# Inside the Canadian Biotechnology Regulatory System: A Closer Exploratory Look

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# INSIDE THE CANADIAN BIOTECHNOLOGY REGULATORY SYSTEM: A CLOSER EXPLORATORY LOOK

## EXECUTIVE SUMMARY


The purpose of the paper is to take a closer exploratory look inside the federal biotechnology regulatory system with a view to understanding more completely how it works but also to raise issues and questions regarding its strengths and weaknesses.

This paper is exploratory because it is by no means a complete research study. The paper draws on some relevant literature about biotechnology and about the nature of regulatory institutions, especially science-based regulatory institutions, but is not itself based on a full research study of biotechnology regulatory product assessment. The paper also benefited from discussion at a one day workshop held on June 23, 2000 but, at the same time it must be stressed that the paper is not a report on the workshop. The workshop was attended by regulatory practitioners from two of the departments or agencies involved in biotechnology health and safety regulation, the Health Protection Branch of Health Canada and the Canadian Food Inspection Agency (CFIA).

The paper is organized into three main sections. The first section sets out key overall elements of federal biotechnology regulation through a brief look at: its historical context; the main features of the federal biotechnology regulatory system (statutory provisions, agency mandates and policies and guidelines) including the consultation processes which were employed to develop such policies and regulations.

The second section is the analytical core of the paper and examines the biotechnology product assessment process. It begins with an initial glimpse of the regulatory cycle for assessing biotechnology products and then revisits these key stages or aspects of the regulatory cycle through a set of template questions posed and issues explored. These stages begin with the regulation of biotechnology research and field trials ( regarding plants with novel traits) which is in the jurisdiction of the CFIA. The regulatory cycle eventually proceeds to a point where a novel food product application must be given a safety assessment by Health Canada. This phase starts with prior consultations between a proponent company or university researcher and regulators, and then proceeds to the point when a product application is received by the regulators. Following an assessment process, the stages end either when the regulator issues its view that it has "no objections" to the product (Health Canada's term) or "approves" the product (The CFIA's term) or when the product is not approved or is withdrawn.

A 10 point package of conclusions and challenges are discussed in the paper.

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1) The present federal biotechnology regulatory system has several strengths including the knowledge, professionalism and capacities of its core science assessors, and also reasonable evidence of an open approach to public consultation in overall rule-making regarding laws, regulations and guideline and standard-setting. The fact that the biotechnology system builds on, and functions within, the large regulatory regime for novel foods and overall health and safety regulation is in many ways also a strength.

2) The present system is complex and consists of a multiple pathways system depending on the different statutory and technical needs of foods, seeds, fertilizer supplements, feeds, and animal health (and even more broadly if the environmental and aquatic elements are added from the Environment Canada and Fisheries and Oceans Canada domains which were not examined in the paper). The nature of the present system is being communicated to the Canadian public in clearer ways than a few years ago but there is still a long way to go regarding a fully communicated and transparent system.

3) The infusion of new funds for biotechnology regulation in the federal 2000 budget is a welcome and needed step but there are still concerns about the adequacy of R&D support within Health Canada and the CFIA, for the direct needs of biotechnology regulation. These issues need further serious exploration particularly given the increasing complexity of the next generation of biotechnology products and given the questions that can properly be raised about whether any of the regulators are assessing the cumulative impacts of the composite of biotechnology products. These funding issues are also important given the need to retain and attract expert front-line regulatory scientists.

4) The issue of utilizing outside expertise in product assessments needs further detailed discussion and exploration. The paper shows that the lessons of the rbST case did not extend for the two regulators to whether outside expertise can or should be utilized for the novel food area or its biotechnology aspects. There are important options and issues that could be explored here such as whether the Health Canada Office of Food Biotechnology or the CFIA's regulators could/should use outside expertise to review the input from the in-house assessors. A further issue here obviously is whether such outside expertise should be used on a regular basis or on an exceptional basis and if the latter, how "exceptional" circumstances are defined which might trigger the use of such outside experts. There is also the issue of what kinds of expertise such outside experts should possess and whether enough such experts exist in Canada. If utilized, their availability in a timely fashion would also be crucial for the regulatory system as would issues about any actual or potential conflict of interest questions regarding experts chosen for such work.

The paper stresses that the question of outside experts cannot be separated from the use of outside expertise in other non-biotechnology novel products. It may be difficult to single out biotechnology for this kind of outside expert review element but at the same time, the issue does raise questions about how to deal with new technology products where in-house expertise may not be sufficient and where the public has a right to expect a full airing of the safety and risk-benefit issues involved at the product level.

5) More transparent ways to define the boundaries of commercial privilege are a further issue to arise from the paper. The analysis suggests that this feature of regulation
as it impacts on biotechnology products has not been transparently discussed. The issue is complex, however, in that it is linked to trade-offs in related areas of law such as freedom of information and privacy. It is an issue that is also linked to the question of outside expertise as in item 4 above, but it extends to other issues that need to be explored and debated in the public domain. These further issues include the ability of the regulator to communicate risk, both health and environmental risk, given that commercial privilege and other laws limit what can be communicated to the public about the product and it also affects potential post-market review processes or information exchange. A more formal consultation process with business and other stakeholders is needed to discuss what the real limits are to commercial privilege in the case of biotechnology products and whether there is a special case for this regarding biotechnology as opposed to other novel food products or other plants with novel traits.

6) Public consultation on product assessments and socio-economic and ethical criteria are twin realms which raise even broader questions than that of the use of outside expertise. The paper shows that Health Canada and the CFIA's general consultation processes on regulations and guidelines are quite extensive and relatively open in nature. But they have not focussed at all on more open consultation at the product assessment level based on such broader criteria. Such a broadening of input would have to deal with not only "what" consultation would centre on but also "when" and "how". Furthermore, no discussion of this issue can dodge the question of what kind of democracy is being advocated through

different contending reform ideas: Cabinet-Parliamentary democracy; interest group and stakeholder democracy; or direct democracy (with each increasingly couched in the new realities of e-government or digital democracy). These very big regulatory questions would also raise the issue of whether reform applies only to biotechnology products rather than all novel products and how they would effect the efficiency of the Canadian regulatory system compared to other countries' regulatory regimes.

7) The study has thrown doubt on the adequacy of transparency in how research and field trials are regulated. On the one hand there are positive features such as the practice of inspecting 100 percent of the field trial sites. But there are also gaps in transparency regarding public knowledge of site locations and in the process of developing guidelines for determining mitigating risk or reproductive isolation. There are also extensive amounts of self-regulation in these aspects of biotechnology which the Canadian public needs more reassurance about and
transparent information on.

8) The study has also indicated gaps in information and understanding about how the appeal process works regarding product assessment and what kinds of post-market review processes are built in once a product is on the market. There are no publically identifiable appeal processes or post-market review mechanisms for biotechnology novel foods or certainly none that are readily communicated to the Canadian public. This key aspects of the process needs further research and debate about what kinds of appeal and post-market review mechanisms are needed.

9) The paper notes the presence of offices of biotechnology in both Health Canada and the CFIA and applauds the effort to provide "one stop" service regarding the coordination of the application process and to better coordinate federal biotechnology policy. However, for some Canadians, a further question is whether there ought to be one "stand-alone" biotechnology regulatory body. Such ideas about a single biotechnology regulator have been rejected in the past. And this question in turn begs again different versions of the ultimate question "how different is biotechnology?" from other novel products.

There is value in further exploring this issue of a single regulator if, for no other reason, than as a vehicle for dealing with some of the more particular areas raised above. Issues such as the role of outside expertise and the role of public consultation would undoubtedly arise as would the complex scientific issues regarding different kinds of biotechnology product use. Inevitably again, the single regulator question involves trade-offs regarding how special or different biotechnology is from other health and safety areas. However, the analysis has also drawn attention to the fact any single biotechnology regulator would hardly be an institutional or democratic panacea. Even if such a stand alone biotechnology regulator was established, interdepartmental coordination challenges and complexity would still be present. Some coordination problems would simply become re-formulated as "stove-pipe" issues within a single regulator and still other issues would remain as to how to deal with and coordinate issues with other still remaining outside bodies such as the rest of health and food regulatory systems ( and hence other non-biotechnology novel products).

10) The analysis brings out the importance of key "accepted approaches" in product assessment such as the concept of substantial equivalence. There is little doubt that the biotechnology regulatory system for novel foods and for plants with novel traits uses this as the starting point for assessment. And regulators are right to stress that this concept does not itself constitute the assessment process. It is certainly possible, however, that the concept of substantial equivalence may be criticized or need further

scrutiny as more complex biotechnology products come into the assessment process or as pressures arise for the assessment of cumulative impacts.

Any regulatory system has to evolve some form of institutionally or professionally tested "accepted approaches" such as the role that substantial equivalence plays in the regulation of novel food and plants with novel traits. But such systems are also subject to other concepts and ideas which different interests in society (nationally or internationally) want to see become more influential. One such concept which the paper only hinted at is the precautionary principle. This principle is not a stated part of the six principles of the federal biotechnology regulatory system but there is undoubtedly a growing debate among the regulators (all four departments or agencies) and among stakeholders as to exactly what it might mean for regulatory decisions and processes. And it is certainly at the centre of debates about the nature and evolution of the regimes for the international regulation of biotechnology. The paper offers no definitive conclusions on the impact of this concept on the regulators we have focussed on except to say that in some way it does present a partial challenge to the core idea that regulation will be only science-based. The role of the precautionary principle is itself a complex question and would undoubtedly arise as an issue in any discussion of several of the items already highlighted in these concluding observations.

Overall, the author concludes that the federal biotechnology system has some strengths but it is also evident that there are important gaps in the regulatory regime as a whole which need further research, public discussion and regulatory reform. The biotechnology regulatory system is complex for good reasons but the debate about it needs to be sharpened and more focussed so that Canadians have a better understanding of its role in a key aspect of Canada's early 21st Century economy and society.

CONTENTS

INTRODUCTION

Canadians have concerns about biotechnology food products but have little knowledge of how such products are regulated by the Government of Canada. The purpose of this paper is to take a closer exploratory look inside the federal biotechnology regulatory system with a view to understanding more completely how it works but also to raise issues and questions regarding its strengths and weaknesses. Existing studies have examined some of the broad features of the regulatory system but have not adequately conveyed how it works in detail (Canada, 1998; Doern and Sheehy, 1999; Prince, 2000; Doern, 2000).

This paper is exploratory because it is by no means a complete research study. The paper draws on some relevant literature about biotechnology and about the nature of regulatory institutions, especially science-based regulatory institutions, but is not itself based on a full research study of biotechnology regulatory product assessment. The paper has benefited from discussion at a one day workshop held on June 23, 2000 but, at the same time it must be stressed that the paper is *not* a report on the workshop. The workshop was attended by regulatory practitioners from two of the departments or agencies involved in biotechnology health and safety regulation, the Health Protection Branch of Health Canada and the Canadian Food Inspection Agency.[1] The regulators present at the workshop, several members of the Canadian Biotechnology Advisory Council (CBAC) and the author discussed the template of questions set out in Appendix I. It dealt with several key regulatory issues and processes centred on the key stages a biotechnology product went through as it was assessed for safety in the federal government's biotechnology regulatory system.[2] The paper also draws on the author's own cumulative research and experience regarding the study and behaviour of Canada's regulatory institutions and systems of governance.

The paper is organized into three main sections. The first section sets out key overall elements of federal biotechnology regulation through a brief look at: its historical context; the main features of the federal biotechnology regulatory system (statutory provisions, agency mandates and policies and guidelines) including the consultation processes which were employed to develop such policies and regulations. It also briefly sketches out the T45 case study, a biotechnology case study used for some illustrative purposes at the workshop (Health Canada, 2000).

The second and longest section is the analytical core of the paper and examines the biotechnology *product* assessment process. It begins with an initial glimpse of the regulatory cycle for assessing biotechnology products and then revisits these key stages or aspects of the regulatory cycle through a set of questions posed and issues explored. These stages begin with the regulation of biotechnology research and field trials ( regarding plants with novel traits) which is in the jurisdiction of

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[1] Special thanks are owed to the regulators present, to CBAC members, to Michael Prince, and to one non-governmental external peer reviewer for useful and constructive comments on the early drafts of this paper.

[2] Each of the template questions in Appendix I are addressed in this paper but not always in exactly the same order in which they are listed there. A somewhat different sequencing was occasionally needed for the purposes of this report as explained below. Table 4 provides a very *brief summary* guide to issues and points raised by these questions. But the reader must ultimately relate Table 4 to the larger discussion in the text of the paper itself and, importantly, to the other sources cited, especially the regulatory bodies information in their publications and web sites which is by definition more detailed and technical. There is no doubt that the biotechnology regulatory system is complex to describe in a relatively brief paper. It consists of more than one cycle and is not always linear or stage-like in nature.

the CFIA. The regulatory cycle eventually proceeds to a point where a novel food product application must be given a safety assessment by Health Canada. This phase starts with prior consultations between a proponent company or university researcher and regulators, and then proceeds to the point when a product application is received by the regulators. Following an assessment process, the stages end either when the regulator issues its view that it has "no objections" to the product (Health Canada's term) or "approves" the product (The CFIA's term) or when the product is not approved or is withdrawn. The key questions in the cycle are then examined as set out in Appendix I.

The third section of the paper offers conclusions and commentary not only about what lessons might be learned from this initial closer exploratory look but also about what else needs to be examined or changed through further study and research and extended public debate.

## FEDERAL BIOTECHNOLOGY REGULATION: CONTEXT AND KEY FEATURES AND CONCEPTS [3]

### Historical Context

Biotechnology has gradually emerged on the national and international policy and economic agenda in the 1980s and 1990s in three main ways: in an evolving biotechnology regulatory system responding to the development of new products and processes by industry and university researchers; in overall federal biotechnology strategies in 1983, the early 1990s, and 1998; and in periodic controversies about products and scientific developments.

The main way in which biotechnology has emerged is in the gradual fashioning of a biotechnology regulatory system in response to the development of products. This led to the development of a Federal Regulatory Framework for Biotechnology (see more below). There is no *single* biotechnology regulator, though there are offices of biotechnology within both Health Canada and the CFIA. Instead, a framework of principles was developed to guide the several regulatory bodies and departments which were being called upon to assess biotechnology products (Canadian Food Inspection Agency and Health Canada, 2000; Canada, 1998; Doern and Sheehy, 1999).

A second way in which biotechnology emerged as a policy-regulatory issue was through a series of federal biotechnology strategies. An initial 1983 National Biotechnology Strategy was essentially an effort to promote R&D, investment, and market acceptance of this new technology. It was updated in the early 1990s and then was replaced by the 1998 Canadian Biotechnology Strategy (CBS), the focus of which was much broader. The CBS is intended to "support the responsible development, application, and export of biotechnology products and services" balanced within the context of "social and ethical considerations" (Canada, 1998, p. 1). The CBS sets out a policy framework consisting of a vision, guiding principles and goals that reflect biotechnology's importance both to the economy and to Canada's quality of life. Ten themes "for concerted action" are identified to be implemented on a partnership basis with stakeholders such as the provinces, industry, academia, citizens, environmental groups and other interests.

The centrepiece of the renewed CBS is the establishment of the Canadian Biotechnology Advisory Committee (CBAC), an expert panel which now advises ministers on the "ethical, social, economic, scientific, regulatory and environmental and health aspects of biotechnology" (Government of Canada, 1998, p.1). The CBAC has no role on specific regulatory decisions. But its policy advisory role

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[3] In essence, this entire section answers or deals with issues related to template question 5. All of the other template questions are dealt with in the next section of the paper.
See also Table 4.

includes its serving as a forum to give Canadians a voice in an "open and transparent dialogue on biotechnology issues" (Government of Canada, 1998, p. 1).

A third way in which biotechnology has gained a greater profile on the national and international scene is that it has become central to particular policy or regulatory controversies. These range from global scientific issues such as the cloning of Dolly, the sheep, gene prospecting and its links to biodiversity, and the huge human genome research project (Grace, 1997; Appleyard, 1999; Rifkin, 1998; Shiva, 1997; Mironesco, 1998). The potential for biotechnology to be elevated to government-wide and national controversy has been amply exhibited in the United Kingdom where, throughout 1999 and 2000, the British Government's policies and institutions regarding genetically modified (GM) food came under sustained and fierce attack by environmental and other groups and engaged several ministers including Prime Minister Tony Blair in high level backtracking and political damage control (Flynn, Marsden and Harrison, 1999; Hunt, 1999). But controversy can also includes specific products such as Canada's debate over the regulation of rbST (MacDonald, 2000), a biotechnology product that enhances the efficiency of milk production in cows which has been approved for use in the U.S. but which has been rejected in Canada.

The Federal Biotechnology Regulatory System

The 1993 Federal Regulatory Framework for Biotechnology provides the overarching principles for the functioning of the federal biotechnology regulatory system (Canada, 1998; Doern and Sheehy, 1999). Biotechnology is defined in Canadian legislation as "the application of science and engineering in the direct or indirect use of living organisms or parts or products of living organisms in their natural or modified forms". Therefore, the federal framework was developed in the light of both interdepartmental and stakeholder consultation processes with diverse interests.

The framework is centred on a set of six principles with respect to the regulation of biotechnology. These include:

- maintaining Canada's high standards for protecting the human health of Canadians and the environment;
- using existing laws and regulatory departments to avoid duplication;
- develop clear guidelines for evaluating biotechnology products that are in harmony with national priorities and international standards;
- providing a sound, scientific knowledge base on which to assess risk and evaluate products;
- ensure that the development and enforcement of Canadian biotechnology regulations are open and include consultation;
- contributing to the prosperity and well-being of Canadians by fostering a favourable climate for investment, development, innovation and the adoption of sustainable Canadian biotechnology products and process (Canada, 1998, p. 12).

In various ways the six principles are intended to reflect a reasonable and balanced trade-off between ensuring the protection of individuals and society in relation to environmental, human, and animal health and safety, and securing the practical benefits of biotechnology products/processes and

Canadian competitiveness in this sector. The principles also reflect Canada's international commitments under the United Nations Commission on Sustainable Development, the United Nations Convention on Biological Diversity and the World Trade Organization and NAFTA.(Buckingham, et.al. 1999; Phillips and Buckingham, 2000). Later sections of the paper discuss these international aspects, and the need for harmonization, some aspects of which were forged after the six principles cited above were enunciated.

Some 43 biotechnology novel food products have proceeded through the regulatory system, have been assessed by Canadian regulators and are on the market. But the system has been criticized. Some commentators and interests see the current system as being flawed because it is not more centrally controlled by Environment Canada through CEPA legislation. Others would view it as profoundly illegitimate if it was so centralized and regard the present system as being more legitimate and effective precisely because it recognizes sectoral variety and scientific and technical complexity.

In addition to the above principles, the federal biotechnology product assessment process is also governed by *generally accepted approaches* which Canadian and international regulators have evolved regarding the regulation of novel foods:

- First, the emphasis of the safety assessment is on the final product. The safety assessment of foods developed using genetic engineering considers: how the food crop was developed (i.e. the process used) including the molecular data which characterize the genetic change; composition of the novel food compared to non-modified counterpart foods; nutritional information compared to non-modified counterparts; potential for new toxins; and potential for causing allergic reactions.

- Second, a guiding principle in the safety assessment is "comparison of molecular, compositional and nutritional data for the modified organism to those of its traditional counterpart, where such exists. It is expected that once substantial equivalence to an existing food product can be established, no additional safety testing would be required" (Health Canada, 2000, p.5: see sections below for further discussion of the concept of substantial equivalence).

- Third, where similarity or degree of *substantial equivalence* cannot be established, " a more extensive safety assessment may be necessary". In addition the regulators stress that "initial assessments" will "necessarily be on a case-by-case basis" (Health Canada, 2000, p. 5).

Overall regulation is also governed by the general operation of phases of decision making which encompass risk assessment, risk management, and risk communication. *Risk assessment* involves scientific analysis as to: the likely severity of adverse health and environmental effects, the size of the population at risk, and other related factors. Health Canada engages in health risk assessment regarding novel foods, whereas the CFIA does environmental risk analysis regarding plants with novel traits and also risk regarding feeds, seeds, and animal health. Risk management involves analysis and positive actions to reduce or avoid risks or engage in actions to forbear. Such actions are determined by statutory responsibilities, commitments and partnerships, and by, assessing public health or other benefits relative to risks. The ability to manage risks is also partly a function of available resources including staff, expertise, and money. Risk communication could be defined as "any purposeful exchange of information about health or environmental risks", but can also extend to communication which "seeks to change attitudes and behaviour in light of knowledge about health risks" (Health Protection Branch, 1997, p. 34).

As Table 1 indicates, the federal biotechnology regulatory system is also crucially governed by the statutes and mandates of four federal departments and agencies with direct regulatory roles: Health Canada; the Canadian Food Inspection Agency (CFIA) ; Environment Canada; and Fisheries and Oceans

Canada. This paper focusses primarily on the first two agencies because of their primacy in areas related to food biotechnology and to plant, feeds, seeds and animal biotechnology. Health Canada regulates food biotechnology under its novel foods regulations whereas the CFIA does not regulate food biotechnology except in an enforcement capacity. The roles of Environment Canada and Fisheries and Oceans Canada are not examined in this paper but are certainly important for understanding the system as a whole.

**Table 1**: **Legislative Responsibility for Biotechnology**

| **Products regulated** | **Federal agencies / departments** | **Legislation** | **Regulation** |
|---|---|---|---|
| Products for use not covered under other federal legislation | Environment Canada<br>Health Canada | Canadian Environmental Protection Act | New Substances Notification Regulations |
| Drugs, cosmetics. medical devices, and foods | Health Canada | Food and Drugs Act | Food and Drugs Regulations;<br>Novel Foods Regulations;<br>Medical Devices Regulations;<br>Cosmetics Regulations |
| Fertilizer supplements, including novel microbial supplements | Canadian Food Inspection Agency | Fertilizers Act | Fertilizer Regulations |
| Feeds including novel feeds | Canadian Food Inspection Agency | Feeds Act | Feeds Regulations |
| Plants, including plants with novel traits, including forest trees | Canadian Food Inspection Agency | Seeds Act<br>Plant Protection Act | Seeds Regulations |
| Veterinary biologics | Canadian Food Inspection Agency | Health of Animals Act | Health of Animals Regulations |
| Pest control products | Health Canada | Pest Control Products Act | Pest Control Products Regulations |
| Aquatic Organisms (under development) | Fisheries and Oceans Canada | Fisheries Act | Fisheries Regulations |

Source: Canada (1998) Renewal of The Canadian Biotechnology Strategy: Related Resource Documents (Ottawa: Industry Canada), p. 13.

This section does not describe the details of each of the several statutes. Table 1 is simply intended to be an initial guidepost. What it initially conveys is that once we go "inside" the regulatory system, there are ultimately *several pathways* and erstwhile stages of product assessment depending upon the intended use of the biotechnology product. Thus the pathways are not just the product of laws and regulations per se, but also grow out of different inherent physical and technical realities to the nature of foods versus animal feeds, versus seeds versus aquatic products etc. There are also different

institutional cultures in the two regulatory bodies we are focussing on, the CFIA and Health Canada (Prince, 2000; Beaver, 1997; Howse, 1997, Doern and Reed, 2000)

The Consultation Process for Developing Regulations, Guidelines or Standards

While the core of the paper focusses on the regulation of biotechnology *products*, it is crucial in this introductory section to appreciate the consultation processes which accompanied the development of the regulations which govern biotechnology (including guidelines and standard-setting). These processes involved key stakeholders and the public.

Key aspects of this consultation activity are governed by federal government-wide policy on regulation (Treasury Board, 1995) including the requirement for a Regulatory Impact Assessment System (RIAS). The RIAS process introduced in 1988, requires each federal department to submit an impact statement for each new regulation and amendment (Mihlar, 1999). The RIAS focusses around a requirement for a basic cost-benefit analysis along with other important features of pertinent information and public transparency. The policy requires that departments and agencies such as the CFIA and Health Canada publish proposed regulations and amendments in the Canada Gazette. Specified forms of information are required and opportunities for commentary by stakeholders are built into this multi-step process. The RIAS aspect of the process also requires that the costs and benefits of the regulations as such are also estimated and revealed. The cost analysis relates only to the financial costs to business and the government of the regulatory system being proposed. It does not assess the products or the social costs.

In addition, the CFIA and Health Canada carried out their own consultation processes that both build-on the RIAS consultation process and extend it, taking into account their own ways of relating to their stakeholder communities and the public. In this brief section, we note two relatively broad consultation processes which shaped, and resulted in two key features of biotechnology regulation, Health Canada's consultation process in the 1990s that produced the current regulations on novel foods, and the CFIA's consultation process which was centred on the CFIA legislation itself (when the CFIA in 1997 became a new separate operational agency) but which also extended to some regulatory change flowing from the main statute (Canadian Food Inspection Agency and Health Canada, 2000).

Health Canada's consultations on novel foods began in 1992 with an Information Letter sent to all stakeholders. This led to a formal consultation draft "Guidelines for the Safety Assessment of Novel-Foods" in 1993. A workshop on the regulation of agricultural products of biotechnology was also held in 1993. Publication of "Guidelines for the Safety Assessment of Novel-Foods" followed in 1994 and the formal Gazette-based process followed.

A pre-publication phase launched in 1995 resulted in 35 responses from stakeholder groups. These groups ranged across the full spectrum including consumer advocacy groups, provincial governments, food and biotechnology companies, academics, industry associations, and standards organizations. Three years later in 1998, a second pre-publication Gazette-based phase occurred which elicited 9 responses. Overall there were numerous formal and informal meetings and written and verbal communications. Proposals and guidelines were also posted on Health Canada's web site. The RIAS element also raised issues regarding not only the details and adequacy of the consultation process but also resulted in clearer and narrower definitions of "novel food" and of what constituted "major change". Some comments were also received about the extent and nature of regulatory benefits, costs and burdens.

The above points reflect a process of considerable length and complexity across virtually a whole decade but we have by no means conducted an analysis of the process. For example, the fact that there were 35 groups involved initially and then it dropped to 9 can be interpreted in a least two ways. The 26 groups that ceased to formally respond might have been satisfied with their input. Or despite the fact that

Health Canada does fund some group's involvement, they may simply not have been sufficiently funded to be able to play the "long game" of consultation. It is also important to note that these consultations were about novel foods which, as we have seen, is a larger regulatory realm than biotechnology products per se.

The consultation process for the CFIA was presented at the workshop in a broader context still in that it focussed on the CFIA legislation. There is little doubt that consultation activity was varied and quite extensive. For the CFIA, the story necessarily extends to its pre-1997 situation when some of its component parts resided in Agriculture and Agri-Food Canada. The seeds, feeds, and animal health elements had fashioned over the years their own ways of dealing on a regular basis with their specific stakeholders and with the public (Canadian Food Inspection Agency and Health Canada, 2000; Prince, 2000; Doering 1996). Consultation processes regarding plants with novel traits and novel feeds can be traced to 1988 and took the form initially of work through advisory committees and a broader consultation in 1993. They then extended to the eventual Canada Gazette phases, including a pre-consultation phase which involved over 2000 stakeholders. The CFIA also includes in its public consultation processes its appearance on frequent occasions before Parliamentary standing committees between 1995 and 2000 and the larger processes which formed part of the Canadian Biotechnology Strategy in 1998.

As was the case with our look at Health Canada's consultation, the CFIA's consultative approaches cannot be readily judged in this paper. What is evident in both cases is that consultation has been important and has become more elaborate and complex. Both Health Canada and the CFIA are aware that they will increasingly be judged as regulators not only by what they regulate but also on how they regulate not only regarding biotechnology but also across their very wide regulatory mandates.

It is also useful to stress at this stage that there are also other crucial self-regulatory realms and institutions involved including public and private laboratories and standard-setting bodies and associations. They are all part of a larger regulatory governance system on which accountability and transparency demands are growing ( Doern, Hill, Prince and Schultz, 1999). Also increasingly a part of this governance system for biotechnology and for novel foods, feeds and plants is the ever extending international regime whose key features and harmonization pressures and requirements we have noted and which are examined further below (Health Canada 2000a; Canadian Food Inspection Agency, 2000a; Paarlberg, 2000; Lynas, 1999; Doern, 2000a)

## The T45 Case Study As Illustrative Aid

To convey key realities of the product assessment process a case study of AgrEvo Canada Inc.'s application was discussed at the workshop. The company's initial application "Novel Food Safety Assessment for Glufosinate Tolerant Canola Lines Derived from The Transformation Event T45" (hereafter referred to as "the T45 case study") was written to meet the assessment criteria laid out in *Guidelines for the Safety and Assessment of Novel Foods, Volume II: Genetically Modified Microorganisms and Plants (*Health Canada, 2000). AgrEvro Canada has given permission to the Office of Food Biotechnology of the Health Protection Branch at Health Canada to use aspects of its application for a training manual which Health Canada has begun using for training new regulators, especially in courses it has designed for regulators from developing countries. In its written form, the case material, which Health Canada had augmented for the June 23rd workshop with its own material on assessment criteria and guidelines, focusses on what technically is done or needed for key aspects of assessment, namely: *molecular; compositional; toxicological, nutritional and allergenicity data.*

In our discussion below, we refer selectively to the case study material as an illustrative aid regarding what is assessed and how key aspects of regulatory assessment are managed and coordinated so

as to allow us to see "inside" the regime as a whole. These features tended to emerge in discussion at the workshop rather than just in the written case itself.

**TABLE 2: Key Aspects of Novel Food Assessment**

- *The host organism*. In order to assess the substantial equivalence of any novel plant, it is imperative that the evaluator has detailed information about the natural history of the non-modified host plant. The biology of each of the major crop species in Canada has been reviewed and published by the Plant Biotechnology Office of the Canadian Food Inspection Office of the CFIA;
- *The donor organism.* Information about the natural history of the donor organism is required, particularly if the donor or members of its genus naturally exhibit characteristics of pathogenicity or toxin production, or have other traits that affect human health ;
- *The modification process*. A detailed exposition of the molecular characteristics of the novel plant is required in order to demonstrate that the developer has critically analyzed the plant and its products, including the novel genes and novel proteins. The method by which the novel traits are introduced into the host plant determines, in part, the information requirements for the assessment of the molecular biology of the plant;
- *DNA analysis of the plasmid backbone*. Agrobacterium-mediated transformation of plants is the most commonly used method for introducing novel genes into the plant genome. It results in the insertion of single, or often, tandem copies of the DNA cassette as delineated by the left and right border repeats of the T-DNA. Sequences from outside of the left and right borders of the T-DNA may also be integrated along with the T-DNA, therefore the applicant must determine if any such plasmid sequences are present in the host plant genome.
- *The genetic stability of the modified organism*. The inheritance and stability of each introduced trait that is functional in the transformed plant must be determined. For each novel trait, the pattern and stability of inheritance must be demonstrated as well as the level of expression of the trait. If the new trait cannot be measured directly by an essay (e.g. ELISA), then the inheritance of the new trait will have to be determined by examining the DNA insert directly, and the expression of the RNA;
- *Expressed Material/ Effect*. The transcription and/or translation products of a novel gene, or genetic element, that has been introduced into the plant genome, or these same products arising from a modified endogenous gene, or genetic element, must be characterized. Where the result of the modification is the expression of a novel protein, or polypeptide, this material must be characterized with respect to: identity; functionality; and, where appropriate, similarity to products from traditional sources. In cases where the modification is the expression of a novel non-translatable RNA transcript, the sensitivity and specificity of the desired action should be established. Examples of this include the production of anti-sense mRNA or other RNA species resulting in the reduced production of an endogenous protein. The altered regulation or expression of non-target host genes should be investigated in the course of assessing the safety and nutritional acceptability of the food products from the modified plant.

Source: Adapted from Health Canada 2000, pp. 1-24.

The product in the T45 case study has been on the market since 1996 and hence had gone through the biotechnology regulatory process earlier in the 1990s. Moreover, prior to the novel food safety assessment of T45, Health Canada had approved two novel foods derived from glufosinate tolerant canola lines, HCN92 (Innovator) and HCN10, both of which derived from the transformation event Topas 19/2 (Health Canada, 2000, Chapter 1, p.4). This fact is of regulatory importance because it meant that the T45 case was a product on which the regulators could build on earlier quite closely related knowledge. As mentioned, the T45 case is too complex for detailed presentation but key aspects of what is assessed are shown in Table 2. The needed molecular; compositional; toxicological, nutritional and allergenicity data are variously brought to bear on the aspects shown in Table 2, such as characterizing and showing the: host organism; donor process. For example it does not deal with environmental assessment and feed assessment organism; modification process, genetic stability of the modified organism; DNA analysis of the plasmid backbone; and expressed material/ effect. But Table 2 does not convey the full complexity of the different aspects of the product assessment carried out by CFIA.

## THE CORE BIOTECHNOLOGY PRODUCT ASSESSMENT PROCESS: STAGES, QUESTIONS AND ISSUES

The majority of the questions and issues discussed in this section attempt to follow the progress of an application through its various stages inside the two departments/agencies but, as already indicated, the processes are complex.

### A Stylized Glimpse of the Process

The approach here is first to sketch out, in a stylized manner, an initial glimpse of what happens and how broadly applications are handled. However, as other questions are addressed below, it will quickly be necessary to re-introduce the differences that arise from different statutes, agency case review processes, institutional cultures, and technical/physical features (foods, plants, etc) and elements such as when molecular; compositional; toxicological, nutritional and allergenicity data are brought to bear at different stages. But, it must also be stressed that space limits do *not* allow the paper to go into the details of *each* of the food, plants, seeds, feeds, and animal health realms. With these caveats in mind, Table 3 itemizes the core stylized steps and features of the product assessment process.

Table 3 was constructed by the author from information and discussion supplied by CFIA and Health Canada at the workshop (Canadian Food Inspection Agency, 2000; Health Canada, 2000d; ) and also available on the two agency's websites.[4] At the same time, however, Table 3 does not capture more detailed but important features or sub-stages of the process. For example, the assessment of herbicide tolerance on a genetically modified product could be routed in three different ways as it was assessed for herbicide tolerance. As a novel food product it is routed through Health Canada where it undergoes safety assessment. As a seed and animal meal product, it is routed through the feed section of the CFIA for safety assessment. And as seed product it undergoes environmental review by the Plant Biotechnology Office of the CFIA (Canadian Food Inspection Agency, 2000b). In each section below, we "revisit" the stages and elements profiled in Table 3 to fill in further gaps and layers of complexity in our picture of the biotechnology product assessment process. Table 4 provides a further visual summary

[4] Canadian Food Inspection Agency (Plant Biotechnology Office Website) http://www.cfia-acia.agr.ca, and Health Canada Website, http://www.hc-sc.gc.ca/food-aliment.

guide to these complexities and links them to answers and issues related to the template questions in Appendix I.

**TABLE 3**: **The Stages of Overall Product Assessment: An Initial Glimpse**

- The earliest stage of regulation centres on research and field trials. For the purposes of this paper we use mainly the example of regulating plants with novel traits which is centred in CFIA. The phases of regulation at this point involve plants with novel traits which are: *contained* (in a laboratory or greenhouse); *confined* (involving field trials-reproductive isolation); *unconfined* (reduced or no reproductive isolation; and *commercialization* (variety registration; food use; feed use). If the commercialization involves use as a food then the overall process shifts to Heath Canada under its regulations for novel foods. Most of the rest of this initial glimpse thus deals with how novel foods are regulated by Health Canada. But references also are made to CFIA.(See also Appendix II).
- When an application is received from a proponent company, one regulatory officer is assigned the application but it is never the case that only one person assesses the application. This is due to the fact that the scientific aspects of the assessment of safety are inherently multi-disciplinary and quite genuinely complex in a scientific-technical sense.
- The application (which in Canada includes raw data rather than just summaries of data) is typically very voluminous (quite literally several volumes in length) and hence no single science officer ever in a sense "reads" or "assesses" the whole application. Rather a core of science officers assess each of the aspects within their competence:
  - molecular
  - compositional
  - toxicological
  - nutritional, and
  - allergenicity data.

  This group becomes an informal but crucial team which then both checks off whether the application meets some key checklist items or aspects but the group also discusses, analyses and debates the adequacy of the data and its implications. Thus the assessment process is quite reductionist in nature and then is augmented by a group process of discussion.
- The core of science officers for this work on biotechnology products consists of not much more than 10 experts in Health Canada and 10 in the CFIA (for its aspects of biotechnology in plants, feeds, seeds, and animals) with perhaps another 20 or so experts within the government science-establishment whose expertise is drawn on in a more periodic basis. These in total are the "front-line" officials in the safety aspects of biotechnology regulatory system and they possess masters or doctoral degrees in their areas of the sciences.
- Where the review team believes there are clarifications needed or deficiencies in the data and studies present these are requested and required from the proponent firm. If such further information is not supplied, the application process stops and indeed the regulatory clock may be turned back to zero (see more about regulatory clocks and time-frames below).
- While the reviewers must rely on data and studies supplied by the proponent company and therefore do not re-do the studies (de novo) they are also able to draw on an extensive published peer-reviewed scientific and technical literature as well as expert reports and international guidance documents.
- The review process for each product application can take 12 to 18 months in Health Canada's novel foods assessment process but there are other specified time periods and "time clocks" during which certain aspects of regulation and information have to occur (discussed further below).

- Within Health Canada the progress of applications in the assessment process or cycle are monitored and reviewed and disputes resolved or referred. There is a Food Ruling Committee which has existed for years and which meets each month to deal with many different kinds of food product decisions. The Office of Food Biotechnology at Health Canada receives the comments from the various assessors and prepares a recommendation which is taken to the Food Ruling Committee. It thus seems to involve a more formal process than CFIA. CFIA's decisions in plants, feeds, seeds and animals does not involve consideration by an equivalent single committee but decisions are collectively discussed in other ways.
- Eventually the formal process ends when Health Canada advises the applicant that it has "no objections" to the product. The CFIA "approves" products in its areas of regulation.
- Potentially, an appeal process and a post-market review stage completes the full cycle of regulation but these are not as clear-cut a phase for biotechnology products (see further explanation below)

Regulating Research and Field Trials (Plants With Novel Traits)

The main aspect explored here is centred on how research on *plants with novel traits* is regulated by CFIA. Again, our treatment of it here must be considered as covering only the barest of outlines (see Appendix II for further points). The primary trigger for assessment is the novelty of the product rather than the specific means by which it is produced. Hence, regulators are looking for plants with novel traits (PNTs) not specifically plants modified by recombinant DNA techniques. And again the concept of *substantial equivalence* is the starting point for assessment.

The sequence or cycle of regulation then proceeds through the stages indicated below (contained, confined, unconfined, commercialization) with each stage having potentially different self-regulation, regulators or shared regulators as follows:

- *Contained* (Laboratory, Greenhouse)....self-regulated by firms, laboratories, and/or through ISO certification, including rules by research granting bodies.

- *Confined* (Research Trials-Reproductive Isolation)...regulated by CFIA's field testing assessment.

- *Unconfined* (Reduced or No Reproductive Isolation)....environmental assessment by the CFIA, and (if above trials are approved) then;

- *Commercialization* (Variety Registration and Feed Use)....regulated by the CFIA and food use by Health Canada (Canadian Food Inspection Agency, 2000).

First, the initial *contained* stages raise issues about self-regulation and how confident the public can be about its transparency, efficacy, safety and compliance aspects. At the same time, however, it is difficult to envisage how this aspect could be anything other than dependent on significant forms of self-regulation given the numerous sites and locations for research and field trials.

Second, in the past 12 years there have been about 5500 field trials for plants with novel traits (not all of which are biotechnology). *Confined* field trails do specify the space or number of hectares that can be used, restrict the number of trials per province, and impose other requirements, including site monitoring, the disposition of plant material, and post harvest restrictions and monitoring (See Appendix II). In the last two years CFIA has inspected 100 percent of its current season trials but only about 10

percent of the post-harvest sites. The regulatory and compliance process is crucially dependent on records being kept. Recently, cost-recovery was introduced by the CFIA to fund aspects of the regulatory process.

Since this phase already takes the analysis into the inspection process, it is useful as a third point of observation to note that the CFIA is largely an inspection operation (Doering, 1996; Prince, 2000, Moore and Skogstad 1998). About 500 of its staff are based in Ottawa but the 4100 other staff in the regulatory front-lines are in the CFIA's field offices. However, because, the CFIA is inspecting the many different aspects of its mandate, it follows that its inspectors are engaged in a "multi-task" mode of inspection. Little was explored at the workshop about the explicit biotechnology competence of the inspection force or processes.

**TABLE 4**: **A Summary Guide to Regulatory Stages and Template Issues**

| **Stage or Aspect**<br>**(TQ denotes template questions in Appendix 1)** | **Key Features, Issues or Questions**<br>**(See text and sources for elaboration)** |
|---|---|
| Regulating research/field trials (plants with novel traits) (TQ1) (See also Appendix II) | - CFIA regulates as part of process for regulating all plants with novel traits;<br>- concept of substantial equivalence is starting point for assessment;<br>- stages of research regulated are: contained; confined; unconfined; commercialization;<br>- 5500 field trials in past 12 years;<br>- 100% of trials now inspected;<br>- lack of mandatory public notice about field trials;<br>- environmental risks assessed by CFIA |
| Prior Discussion Before Application Received (TQ2) | - Health Canada regulates under Novel Foods Regulations;<br>- considerable discussion between proponent and Health Canada well before application sent;<br>- guidelines describe requirements for safety assessment;<br>- further consultations help identify exact data required on the exact characteristics of the product and on the extent of novelty;<br>- substantial equivalence is starting point for assessment; |
| Who Does The Product Assessment? (TQ3) | - about 10 scientists form the core assessment group in *each* of Health Canada and CFIA;<br>- all reviews done by in-house scientists; working as teams with individual scientists assessing aspects related to their expertise;<br>- outside expert panel used in rbST case but this was exception and centred on animal health;<br>- peer-reviewed literature and international expert reports are drawn on regularly;<br>- application data is voluminous and complex; |

| | |
|---|---|
| Final Decisions and Dispute Resolution (TQ4) | - several science assessors must agree to their aspect of assessment on scientific grounds;<br>- discussion among team where there is dispute over the science;<br>- dispute resolution can move up the hierarchy within Health Canada or CFIA to Director or higher level official (who are also scientists);<br>- Final decisions reviewed by Food Ruling Committee at Health Canada and through a more informal but collective process at CFIA;<br>- rbST case used outside expert panel but no automatic "appeal" to such outside panels if dispute over science;<br>- no public involvement in product assessment process for biotechnology or other novel food assessments or for assessments of plants with novel traits;<br>- overarching concerns by some that neither regulator has a process for dealing with the cumulative impacts of biotechnology products;<br>- issues of commercial secrecy are involved, tied to access to information and privacy laws; |
| Length of Process (TQ6) | - 43 biotechnology products assessed and on the market to date;<br>- biotechnology food products take 12 to 18 months of calendar time; but some can take 6 months;<br>- time required depends on level of complexity and inherent novelty of the product;<br>- rough estimate that assessments involve about 80 to 100 person-hours on average but no firm data on this presented;<br>- other specific "time clock" provisions must be adhered to by the proponent; if non-compliance then clock is set back to zero.<br>- performance criteria and regulatory efficiency is a factor in general management assessments of all federal regulators; but none specific to biotechnology regulatory performance per se.<br>- user fees required for selected aspects of CFIA regulation but none for Health Canada. |

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|---|---|
| Interdepartmental Aspects (TQ7) | - Interdepartmental coordination is extensive but within the limits of both Health Canada and CFIA's primary separate statutory duties and mandates;<br>- Expertise is shared and extensive consultation occurs among scientists in both agencies;<br>- Some debate occurring among agencies about the impact of the precautionary principle, emanating in various ways from Environment Canada, Health Canada and CFIA but no definitive consensus on impact of the principle on actual regulatory practice;<br>- Concerns about "single-window" regulation only partly addressed through Office of Food Biotechnology in Health Canada and the Office of Biotechnology at CFIA. |
| International Aspects (TQ8) | - Product assessment is a national process but international influences growing;<br>- great use of international peer-reviewed literature;<br>- frequent consultations with scientists in other national regulators (especially U.S.)<br>- Key "accepted approaches" (such as substantial equivalence) are used and are continuously examined through FAO, WHO and OECD expert review processes;<br>- other bilateral agreements (Canada-U.S.; Canada-E.U.) on harmonizing assessment approaches; |
| Scientific Versus Other Criteria for Review (TQ9; TQ10) | - Assessments based on science is the statutory requirement in Canada;<br>- non-science (social, economic or ethical) criteria not discussed in paper but are a part of current/recent studies by CBAC and internationally by Nuffield Foundation in UK;<br>- debate could be linked to variety of issues and values including; the biases of individual science assessors as citizens; the pressures to approve products because of global competitiveness; the meaning of the precautionary principle; the use of non-experts in product assessment decision processes; and contending concepts of democracy; |

| | |
|---|---|
| Communication of Final Decisions and Appeals (TQ11 and TQ 12) | - Health Canada's decisions state that it has "no objections" to the product; CFIA uses the term "approves" for its decisions if all conditions met;<br>- Health Canada's final decision documents are put on its website;<br>- Difficult choices as to how long documents should be and how much technical information should be included to communicate decisions;<br>- Kinds of information which can be made public is influenced by commercial secrecy and hence affects issues of communicating risk; trade-offs between freedom of information and privacy law also involved.<br>- there are no formal appeal or review processes provided in Health Canada's novel foods process for firms, stakeholders or citizens to final regulatory decisions;<br>- CFIA has regulatory features through which new scientific information could result in a changed decision. |
| Post-Market Review (TQ13) | - No systematic program for post-market review of biotechnology novel food products;<br>- Post-market concerns could be brought informally to the regulator by citizens;<br>- CFIA has several follow-up processes regarding research and field trials (see Appendix II) but these are not post-market as such;<br>- consumer choice and information are key issues since many consumers are unaware that they are consuming biotechnology food products; this is a key market issue but not a formal part of what is normally thought of as post market review. |

A fourth aspect of regulation centres on the confined trial sites. There is no mandatory public notice about the trials nor any information about the exact location of the trials. A 30 day notice is given to the Provincial governments involved. The absence of public notice and information on exact location is largely due to two factors. First, there is a fear of damage to the site which may invalidate tests. But second, keeping in mind recent very public anti-GM food and plant protests in the U.K. (where sites were revealed) there may simply have been a desire by regulators to avoid such front page and media opportunities to the critics of the GM food industry.

There is also an *unconfined* environmental release safety assessment. Following an unconfined release approval, there are generally no requirements for reproductive isolation, site monitoring or post-harvest land use restrictions (except for Bt insecticidal protein expressing plants where resistance management plans are imposed (Canadian Food Inspection Agency, 2000).

A fifth and final point about the process overall, is how the "environmental" aspects are assessed in the broader confined and unconfined stages. The concerns here are both scientific and jurisdictional and go well beyond specific products. Scientifically, the concern is whether the process of assessment overall allows for the examination of cumulative impacts (Nuffield Foundation, 1999). Field trials are not assessed through public consultation processes in the way in which Environment Canada's Canadian

Environmental Assessment Agency (CEA) conducts its environmental assessment under its legislation. But the CFIA does assess some environmental aspects in this research/trial phase and environmental assessment is an aspect of its inspections and enforcement (see Appendix II for further details).

Prior Discussion Before Application is Received

At some point after research and field trials have been successfully completed a proponent company or researcher with a novel *food* product must apply to Health Canada to have it assessed. It should not be surprising that prior to a company or researcher submitting a product application there is considerable discussion between the product proponent and the regulatory officials. In some cases this could be two or more years before the application. Individual regulatory groups also have detailed product-specific guidelines which describe the information/data requirements for a safety assessment. These discussions and the guidelines are a necessary and desirable process for both parties. For the regulator it ensures that the correct kinds of analysis and data are supplied and that there are no misunderstandings about what these requirements are. For the proponent, it also helps to reduce the uncertainty that is inevitably a part of product regulation. The regulatory guidelines describe the requirements for a safety assessment but consultations with regulatory officials are encouraged to identify what exact data will be required based on the exact characteristics of the product and on the extent of novelty compared to products already on the market.

It is also crucial to point out that the early discussions are also vital to the proponent in that it develops its product knowing that regulatory approval (i.e. no objections) is crucial to product acceptance. But at the same time, the firm has its own internal reasons for wanting good science *within* the firm to underpin its products. These are centred on commercial and competitive pride in having a good efficacious product, but they are also centred on a healthy fear of future liabilities if the product is unsafe or not efficacious.

Who Does the Regulatory Product Assessment/Review?

We have already provided a partial answer to this question in the initial stylized glimpse of the novel food product assessment process above through our reference to the core teams and to the fact that it is always a group of scientists that conduct the review, and to the fact that about 10 such scientific experts form the core review group in each of Health Canada and the CFIA. Thus the reviewers are in-house scientists. Scientists on contract are not utilized nor are special outside expert panels drawn on. An outside expert panel was used in the rbST case, largely because of public pressure and controversy but the rbST case did not deal with a novel food product application but rather with a veterinary drug. Health Canada's decision not to approve its use in Canada is based on the presence of an unacceptable risk to the health of milk-producing cows (MacDonald, 2000).

Related peer-reviewed literature and research is also drawn on by the assessment teams as they make judgements about the product and its properties and potential effects. But the product data and information is not itself subject to an automatic outside or external peer review itself, such as would occur if research was to be published in a recognized scientific journal. The T45 case material by Health Canada indicates clearly, however, that "the evaluation of an application for a novel food safety assessment is comparable to the peer review of a manuscript for publication in a scientific journal. Accordingly, the quality of the text and data presented must be commensurate with this. Experimental procedures should be described in sufficient detail (or referenced accordingly) so that the methodology can be repeated" (Health Canada, 2000, Training Module 2, p. 5). The same document also makes clear, the voluminous and detailed nature of the data and information that must be submitted both for novel

foods derived from genetically modified microorganisms and plants and their products (Health Canada, 2000, Training Module 1, pp.1-27).

Questions automatically arise in this context regarding whether or not the two regulatory bodies have enough in-house or general R&D which they can draw on and develop and which is directly informed by their *regulatory science* capacity needs. The federal budget of 2000 has provided $90 million of additional funds and some studies are underway which are directly geared to such regulatory science and capacity needs. The availability of new funds is also crucial to the regulators' ability to keep and attract qualified people in a highly competitive field. There are only two such sources of funding, either taxpayers pay or the regulated firms pay user fees, but the user fees have implications for regulation as a public versus a private good. (Doern and Reed, 2000).

Who Makes the Final Decisions and How Are Disputes Resolved?

The discussion above indicates that decisions in any final sense are shared within the regulatory body in that several scientist-assessors must agree to their aspect of assessment on scientific grounds. During this multi-dimensional process, there can certainly be disputes and differences of opinion within the agency and perhaps between the proponent firm and the agency. These differences must essentially be talked about and resolved partly on a professional- collegial basis among the teams. In part then, this form of dispute resolution functions on trust and mutual professional respect for complementary and separate realms of expertise. All regulatory systems must function partly on the basis of trust but none can gain public legitimacy on this basis alone (O'Riordan, 1996; Powell and Leiss, 1997; Doern and Reed, 2000; Holmes, 1999).

If disputes have to be moved up the hierarchy within Health Canada and the CFIA, then by definition a higher level official becomes involved, possibly at the Director or even Director General level. These individuals also are usually scientifically trained and are likely to have formerly been front-line science assessors. As we have seen, Health Canada also has a more formal Food Ruling Committee for the overall management of product case assessments and disputes. The CFIA has no equivalent overall committee for its aspects of biotechnology product regulation (though there is considerable discussion across sectoral lines at CFIA).

This paper cannot comment further on exactly how these processes work since no research as such has focussed on these dynamics. Some examples were given at the workshop such as one involving the CFIA where a difference of view over the kind of data being submitted was eventually resolved when the head of the CFIA called in the CEO of the company involved.

Some calls or pressure from companies (sometimes to ministers or MPs) may arise if they believe that the approval or broader process is taking too long (see more below), but, in general, biotechnology firms are very conscious of how crucial regulatory assessment is to the public acceptance of a biotechnology food product and hence tend to keep many of their frustrations to themselves. Again, this kind of observation must be treated as a comment only because no systematic study has addressed this aspect of biotechnology product regulation.

Ultimately, if successful, the proponent company receives a letter from the head of the agency or other senior official indicating that the regulator has "no objections" to the product going into the market. Health Canada uses the phrase "no objections" whereas the CFIA for its aspects of biotechnology product regulations for plants, feeds, and animals uses the term "approves". There are few instances of formal or official " rejections" of a biotechnology product but there can be defacto withdrawals from the product assessment process. Such withdrawals are certainly not a formal stage in the process but could arise simply if the proponent does not submit requested data or if assessment showed that some aspect of

assessment was not met. Its application assessment would simply cease, either totally or until the proponent decided that it would comply.

The dual questions of "who decides?" in general and "who decides when there is no internal scientific agreement?" is ultimately related to two other contentious aspects of the assessment and decision process as a biotechnology product proceeds through the regulatory cycle. The first is whether expert panels of outside (non-regulatory agency) scientists should look at each product or should be a part of exceptional "appeal" procedures. This is what happened eventually in the rbST case. If outside expert panels were used on every biotechnology product case, this could potentially enhance public confidence in science-based and transparent regulation. But it would also undoubtedly increase the time needed for regulatory assessment and could adversely impact on the Canadian industry's ability to get good products on the market compared to competitor firms of other countries in relation to their national regulatory systems' efficiency.

If outside panels were used only on *exceptional* cases, the problem is to decide what the criteria of exceptionalness would be. The rbST case has been looked at quite closely by Health Canada but the use of outside expert panels (regular or adhoc) has not been the main overall lesson drawn from it. Instead "lesson-drawing" by Health Canada regulators has focussed on improving the overall clarity and transparency of the data-requirements process and procedures.

Another issue of key importance is that the question of using outside expert panels (let alone wider forms of citizen involvement) cannot be divorced from the question of why this reform might then only apply to *biotechnology* products. Why not all drug and food products? But if applied system wide to all these realms in the jurisdiction of Health Canada and the CFIA (not to mention Environment Canada and Fisheries and Oceans Canada) then there are enormous implications for the effectiveness and efficiency of product regulatory processes as a whole. Ultimately these issues are also tied to contending concepts of democracy and to how much and what kinds of participative direct democracy, versus interest group or stakeholder democracy versus representative Parliamentary-Cabinet democracy is being advanced, either in the name of reform or in defence of the status quo (Anderson, 1999; Prince, 2000; Doern and Reed, 2000).

The issue of expert panels (and of broader forms of public consultation) in the *product* regulatory cycle is also affected by rules, norms and practices regarding *commercial secrecy*. Such secrecy is a powerful norm which government regulation supports either for statutory reasons (including trade-offs between freedom of information law and privacy legislation) but also partly due to inertia and convention. Proponent companies do not want their commercial secrets revealed to competitors while products are being evaluated by government regulators. Thus biotechnology product regulators at present are obliged to adhere to both transparency and secrecy as overall regulatory values because both are required in different ways as part of a balanced regulatory system.

However, it is clear that this poses a dilemma. The need of companies to protect what they claim is commercially sensitive has a major impact on the ability of the regulator to communicate risks to the public. Accordingly, it is important to ask who precisely determines what is commercially sensitive information such as data collected on pre-market product approvals. The question regarding novel food products is almost totally determined without any public debate about where crucial lines should be drawn regarding *biotechnology* novel food products.

<u>How Long Is the Product Assessment Process: Calendar Time and Real Time?</u>

As mentioned, 43 biotechnology products have been assessed and are on the market. A logical question centres on how long product assessment takes both in calendar time (the time from receipt of application to the end of the full process) and in real time (the number of person-hours spent by

science-assessors and others in assessing the file). Clearly, firms and regulators are both ultimately interested in an efficient regulatory system but also one that effectively assesses safety and risk.

Complete data is not available but the regulators' overall response at the workshop was that biotechnology food products on average can take 12 to 18 months of calendar time to complete the full assessment process but that some products can be done closer to the time scale of 6 months. Clearly, the level of complexity of the biotechnology product and its inherent novelty can and should determine the time actually needed. It must also be remembered that the regulators are relating these time scales to the *overall novel food* regulatory assessment process which includes products other than biotechnology products.

As for the real time or person-hours dimension of the question, only tentative guesses emerged in discussion at the workshop. Estimates of 80 to 100 person hours on average were mentioned regarding Health Canada but there is no firm public data on this aspect of time and there is no indication that such data is even kept either as average figures or as a range of times, depending again very crucially on the complexity and degree of novelty of the product application.

There are some other time specifications set out in the regulatory assessment process. For example, Health Canada specifies that the manufacturer or importer must notify Health Canada 45 days prior to the sale or advertising for sale of a novel food product (Health Canada, 2000d). The CFIA (and also the Pest Management Regulatory Agency) are also notified of all food petitions submitted to Health Canada. Health Canada is also committed to determining within 45 days if additional data/information is required to complete the safety assessment of the novel food. But if there is non-compliance with requests for such data/information, the 45 day clock is set back at zero. This kind of provision supplies a necessary regulatory lever to ensure that the regulator can get the data/information it needs. It should be noted in passing that this potential "turning back of the clock" feature is not a part of the regime for regulating novel feed products.

In the last decade virtually all health and safety and other regulators (in Canada and elsewhere) have been under pressure to produce and adhere to better service or performance standards in their regulatory activity (Doering, 1996; Doern, Hill, Prince and Schultz, 1999). Performance standards are part of the management accountability regime and business plans for both Health Canada and for the CFIA but there are no separately designated performance measures for biotechnology products (Canadian Food Inspection Agency, 1997).

In some areas the pressure for performance standards has been linked, as we have seen, to the use of user fees paid by industry to partially fund the regulatory body. User fees have not been adopted for the Health Canada novel food regime and the CFIA has also resisted pressure for a user fee regime, in many, but not all of its regulatory realms. In the CFIA's case this resistance comes not only from the regulator but also from the numerous small-businesses which form part of the CFIA stakeholder community (Prince, 2000; Doern and Reed, 2000). However, CFIA does charge fees for regulating field trials, environmental releases of plants with novel traits and for novel feeds.

Interdepartmental Aspects of the Product Assessment Process

The handling of biotechnology product assessments clearly involves important interdepartmental aspects. First, as we have seen, the system as a whole involves four main departments and agencies and their relevant statutes and guidelines. With respect to novel foods derived from plants with novel traits, our focus in this paper, there is a complementary role between Health Canada and the CFIA.

The CFIA is responsible for the administration and enforcement of eleven acts. These include the Feeds Act, Health of Animals Act, Seeds Act, and Plant Protection Act already mentioned in Table

1and of specific import in different kinds of biotechnology products. The CFIA is also concerned with the Consumer Packaging and Labelling Act (regarding its food provisions) which is another area of biotechnology regulation not covered by this paper.
The CFIA is also responsible for the administration of several provisions of the *Food and Drugs Act* as they relate to food (excepting provisions that deal with public health, safety or nutrition); and for the enforcement of the *Food and Drugs Act*. Health Canada has the regulatory role regarding public health, safety and nutrition.

There is a necessary extensive amount of cooperation and team work across the two regulatory bodies when it comes to mobilizing and sharing expertise to assess products. The jurisdictional and statutory separation of duties is ensured in final decision making but the relatively small core of front-line expertise means that defacto sharing of expertise and a sense of trust and mutual respect is crucial.

Our concern here is with product assessments, per se but another interdepartmental aspect which must be mentioned again in this context is the interdepartmental concerns about the meaning and application of the precautionary principle. This principal has tended to be enunciated and advocated first and most often by Environment Canada (one of the four departments in the federal biotechnology regulatory system) and by environmental NGOs but it has also entered the interdepartmental and cross-governmental realm of discussion through Health Canada and health NGOs, initially because of the Krever Commission and controversies over the regulation of blood, but more generally as well. However, Health Canada's novel food and biotechnology regulators argue that their overall system for assessing products is itself a practice of precaution even though there is no mention of the concept in its statutes (although it is explicit in environmental laws administered by Environment Canada such as CEPA). In other words precaution is said to apply because a product is not approved if some safety issues have not been adequately addressed. Similar views are held at the CFIA. Not much more can be said about this as an interdepartmental aspect or as a feature of this paper except to say that it is now a much more explicit part of the debate at all levels, product assessment, overall regulation, and international regimes for international trade in food (UNEP, 1999; Stirling, 1999; Paarlberg, 2000; Doern, 2000a; European Commission, 2000).

One further issue regarding interdepartmental aspects is that of "single window" regulation. Private firms will often complain if they have to apply at several different places
or entry points and want to avoid overlap and excessive regulatory burdens. Such overlaps may not be even "interdepartmental" among the four agencies. They could also apply *within* Health Canada or the CFIA. To address these concerns, Health Canada has established the previously mentioned Office Of Food Biotechnology to function as a "single window". The CFIA also has an Office of Biotechnology but it is much less clear whether it functions in any direct regulatory role.
At present it is staffed mainly by non-scientists whose primary role is one of liaison and communications with other departments in the larger context of the Canadian Biotechnology Strategy.

A further extended version of these concerns about a single window nominally comes from citizens and interest groups who might want, quite simply, a separate single biotechnology regulatory body. However, even if such a stand alone "biotechnology regulator" was established, coordination problems would still be a dominant concern. Some would simply become re-formulated as "stove-pipe" coordination issues *within* a single regulator and still other issues would remain as to how to deal with, and coordinate, issues with other still remaining outside bodies such as the rest of health regulatory system and the rest of the food regulatory system.

International Aspects of the Product Assessment Process

Space does not allow any extensive account of the international aspects of biotechnology food product assessment. The system of product assessment is still very much a *national* system of assessment in that the same product will need national regulatory assessment in countries where the product is to be marketed. National regulatory sovereignty means that permission to market products does not always happen in all national jurisdictions, as the rbST case showed and as general disputes between the EU and North America make clear (Paarlberg, 2000; Phillips and Buckingham, 2000; Doern, 2000).

With respect to actual product assessments in Health Canada and the CFIA, there are certainly international aspects of assessment present in three respects. First, the science of biotechnology is global science and hence the peer-reviewed literature is international and is drawn on in the product assessment process. Second, science assessors within Health Canada and the CFIA have their peers in other countries' regulatory bodies (especially in the U.S.) with whom they are in regular contact. This does not mean at all that they simply adopt the conclusions reached elsewhere. But it does mean, that they can make queries about particular technical and analytical problems and obtain advice (and of course tender advice to other regulatory staff abroad who are contacting the CFIA and Health Canada on a similar quest for shared knowledge).

The third way in which international aspects influence product assessment is of course through the influence of the previously mentioned "accepted approaches". This is especially the case for the concept of *substantial equivalence* (see earlier definition) This concept was adopted through international experience and discussion largely in the 1990s. These discussions and enunciations of the substantial equivalence approach emerged in international arenas such the FAO and WHO and then in the OECD in 1993 (Organization for Economic Cooperation and Development, 1993). The approach was further endorsed and reinforced after a 1996 FAO and WHO expert consultation reviewed how several food product cases had been handled in various regulatory systems (Food and Agriculture Organization, 1996). It was also the focus of a joint FAO and WHO expert consultation in 2000 (World Health Organization, 2000).

The concept of substantial equivalence is very much a central concept in Canada's (and seven other countries') biotechnology product assessment process as a way of determining how extensive the search for novel traits is and hence what kinds of data and research can be reasonably relied upon by the teams of regulatory scientists. But substantial equivalence is *not* the assessment process itself. It is in effect the starting point but full assessment is centred on the substantive assessment of products by the science regulatory teams as sketched earlier (Health Canada, 2000a). Thus, substantial equivalence cannot and will not be applied in the assessment of a novel food for which there is no adequate comparator as described in Health Canada's safety assessment guidelines and further detailed in the WHO study (World Health Organization, 2000). In these cases more detailed and more comprehensive data will have will have to be generated.

This concept, as a starting point, therefore has considerable support among professional regulators but it is a contested one, especially by those who see the next generation of biotechnology products being based on more complex and uncertain forms of genetic modification (Millstone, Brunner, and Mayer, 1999).

A further area of international actions are those centred on promoting the harmonization of regulatory systems and approaches. For example a series of meetings between Canada and the U.S. produced an agreement in 1998 as to how regulators in both countries would deal with the application of molecular criteria in plant biotechnology (Canadian Food Inspection Agency, 2000).

Scientific Evidence Versus Other Socio-Economic Criteria of Review?

As discussed earlier the core of the biotechnology product assessment process is centred on scientific evidence and science-based decision making as brought to bear both through the expertise of scientist-officers who do the assessment and through their use of other peer-reviewed scientific research. The natural question arises as to whether product assessments are, or should also be, influenced by other socio-economic criteria and values (Nuffield Foundation, 1999). And this question in turn raises the issue of how and when they should be a part of any process. It must be stressed that this paper and the workshop did not explore this complex and important issue. All that can he highlighted here is what other socio-economic issues might potentially include (Nuffield Foundation, 1999; Stirling, 1999; O'Riordan, 1996; Powell and Leiss, 1997; Holmes, 1999; Doern and Reed, 2000).

One aspect might simply be that some of the scientist-assessors employed by the regulator have strong biases *as citizens* and individuals for or against biotechnology products. This is a possibility although the notion that *teams* of scientists actually assess a product should be one powerful antidote to minimize this possibility.

A second aspect of "socio-economic" criteria is whether there is an institutional bias in the regulatory system that becomes pro-business (or pro-approval of products) in nature. Some of this suspicion has arisen because of the greater mention in mandates and principles of the global trade, innovation, and market access aspects of the regulatory regime. It can also be argued that the increased use of user-fees paid by industry to fund regulators also exerts a pressure (or even the perception of pressure) to speed the assessment process. The effort in key aspects of international health and safety regulation to develop efficiency "league tables" such as in drug regulation to compare different national regulators is also a part of this scepticism. The federal regulators at Health Canada and the CFIA strongly argue that no such systemic bias exists and that health and safety assessments based on science is the dominant criteria and indeed that governing laws do not allow them to take into account other criteria.

A third aspect of the socio-economic criteria question is that the *precautionary principle* is seen by some of its critics as being a door though which many dubious criteria could enter the decision process. For others, however, precaution is seen as a natural part of good risk-assessment and indeed of scientific peer review itself (Stirling, 1999).

Finally, the actual or expanded use of socio-economic criteria is necessarily linked to our earlier discussion of whether broader public consultation is built into the *product* assessment process as opposed to, or in addition to, the general biotechnology regulatory process (see more below). This is also tied into a host of important criteria which include ethical criteria, criteria regarding individual consumer choice and the aforementioned contending definitions of, and approaches to, democratic governance.

Communication of Final Decisions to Applicant and Public

We have already noted that Health Canada's final decisions about a novel food product, indicating that the regulator has "no objections" are communicated in writing to the proponent company. But the other aspect of communicating final decisions centres on communication to the public. Health Canada and CFIA both publish their regulatory decisions. But their regulators brought out in the workshop some of the dilemmas and trade-offs in this aspect of transparency.

For example, final decision documents on novel food products are put on Health Canada's website but the content of these documents does pose a challenge regarding how much detail and information needs to be in the decision document. Documents which are both too long and too technical

can generate criticism from the public. However, any shortening of the document can also lead to the criticism that they are not revealing key parts of the information.

A further factor of considerable import is that the document must be crafted so as not to reveal commercial information that would of course be valuable, if published, to the proponent firm's competitors. This constraint eventually takes us back to the earlier discussion of commercial secrecy and privilege and how the lines between public and private are themselves determined, including their links to access to information legislation and privacy laws.

Appeal Procedures

In any regulatory system, there are usually provisions for appeals or at least a discussion arises of why certain kinds of appeals may not be deemed desirable. We are speaking here of appeals to *final* decisions rather than our earlier discussion of appeals or reviews of decisions *during* the assessment process (including extraordinary processes such as those that accompanied the rbST decision). The workshop and other background inquiries for this paper suggest that CFIA has provisions in its regulations whereby new scientific information can result in a changed decision (see more below). But for novel food biotechnology products there is no formal appeal process for either the proponent firm or for the public.

If any such appeal process was to be developed it would inevitably raise key debates about *to whom* the appeal would be made and *on what grounds*. The "to whom" question raises candidates such as the minister, expert panels (almost a form of "science-court"), and the regular courts, each with different claims to: efficacy and efficiency; relevant or dubious expertise; degree and basis of potential "politicization"; and speed of resolution and decision-making.

Even in the absence of an overt appeal mechanism for biotechnology products (by the firm or the public) there may well be action that may in future be taken regarding such products through the courts and the legal system under administrative law, the Charter of Rights and Freedoms, and the Constitution. Or such action may be taken in other countries or under the auspices of trade law and dispute settlements and thus have implications for Canadian practice. None of these mechanisms or arenas were fleshed out at the workshop and are thus mentioned here only for the sake of completeness.

How are Biotechnology Products Monitored at the Post-Market Stage?

This question in one sense has the briefest of answers but in other respects it is more complex. The simpler answer resides on the food health side but the more complex answer resides on the CFIA where post- regulatory follow up to the regulation of research trials is built in.

Once a biotechnology *food* product is on the market, there is no systematic post-market monitoring of the products by the regulators. In other words there is no systematic program of "taking another look" at a product a few years later. Nor are there publically identified ways of simply reporting further on product performance or possible adverse effects (if any).This situation stands in contrast to a growing post-market review function in the broader realms of health regulation, such as in the Therapeutic Products Program of Health Canada (Doern, 2000b). Not all post-market situations are the same of course. For example, drugs have toxic effects which are better known and thus comparisons with novel foods may not be fair regarding the extent of post-market review possible or needed.

This situation does not mean that there are no avenues through which post-market concerns and information might be brought to the attention of regulators. Citizens can always in some way simply contact the regulator. But formal post-market review of biotechnology novel foods is not an explicit aspect of the regulatory process.

While it is not a part of post-market monitoring as such (because actual products have not yet been approved for market use) the CFIA, emphasizes that forms of follow-up review are present after research field tests have been conducted. Appendix II shows some of these but, as noted earlier, this is an area of dispute as to just how appropriate and complete these are.

Though it is not a part of the regulatory "post-market monitoring"activity as such, a final aspect of the food biotechnology regulatory regime is the issue of consumer information and choice. Most consumers of biotechnology products, especially in North America, have been unaware that they were consuming biotechnology food products. This has led not only to demands for choice regarding GM versus GM-free products, but also to firms such as supermarket chains in the UK positioning themselves in the marketplace on the basis of selling only GM-free products. But counterbalancing some of these concerns are other studies such as a recent poll of Canadians which "found 61percent of Canadians are comfortable with biotechnology" and that "66 percent felt that if science deemed a biotechnology product good for your health and safe to use, then science should 'trump' any ethical concerns" (National Post, 2000). The same poll, however, did indicate that concerns rose about genetically-modified food and it also indicated that Canadians wanted the reassurance of an independent science-based regulator.

## CONCLUSIONS AND KEY CHALLENGES

The purpose of this paper has been take a closer exploratory look inside the federal biotechnology regulatory system with a view to understanding more completely how it works. The intent has also been to raise issues and questions regarding the strengths and weaknesses of this system with the focus clearly on the regulation of novel foods and on plants with novel traits rather than all aspects of the system. The paper has drawn on some relevant literature about biotechnology and about the nature of regulatory institutions, especially science-based regulatory institutions, but it must be reemphasized that it is not based on a full research study of federal regulatory product assessment.

Focussing on the 13 template questions and aided by other basic information presented by Health Canada and CFIA regulatory practitioners, we have partially mapped and probed the regulatory system, through two levels of analysis. First, we set out federal biotechnology regulation through a brief look at: its historical context and at the main overall features of the federal biotechnology regulatory system (statutory provisions, agency mandates and policies and guidelines) as well as the overall consultation process for regulation making. Second, we looked closely at the core biotechnology product assessment process partly through an initial summary glimpse of a stylized process and then through a further discussion of key issues and features. In our account we have referred to most of the key elements of the system for overview purposes but our focus in the product assessment process has been on biotechnology plants with novel traits and on novel biotechnology foods.

We have also seen that the overall biotechnology regulatory process and its complex sub-processes function in the context of:

- a set of laws (several statutes) with biotechnology and other regulatory purposes;
- four main departments and agencies (each science-based; but only two of which were explored);
- a set of six stated principles which are not necessarily statutory;
- a set of "accepted approaches" derived from national and international experience including the concept of *substantial equivalence*;

- a set of international agreements and obligations (environmental and health)

Given such a complex regime it is inevitable that a mix of conclusions, recommendations, and new questions for policy and research arise from the analysis. The ten point package of conclusions and challenges discussed below must also be placed in the context of the overall strengths and limitations of the paper and of the sources drawn on for the analysis.

1) The present federal biotechnology regulatory system has several strengths including the knowledge, professionalism and capacities of its core science assessors, and also reasonable evidence of an open approach to public consultation in overall rule-making regarding laws, regulations and guideline and standard-setting. The fact that the biotechnology system builds on, and functions within, the large regulatory regime for novel foods and overall health and safety regulation is in many ways also a strength (see further observations below regarding the "single biotechnology regulator" question).

2) As the paper has shown, the present system is complex and consists of a multiple pathways system depending on the different statutory and technical needs of foods, seeds, fertilizer supplements, feeds, and animal health (and even more broadly if the environmental and aquatic elements are added from the Environment Canada and Fisheries and Oceans Canada domains which were not examined in the paper). The nature of the present system is being communicated to the Canadian public in clearer ways than a few years ago but there is still a long way to go regarding a fully communicated and transparent system.

3) The infusion of new funds for biotechnology regulation in the federal 2000 budget is a welcome and needed step but there are still concerns about the adequacy of R&D support within Health Canada and the CFIA, for the direct needs of biotechnology regulation. These issues need further serious exploration particularly given the increasing complexity of the next generation of biotechnology products and given the questions that can properly be raised about whether *any* of the regulators are assessing the *cumulative impacts* of the composite of biotechnology products. These funding issues are also important given the need to retain and attract expert front-line regulatory scientists. The paper and the workshop did not have the data or time to deal with these key issues of institutional and personnel capacity but a good case exists for a separate study and examination of these needs.

4) The issue of utilizing outside expertise in product assessments also needs further detailed discussion and exploration. The paper has shown that the lessons of the rbST case did not extend for the two regulators to whether outside expertise can or should be utilized for the novel food area or its biotechnology aspects. There are important options and issues that could be explored here such as whether the Health Canada Office of Food Biotechnology or the CFIA's regulators could/should use outside expertise to review the input from the in-house assessors. A further issue here obviously is whether such outside expertise should be used on a regular basis or on an exceptional basis and if the latter, how "exceptional" circumstances are defined which might trigger the use of such outside experts. There is also the issue of what kinds of expertise such outside experts should possess and whether enough such experts exist in Canada. If utilized, their availability in a *timely* fashion would also be crucial for the regulatory system as would issues about any actual or potential conflict of interest questions regarding experts chosen for such work.

The paper has stressed that the question of outside experts cannot be separated from the use of outside expertise in other *non-biotechnology* novel products. It may be difficult to single out

biotechnology for this kind of outside expert review element but at the same time, the issue does raise questions about how to deal with new technology products where in-house expertise may not be sufficient and where the public has a right to expect a full airing of the safety and risk-benefit issues involved at the product level.

5) More transparent ways to define the boundaries of commercial privilege are a further issue to arise from the paper. The analysis suggests that this feature of regulation as it impacts on *biotechnology* products has not been transparently discussed. The issue is complex, however, in that it is linked to trade-offs in related areas of law such as freedom of information and privacy. It is an issue that is also linked to the question of outside expertise as in item 4 above, but it extends to other issues that need to be explored and debated in the public domain. These further issues include the ability of the regulator to communicate risk, both health and environmental risk, given that commercial privilege and other laws limit what can be communicated to the public about the product and it also affects potential post-market review processes or information exchange. A more formal consultation process with business and other stakeholders is needed to discuss what the real limits are to commercial privilege in the case of biotechnology products and whether there is a special case for this regarding biotechnology as opposed to other novel food products or other plants with novel traits.

6) Public consultation on *product* assessments and socio-economic and ethical criteria are twin realms which raise even broader questions than that of the use of outside expertise. As we have seen, Health Canada and the CFIA's *general* consultation processes on regulations and guidelines are quite extensive and relatively open in nature. But they have not focussed at all on more open consultation at the product assessment level based on such broader criteria. We have not explored these issues in this paper. Suffice it to say, that such a broadening of input would have to deal with not only "what" consultation would centre on but also "when" and "how". Furthermore, no discussion of this issue can dodge the question of what kind of democracy is being advocated through different contending reform ideas: Cabinet-Parliamentary democracy; interest group and stakeholder democracy; or direct democracy (with each increasingly couched in the new realities of e-government or digital democracy). These very big regulatory questions would also raise the issue of whether reform applies only to biotechnology products rather than all novel products and how they would effect the efficiency of the Canadian regulatory system compared to other countries' regulatory regimes.

7) The study has thrown doubt on the adequacy of transparency in how research and field trials are regulated. Our focus in this regard was on plants with novel traits but a very mixed picture emerged. On the one hand there are positive features such as the practice of inspecting 100 percent of the field trial sites. But here are also gaps in transparency regarding public knowledge of site locations and in the process of developing guidelines for determining mitigating risk or reproductive isolation. There are also extensive amounts of self-regulation in these aspects of biotechnology which the Canadian public needs more reassurance about and transparent information on.

8) The study has also indicated gaps in information and understanding about how the appeal process works regarding product assessment and what kinds of post-market review processes are built in once a product is on the market. There are no publically identifiable appeal processes or post-market review mechanisms for biotechnology novel foods or certainly none that are readily communicated to the Canadian public. This key aspects of the process needs further research and debate about what kinds of appeal and post-market review mechanisms are needed.

9) The paper has noted the presence of offices of biotechnology in both Health Canada and the CFIA and applauds the effort to provide "one stop" service regarding the coordination of the application process and to better coordinate federal biotechnology policy. However, for some Canadians, a further question is whether there ought to be one "stand-alone" biotechnology regulatory body. Such ideas about a single biotechnology regulator have been rejected in the past. And this question in turn begs again different versions of the ultimate question "how different is biotechnology?" from other novel products. Or even more broadly we could raise the same questions about regulatory institutions for other new enabling technologies such as the Internet and its dot.com "products".

There is value in further exploring this issue of a single regulator if, for no other reason, than as a vehicle for dealing with some of the more particular areas raised above. Issues such as the role of outside expertise and the role of public consultation would undoubtedly arise as would the complex scientific issues regarding different kinds of biotechnology product use. Inevitably again, the single regulator question involves trade-offs regarding how special or different biotechnology is from other health and safety areas. However, the analysis has also drawn attention to the fact any single biotechnology regulator would hardly be an institutional or democratic panacea. Even if such a stand alone biotechnology regulator was established, interdepartmental coordination challenges and complexity would still be present. Some coordination problems would simply become re-formulated as "stove-pipe" issues *within* a single regulator and still other issues would remain as to how to deal with and coordinate issues with other still remaining outside bodies such as the rest of health and food regulatory systems ( and hence other non-biotechnology novel products).

10) The analysis has brought out the importance of key "accepted approaches" in product assessment such as the concept of *substantial equivalence*. There is little doubt that the biotechnology regulatory system for novel foods and for plants with novel traits uses this as the starting point for assessment. And regulators are right to stress that this concept does not itself constitute the assessment process. It is certainly possible, however, that the concept of substantial equivalence may be criticized or need further scrutiny as more complex biotechnology products come into the assessment process or as pressures arise for the assessment of cumulative impacts.

Any regulatory system has to evolve some form of institutionally or professionally tested "accepted approaches" such as the role that substantial equivalence plays in the regulation of novel food and plants with novel traits. But such systems are also subject to other concepts and ideas which different interests in society (nationally or internationally) want to see become more influential. One such concept which the paper only hinted at is the *precautionary principle*. This principle is not a stated part of the six principles of the federal biotechnology regulatory system but there is undoubtedly a growing debate among the regulators (all four departments or agencies) and among stakeholders as to exactly what it might mean for regulatory decisions and processes. And it is certainly at the centre of debates about the nature and evolution of the regimes for the international regulation of biotechnology. The paper can offer no definitive conclusions on the impact of this concept on the regulators we have focussed on except to say that in some way it does present a partial challenge to the core idea that regulation will be only science-based. The role of the precautionary principle is itself a complex question and would undoubtedly arise as an issue in any discussion of several of the items already highlighted in these concluding observations.

In general then, the author concludes that our closer look inside the federal biotechnology system has revealed some strengths to the system but it is also evident that there are important gaps in the regulatory regime as a whole which need further research, public discussion and regulatory reform. The biotechnology regulatory system is complex for good reasons but the debate about it needs to be

sharpened and more focussed so that Canadians have a better understanding of its role in a key aspect of Canada's early 21st Century economy and society.

APPENDIX 1: TEMPLATE QUESTIONS FOR CBAC REGULATORS WORKSHOP

1) How is the research on new GM food products (e.g. transformations, lab practices, greenhouse practices)? Is it regulated by companies? public funding agencies (e.g. universities, Tri-Council processes, departments)? Government regulators?

2) Prior to the product/application formally being received by the regulator, what kinds of informal discussions and/or information exchange occur between the company's officials/scientists and the regulator's officials/scientists?

3) When a product/application has been received, who does the regulatory review or assessment: in-house scientist? contract scientists? peer review process?

4) Who made the final decision? Officials? Scientist (individual or team)? Were there significant differences of view about the science or risk analysis and, if so, how were they resolved or handled? (appeal up the hierarchy? special mechanism? other?)

5) Why is the product/application regulated? What legislation, regulations, guidelines, policies informed and guided the review process?

6) Identify the dates each step in the regulatory review process happened and how much actual time was spent on that step (not just calendar time)? How does this compare with your average review and approval times for other biotechnology products? for other non-biotechnology products? Identify the minimum and maximum times ever spent on the step and the average of all products at that step.

7) Was any inter-departmental review mechanism or process (formal or informal) needed? If so, what kind? What other agencies were involved in the review?

8) Was any international review mechanism or process (formal or informal) needed? If so, what kind?

9) Where did the evidence come from which was brought to bear on th decision/approval? Firms/proponents? Peer review reports? Government labs? Domestic work versus international tests/trials?

10) What were the objective criteria used in evaluation of the product? What evidence was considered? What evidence was not considered? How do you deal with non-scientific elements (e.g. economic benefits and costs; ethical issues; social impacts)?

11) How was the decision communicated to the applicant? to the public?

12) What formal appeals procedures exist for the applicant? For other interested parties? For the public?

13) Once a decision/approval has been made, how (if at all) is the product monitored in the post-market phase? Who does the monitoring? How are results communicated? Were provisions built in for compulsory review once in the market for a period of time?

APPENDIX II: ASPECTS OF CFIA's REGULATION OF CONFINED RELEASE-FIELD TRIALS
(under terms of Directive 95-01: Field Testing Plants with Novel Traits in Canada)

KEY ELEMENTS

- Reproductive Isolation
- Site Monitoring
- Disposition of Plant Material
- Post Harvest Restrictions and Monitoring

KEY STAGES IN BRIEF:

- Receive Application (review, seek more information if necessary);
- Authorization with terms and conditions;
- Field Inspections (current year; post-harvest).

REPRODUCTIVE ISOLATION
(Distance)

- Brassica rapa 400m
- Brassica napus 200m
- Soybean 3 m
- Wheat 3m
-

SITE MONITORING

- Applicant is responsible for monitoring the trial site on a regulator basis and for keeping trial in compliance;
- Applicant must keep records of monitoring;
- CFIA inspects sites at random for terms and conditions non-compliance.

DISPOSITION OF PLANT MATERIAL

- Must not enter the food or feed chain without federal government approval;
- Must be stored securely and not disposed of;
- May be disposed of in a way which destroys viability.

POST HARVEST LAND USE RESTRICTIONS
(Trial plots may not be planted to the same crop for a
specified period of time)

- Brassica rapa 5 years
- Brassica napus 3 years
- Potato 2 years
- Maize 1 year

Source: Adapted from Canadian Food Inspection Agency, 2000.

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