial GM crops. This production represents the next wave of GM crops, modified to produce pharmaceutical or industrial compounds in both food and non-food crops. Chile has authorized the cultivation of four crops with these traits: rice, canola, safflower and maize. Worldwide pharma and industrial crops are cultivated

[2] Zeneca's tomato is often confused with the first commercialized GM crop: Calgene's FLAVR SAVR tomato, also modified for delayed ripening but intended for consumption as a fresh fruit. FLAVR SAVR used anti-sense technology while Zeneca's approach involved inhibition of enzymes involved in cell wall metabolism.

[3] Besides Zenaca three other companies developed delayed ripening tomatoes: DNTP, Agritrope and Monsanto.

mainly in the stage of field trials and for limited commercially purposes. Thus it is likely that most of the cultivation in Chile corresponds to field trials or seed increase. Again the range of traits engineered into these crops is varied and represents pharmaceutical, food additives and industrial-use compounds (see table 3 for some examples). Based on the data available, it is likely that pharma and industrial GM crops represent a small fraction of total GM cultivation in Chile.

One of Chile's roles in the development of GM crops has been as a tool or a "world laboratory" for testing during different stages of the technology's development: While not a strategic player in scientific or commercial aspects of its development, Chile has been linked to the global networks of GM development in more subtle and surprising ways. This is particularly interesting from the point of view of Chile's limited-production approach to GM technology adoption. ¿How has this shaped Chile's particular regulatory style? ¿What responses - if any at all - did these early trials generate in the public? ¿How have they shaped the controversy? These issues merit further attention and we are exploring then in our research.

The development of a regulatory context

Regulatory action for GM crops in Chile began, albeit precariously, shortly after the first GM food product was commercialized in the world. Chile's first GM regulation was a resolution enacted in 1993 by the Ministry of Agriculture's Animal and Livestock Service (SAG for its acronym in Spanish). The resolution justified the need for regulatory action because "[GM seeds] pose a risk to agriculture" and the SAG was mandated to establish norms regarding "imports dangerous to plants". It limited seed reproduction activity for export purposes only, and outlined a general frame for procedures. Thus Chile's first regulatory action framed the issue as a phystosanitary one aimed at controlling the technology's impact on a specific economic sector. GM products were first framed as an "import plant material" and more specifically as its "seed" form. A new norm was enacted in 2001, which maintained the restriction to the seed export sector but now mentioned "potential benefits", risks to biodiversity as well as impacts on agriculture. The new norm also includes locally produced GM seed in its definition of the regulated entity.

In contrast, regulation dealing with GM products as a "food" was established more than a decade later with a 1996 amendment to the National Food Rule. The amendment mandates oversight of "biotechnlogical events" intended for human consumption by the country's food and drug safety agency, the Public Health Institute (ISP for its acronym in Spanish). This oversight has not generated actual GM food authorizations to date. Currently, there are no labeling requirements for GM foods or foods containing GM ingredients, either imported or produced locally. Table 4 indicates the principal norms that regulate GM crop technology in Chile today along with their enactment date.

Table 4: Principal regulations and norms in GM food and crop oversight

Agency	Type of regulation	Year	Applies to
Ministery of Agriculture's Plant and Livestock Service (SAG)	resolutions	**1993**	GM seed imports
		1997	animal consumption of insect resistant maize
		1999	biosecurity norms for some pharmacrops
		2001	update of 1993 seed import norm
		2002	time frames for import and liberation into the environment of GM seeds
		2005	establishes technical comite for GMOs
		2010	status of information included in petition
Ministry of Health's Public Health Institute (ISP)	modification of 1996 Food Safety Rule	**2003**	oversight of GM food for human consumption
	technical-administrative norm	**2007**	assessment of GM food events for human consumption
	resolution	**2007**	procedures for establishing Approved Events List
	resolution	**2009**	establishment of new expert panel

Regulatory oversight of GMOs by the country's environmental authority has been non-existant to date and environmental impacts are considered only under the SAG's framework of "phytosanitary control". The new Environmental Law enacted in 2009 includes the environmental release of genetically modified organisms (GMOs) under its purview and may change this scenario in the future

There is no explicit framework that coordinates the actions of the two main agencies, SAG and ISP, involved in GM regulatory oversight. In the practice GM "foods" and "seeds" have been treated as two distinct entities. As such regulatory oversight for GM "foods" has not caught up to the reality of GM food products commercially available in the country, yet oversight of crops has yielded a very specific set of norms to deal with seed cultivation. Thus for example, as early as 1997 the SAG established a norm to allow animal consumption of insect resistant maize, and thus address the "loss of commercial opportunity" for remnant seed not exported and which had to be destroyed under existing rules.

In summary, under the existing regulatory scheme internal commercialization of crops or seeds is not permitted, but imports of GM food or ingredients for processing and food is allowed and until recently essentially deregulated. Some seed of GM maize not exported may be – and is -commercialized as animal feed. Imported animal feed is

not segregated and hence may or may not be GM. There are no labeling requirements for GM products in general, either food, feed or crops.

Public participation and decision-making process

Public participation is not mandated for the GM crop/seed review process carried out by the SAG. Petitions are reviewed by a technical committee made-up of regulatory experts and scientists appointed by the SAG. The committee's role is advisory since the final decision rests upon the agency. Once the agency reaches its decision on a petition, the proponent must publish the resolution in the public registry. However, since this registry is not easily accessible to the public it is often hard to obtain information on final decisions. While regulators meet with stakeholders, including NGOs, in various informal and formal venues, the lack of formal mechanisms imply that public participation in decision-making is non-existent. Some negotiated rule or procedure making occurs with stakeholders from the productive sector, specifically seed, organic and honey producers.

Public participation is mandated for the review process for GM foods. The mechanism used to fulfill this mandate is public comments submitted on the ISP website on proponent petitions. The comments are not public nor is the agency obliged to respond to them. In the practice, public participation for petitions under review has been scant. The petitions are reviewed by an expert committee made-up of scientists and agency experts. The committee's constitution is public information and members are identified in the agency's webpage. The agency makes a decision based on the committee's advise, but the final decision to authorize an event rests at the level of the Health Ministry. As mentioned above, the Ministry has yet to make any decision on existing events, although the ISP has reviewed and reached a decision on petitions by biotech companies. This situation is interesting because once the Ministry establishes the "list of authorized events", unauthorized events present in GM foods are technically illegal. In some ways, the lack of regulatory action makes the regulated entity "invisible" for the time being. It is clear that the impact of the list, particularly for processors and importers could be high.

The new Environmental Law in general strengthens public participation in decision-making. Hence the public participation scenario could change if environmental impact assessments are required for GM crops. However, the law has yet to be implemented and its implications for rulemaking and decision-making in regards to GMOs are not clear.

IV. Key actors in the controversy

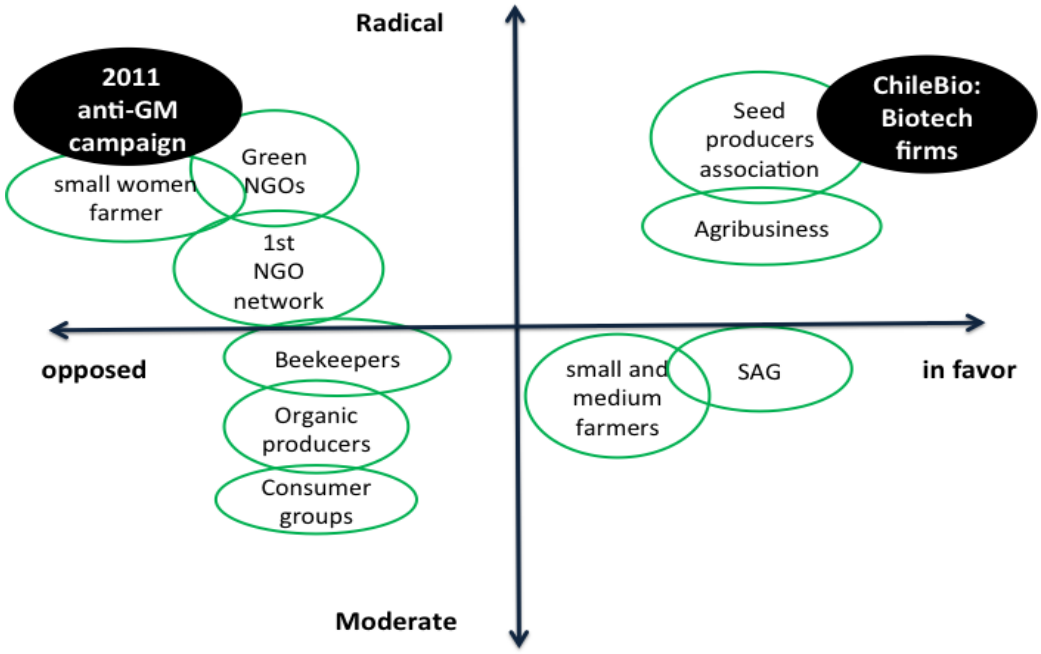
Key events and actors in the controversy

We categorized key actors in the public debate on GM crops in Chile into six main groups: 1) seed companies 2) biotechnology firms 3) environmental and other civil society organizations 4) small and medium farmers 5) organic producers and beekeepers 6) government and regulatory entities. The analysis we present here includes those actors that have intervened in the public debate in an organized manner and/or that are directly affected by decisions related to GM crops. Our preliminary analysis indicates that the organized participation of scientists is not prominent. For the purposes of our current analysis, we will not focus on them as a group.

In our analysis, we identified five main definitions or framings of the problem used by key actors in the GM controversy in Chile: 1) market 2) socioeconomic 3) co-existence 4) uncertainty and risk (closely associated with the status of the GM entity) 5) transparency (information and participation). While not exhaustive, they represent the most salient cognitive and normative framings that shape the controversy and are used to maintain or unsettle the boundaries of Chile's particular regulatory style.

We characterized key actors in Chile according to their position in relation to the first four frames (figure 1). We located the actors according to a continuum ranging from "opposition" to "support" for the technology, based on their particular use of the socioeconomic or market frames. Those actors falling at the "support" end tend to frame GM crops primarily as an emerging and promising market opportunity and as an central solution to poverty, food scarcity and economic development. At the "opposed" end, actors tend to frame GM crops as debilitating new market opportunities and as creating rather than solving issues of world poverty and injustice. We also aligned actors according to their use of the uncertainty/risk and co-existence frames, in what we labeled as "radical" versus "moderate" positions. Radical actors tend to frame the idea of co-existence in absolute terms, as either impossible or irrelevant often accompanied by framing risk issues as highly uncertain or very certain. This is often associated with a cognitive frame that defines GM technology as either something inherently novel or familiar. Moderate actors are more accepting of co-existence and the ability to manage risk. While still preliminary, this mapping suggests that 1) positions within each camp may be quite heterogeneous in terms of how actors use shared frames and 2) the two actors located at the extremes are precisely those more visible and active in the public arena (media, activism etc.).

Figure 1: Map of key actors and their positions



Most importantly, opposition groups in Chile have highlighted and used the framing of access to information or transparency to contest the boundaries - set by the authority together with the private sector – between the technology and civil society. This framing speaks not only to issues of information access but also to public participation and trust in regulatory institutions. It has taken center stage in the last two years and is central to understanding why the controversy ensues.

V. Key events and chronology of the controversy

Organized opposition to GM crops first emerged in the late 90s when a group of civil society organizations created the anti-GM group "La Red por un Chile Libre de Transgénicos" (Coalition for a GM-Free Chile) in 1999. Since then more groups have appeared, with several alliances and campaigns currently co-existing. One of the most active "groups" today is a loose alliance of organizations, coalitions, "green" legislators, farmers and individuals coalescing around an anti-GM campaign initiated in 2011[4]. The campaign is lead by prominent activists of a Chilean pesticide action network (RAP-Chile), which forms part of a Latin-American and International wide network. It has been quite effective in promoting discussions of the topic in a variety of social and mainstream media, revitalizing public debate amongst interested actors as well as maintaining an active website. The issue, until recently, had not attracted broader public or political interest.

[4] The campaign is called "Yo No Quiero Transgénicos" which translates as "I Don't Want Transgenics".

Since their emergence opposition groups have deployed a range of strategies from the generation of research reports, bulletins and press releases to occasional street demonstrations and participation in public debates and seminars. Thru these venues, they have communicated concerns that to some extent echo the demands of GM opposition worlwide. Yet early on opposition actors in Chile framed the issue as one of "transparency" either in the form of labeling or disclosure of GM field locations. With time, the location of GM fields became the dominant frame shared by civil society organizations to articulate their opposition.

Their first action in 2000 was to petition the SAG for information on the exact location of GM field sites. The SAG replied that it could not fulfill the request because field locations were "Confidential Business Information" (CBI). The agency's response set-off a fight over the status of the information that would last more than ten years and end in a victory for opposition groups. Opposition groups initially took the agency's decision to civil courts, arguing unsuccessfully in an appeals court for the information's public status. Their demands had to wait until 2009 when Chile's new Transparency Law opened a door for them to - once again - contest the agency's decision (see table 5 for a detailed chronology of events).

Several aspects of this dispute are interesting for our analysis. First, the dispute over the "status of the information" is in some ways a struggle to (re)define the problem as one of "public" versus "market" nature. In this sense it is interesting that throughout the dispute the agency continued to interpret the norm so as to protect business interests (CBI) over public ones (information access). Second, the seed companies whose information was in dispute argued strongly that the information should not be public for both market (CBI) and "security reasons" (i.e. public knowledge of sites would expose them to vandalism). In the sense, their framing also becomes political. Third, the dispute gained force among a diverse set of "opposition" actors partly because of increased concern by organic and beekeepers about the effectiveness of co-existence measures (co-mingling and cross-pollination) under the existing regulatory scheme. The concern was reinforced and amplified when a cargo of Chilean honey exported to the EU was returned because it contained traces of GM pollen. In other words, for *productive* actors the issue of information also became important. Fourth, the agency finally modified its norm and removed the clause that had allowed it to interpret the location of field sites as CBI. It now allows information to be considered "reserved". In the last year it has also increased, albeit tenuously, public access to information about GM crops. Finally and surprisingly opposition groups did not publish or provide public access to the information released for fear of reprisals. Instead they called on "all citizens and organizations" to exercise their right-to-know and request the now "public" information directly from the authorities.

Another key event amplifying the GM controversy in 2011 was the Chilean Senate's decision allowing the government to ratify the most recent international agreement on property rights for new plant varieties, known as UPOV91. A range of civil society organizations, including indigenous groups, tried to block the senate's decision on grounds that it was "unconstitutional"[5] and took the decision to Chile's constitutional court, a high court separate from the ordinary courts. Dispute resolution under this entity involves public audiences by interested parties, and some GM opposition groups were vocal participant in the process. In this case, GMs were framed in much more political terms as "commodification of seeds" "socioeconomic injustice a" and "multinational technological package". Authorities and supporters of the agreement denied any link between UPOV and GM seeds, explicitly casting any association of the two as a "misunderstanding of the issue" and as vital for both "economic integration and innovation".

[5] They essentially argued that legislators had not yet established the legal framework that would be required in Chile to implement a property rights regime in accordance to UPOV91. They were concerned that once the agreement translated into a legal framework it would erode farmer's and indigenous rights, and favor large, transnational agribussiness.

Chronology and key events in the controversy over GM crops

year	event
1999	First anti-GM coalition of civil society organizations forms
2000	coalition petitions agriculture agency for information on GM field location. The agency replies that locations are "confidential bussiness information" according to existing regulation
2001	Coaltion reps file suits in civil courts 1) contesting the agency's decision and arguing for the public nature of the information 2) against the President of the Republic for not labelling GM food on the basis of consumer right-to-know
2001	Substantial modifications of 1993 norm and significant increase in commercial seed production
2001-2002	Lower court rules in favor of coaltion on both suits but appeals court overturns
2009	Chile enacts transparency laws and establishes a cuasi judicial council (TC) to oversee complaints
2009	TC receives three complaints (from RAP-AL and legal scholars) on the issue of public status of GM information, with emphasis on field location
2009-2010	TC admits suits and rules that: 1) that the information is public 2) that the agency must amend its norm to make explicit the information's public nature
2010	Agency amends norm and provides some site location, pending further consultations with seed companies
2011	Senate authorizes the Chilean government's ratification of the international plant variety protection agreement UPOV91
2011	40 organizations contest the Senate's decision on the grounds that it is unconstitutional via the country's special "constitutional review tribunal". They loose but the tribunal's sentence raises questions about potential negative impacts of UPOV91
2011	Monsanto and other seed companies appeal the TC's decision in civil courts.(decision is illegal)
Nov. 16 2011	Monsato desist from their various appeals
Nov. 29 2011	the SAG provides coalition with requested seed field sites
March 2012	Coaltion makes a call for "all citizens" to petition the agency for GM crop location and information but does not publish the information provided by agency for "fear of reprisals"
2012	**Pollen from GM detected in Chilean honey exported to the EU**

VI. Comparing Chile's regulatory style: ¿ambiguity or flexibility?

We compared Chile's regulatory style to that of the USA and EU based on key aspects laid out in table 6 and selected from the literature (see Dunlop 2000, Jasanoff 1995, 2005, 2006 and Vogel 2002). Our comparison seeks to better understand the Chilean situation and as such is used as an analytical tool. The USA and EU are useful models for comparison because they represent the first two approaches developed worldwide, which to some extent have served as templates for other nations.

Chile's regulatory style appears to be somewhat "ambiguous" and distinct compared with that of the USA and the EU. It shares key aspects of the USA familiarity principle policy: no new laws, a product-oriented approach, close adherence to the principle of substantial equivalence and a market regime. Yet it limits the *scale* by drawing a boundary between seed-export and all other commercial activity when it comes to defining what is and is not permitted. The restriction on commercial production could be interpreted as a nod to the precautionary principle. However as our data shows that within the boundaries of seed production, it is more permissive than restrictive in the types of products and environmental releases allowed.

Chile's particular style is the least participatory of the three, with scarce access points for public input. In this context, cuasi-judicial and judicial reviews in arenas external to regulatory action have been the key means to challenge regulatory framings of problem. This too, aligns more closely with the USA style where reviews by courts have been important to solving disputes and boundary setting (Jasanoff 2005). Chile however belongs to the Continental Law tradition where law codes trump legal precedents and judges have limited authority to interpret the law. In this context, claims by opposition actors have succeeded only under the cuasi-judicial review established by the new transparency law. In this sense their impact has been limited and slow.

In summary, norms and regulations in Chile were developed in a fragmented, reactive and somewhat disconnected manner. Norms aimed at food consumption were developed much later than seed production ones, although GM foods have been on the market in Chile for some time. In this context, production and market issues rather than consumer ones have prevailed. Overall, regulation appears to be a response to 1) global GM market forces and regulatory developments and 2) the actions and needs of Chile's business community and to a much lesser degree 3) civil society interests. The tenuous roles played by both the food and environmental agencies suggest that environmental issues or consumer attitudes were secondary to the development of a regulatory framework. We propose that Chile's regulatory style is a strategy to manage export market uncertainty while promoting a promising agricultural export product. In other words it is based on a policy of caution towards export markets *and* promotion of innovative, competitive products in the agriculture sector. In this sense rather than ambiguity, Chile style appears to be an attempt to embed the system with market flexibility.

Characteristic	EE.UU	EC	Chile
Regulatory Framework	1986 Coordinated Framework for Biotechnology	2002 Strategy for Biotecnology and Life Sciences (equivalent to law)	No comprehensive framework. Isolated norms and rules
Type of legal frame used	use of existing laws	new laws	use of exisiting laws
Policy approach or guiding principle	Familiarity	Precautionary principle	"Caution criteria" or "market caution criteria
Inclussion of ethics and social values	no	yes	no
Leading authority and sphere of action	Food and agriculture (FDA/ USDA)	Food, environment and agriculture (EFSA)	Agriculture (Plant and Livestock Service)
Role of environmental authority	less relevant	very relevant	not relevant (to date)
Regulatory style:	*Product-oriented*	*Process-oriented*	*Product-oriented only for seed and food*
Regulatory regime:	market	expert and judicial	market
Comercial cultivation	*Permissive*	*restrictive*	*permissive in type restrictive in scale*
Field trials and research	*Permissive*	*restrictive*	*permissive in type, restrictive in scale*
Labeling requierements	*No*	*Yes*	*No*
what triggers regulatory action	*plant pest*	*food safety, plant pest, risk to biodiversity*	*plant pest*
judicial status of GMs	promoted	permitted	promoted
Public participation	restricted	open	very restricted and closed
Regulatory responsibility	judicial	legislative and expert	administrative, (limited cuasi-judicial review)

Table 5: comparison of regulatory styles

In their response to the GMO “issue” authorities and regulators enacted a boundary between society and the regulatory process. This boundary was sustained by defining GM seed production as an economic activity that could be effectively managed and *contained* by an expert driven regulatory process. Opposition groups attempted to break this boundary, by appealing not to issues of risk but to a basic “right-to-know" argument. The relatively small scale of GM crop production in the early years contributed to containing their claims and any associated controversy. On the other hand co-existence issues –also framed as market issues - did not arise until much later, when the number of seed companies and acreage started to increase (an issue we do not describe in this paper, but are exploring). This crystallized participation by a broader range of actors, some of them productive sector ones (beekeepers and organic producers) and allowed opposition claims to come to the forefront. This, together with new more “participatory” laws appears to have pushed and made more permeable the regulatory boundary established by the authorities, at least in regards to information access. ¿How will this change Chile’s approach to GM crops and food?

It is noteworthy that some issues have not become the dominant framings of what is stake regarding GMOs in Chile. The reasons for this merits further exploration. For example, GM opposition groups in Chile have not, for the most part, contested regulatory decisions on potentially controversial applications, such as pharmacrops or field trials of new, yet unregulated events. Nor have they contested the procedures for assessing, communicating and managing risk. For the most part, they have been less vocal on many risk issues *specific* to the Chilean context. This is surprising given the heterogeneity of crops actually grown for seed in Chile. Thus regulatory challenges of Chile’s particular context have not been framed as “issues”. For example, they have not posed questions about the potential economic impact of low-level presence of events unauthorized in export markets, an emerging issue given the constant rise in number of events in the context of uneven authorization processes worlwide. We may of course presume some of these issues are discussed in regulatory arenas accessed mostly by experts and some productive sector actors and which we have yet to analyze. Chile’s technocratic culture clearly limits public participation and information access. In the context of the GM debate, this creates a civic epistemology focused on basic questions of democracy: access to information, public participation and and technological accountability.

Conclusions

Chile’s particular regulatory style for GM crops restricts the production scale but is very permissive with regards to the heterogeneity of GM crops authorized and released into the environment. This response to the issue is based on a governmental perspective regarding Chile’s role within the global economy and in particular the agrifood production chain: Chile is an agricultural exporter that must protect its markets. In this sense its regulatory style is based in a “market caution” framing of the issue rather than one associated to any particular view of environmental or human health risks. Thus the authorities established a “regulatory boundary” that allowed different economic sectors to co-exist somewhat harmoniously at the beginning. Any

risks derived from GM seed production were considered primarily thru the "phytosanitary" frame of the Animal and Livestock Service. However the increase in acreage, number of seed companies and heterogeneity of modifications increased the complexity involved in maintaining the boundaries between different actors and the regulated entities. In this context, the episode with honey exported to the EU forewarns of future issues that may result from Chile's decision. For opposition groups, it acted as a catalyst for action and may have reinforced their alliances.

Mechanism for public participation in regulatory decisions and access to information is very poor under Chile's particular style. Chile's particular civic epistemology appears to respond to a technocratic culture that limits crucial public debate. Opposition groups (re)framed the problem early on as one of "transparency and public information", seeking external mechanisms to contest agency decisions. The leading agency's response to these concerns has followed the prevailing market perspective of government policy. Not surprisingly it is perceived as protecting business interests over citizen concerns. In this context civil society organizations have continued to frame their opposition around a basic demand for transparency, raising the issue of public trust. The lack or poor quality of public information available about production in Chile has clearly shaped the public debate, and prevented key questions from arising in the public arena (for example environmental and health risks associated with cultivation of pharmacrop). The adversarial nature of the dispute has reinforced a culture of secrecy and exaggerated claims on all sides, further eroding public trust in regulatory institutions. Chile's existing regulatory style raises the issue of the need to strengthen and broaden the accountability of technological applications.

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