SOME SOCIAL, EDUCATIONAL AND POLITICAL ASPECTS OF BIOTECHNOLOGY

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Summary

This paper addresses the question of how to analyse the impact of controversial biotechnologies, with in particular a focus on genetic engineering in biotechnology. The central theme developed in the paper, is that a holistic and system oriented impact analysis is necessary given the complexity of the relationship between technology and society. Ideas from international political economy and environmental discourses are used to explore this theme, using examples taken from the social, educational and political implications of biotechnology.

1.Introduction

Attempts to evaluate the impact of a technology in society, are more than a matter of measuring indicators. If there is a focus upon one aspect, such as the rise in patents on genetically modified organisms (GMOs) for example, this will not highlight the dynamic forces shaping the influence of biotechnology upon industrial and societal structures. Technology is an endogenous and constitutive factor forming a key component of how we understand societal functions and global political economy. Any discussion of biotechnology and in the particular case of this paper, genetic engineering[1] and impacts arising from this technology, must address the fact that such issues are heavily

[1] In this paper, genetic engineering is the primary focus within biotechnology, and is viewed as being based on the use of recombinant DNA technology, monoclonal bodies and new tissue culture techniques.

interconnected and indeed, are a result of social interactions. Therefore, the path to developing an understanding of these dynamic forces, should stress this interconnectivity and the form of resulting complex relationships between actors.

A further point to consider, is that such paths have two major avenues when examining potential technology impacts. These are from the immediate impact of the use and development of the technology and from the technology transcending risks. That is to say, from the long-term application of the technology.

In this paper, a framework for analysing the impact of biotechnology is presented. The first section of the paper discusses this framework. It uses concepts from international political economy and argues that a non-prescriptive approach is the only suitable method of analysing technological impacts. Technology is viewed broadly from a knowledge perspective and as a particular construction of the social environment in which the technology is created and developed. The second part of the paper extends this discussion to address the current dominant discourses structuring biotechnology decision making. These are linked with the models from international political economy. The third part of the paper focuses upon the use of metaphors and rhetoricism in discussions on biotechnology, which are key routes to constructing and defining truth in society (or as Quéralto describes it, 'pragmatic truth'). The final part of the paper identifies some key regional practices of both developed and developing countries, to achieve and sustain a dominant position in shaping how biotechnology is perceived and its impact upon society from an education, political and social perspective.

2.The Developing Country Identity

The use of the term 'developing countries' in this paper, is difficult to define, especially when discussing the application and impact of biotechnology. This is because of the varying extent to which biotechnology is supported (publicly and privately) and funded in different countries. Spillane for example constructs a comparative table of agricultural biotechnology abilities for 'developing countries' in 2000, stressing the poor specific fit of the label (Figure 1).

Indigenous Biotechnology activity	Countries
High biotechnology capacity : Plant micropropagation, transgenics, marker assisted breeding	Brazil, China, India, Malaysia, Thailand, Philippines, Indonesia
Medium biotechnology capacity : plant tissue culture, micropropagation	Burkina Faso, Cameroon, Côte d'Ivoire, Gabon, Ghana, Senegal, Ethiopia, Uganda, Madagascar, Malawi, Zambia
Low / limited biotechnology capacity : plant molecular biology	Morocco, Tunisia, Nigeria, Kenya, Zimbabwe
Specific and narrow biotechnology capacities : transgenic plants – but lacking in delivery mechanisms to the farmer.	Egypt, South Africa, Nigeria

Figure 1. Indigenous Business Activity, By Country. Source: Spillane (2000).

Nevertheless, as the current primary area of biotechnology controversy (and hence impact focus), is upon the application of biotechnology to agriculture, rather than human medical problems, Spillane in 2000 argues that this provides the developing country identity. This follows the recent shift of attention in developed countries of anti-biotechnology protagonists from the human medical arena, where benefits are now conceded, to the food and agricultural arena, where the supply of food remains a problem in developing countries. As Hayward states,

'Culture and value-systems play an integral role in determining the rate of absorption of new technologies into a production system'

3.Analysing the Impact of Biotechnology

Cilliers stresses that complex problems such as impact analyses, have a variety of inputs which are diverse, possessing both short and long range effects and affect the outcome of the problem or use of a technology, in an unpredictable manner. In other words, such problems have more possibilities than can be actualised. Our understanding about the nature of relationships between societies, individuals and the balance of power between social groups facing new technologies, is according to Hayward comparatively under-developed. Nevertheless, some form of systemic analysis is sought in this paper. Perhaps one starting point is to note, that at their source, the results of the impact of technology are dependent upon the establishment and propagation of knowledge.

We can view knowledge as a form of preferred values, social practices and norms of behaviour of concerned actors involved in the development and use of biotechnology. As such, this paper is keen to argue that knowledge extends beyond the collection of information on biotechnology, such as techniques, risks and so forth, but also embraces how these are manifested and interpreted by individuals. Lemaux for example, discusses in 1998 how risk and safety for the public cannot be quantified or measured in the same manner that scientific risk is determined. Accepting these differences means issues such as how trust is developed between consumer and manufacturer can be addressed[2]. Such analyses will therefore be also concerned with the time, context, meaning and agency of these actors. In summary, such a focus and definition of knowledge provides the units of analysis for this debate on the impact of biotechnology and more broadly, environmental policies and practices[3].

From a conceptual standpoint, we can label this approach as a knowledge based discourse. It offers a useful approach to the issue of the impact of biotechnology, particularly from an educational, social and political background. Stehr argues that at a slightly broader level, environmental discourses will also embrace the diverse knowledge base of biotechnology, and specifically, how that knowledge is constructed, accepted and perhaps most importantly, propagated and sustained within society. The logic of these

[2] The ESRC report in 1999 made a similar point, that any impact analysis must not solely focus upon knowledge from such a narrow scientific perspective.
[3] See Dryzek's book for a rigorous discussion of these dynamics.

value systems though, is not completely malleable to redefinition. As Thompson argues, there are clear synchronic elements where such systems both constrain and propagate actors interests and preferred practices. Some of the factors affecting public perception of biotechnology and hence its immediate and transcendent impact focus according to Leamaux, upon:

(a) *the role of science and technology (S&T) in society:* For example, there is strong US and Japanese support for a proactive S&T support system, whilst in the EU there is more concern generally about long term consequences of S&T activities (transcendent risks).
(b) *Publication educational efforts in society*: This is the level of intensive efforts to involve scientists, key public opinion leaders and media representatives in an ongoing debate over biotechnology and genetic engineering in particular. The key objective is to avoid an informational void being created, facilitating anti-biotechnology interests to generate a different knowledge structure.
(c) *Role of regulatory policy* in society: This is a focus on effective risk communication and, as noted earlier, a clear understanding that the public perception of risk can be very different from that of the scientific community.

It is clear that the scientific understanding of biotechnology knowledge stems from the unravelling of the DNA molecule. However, there are competing interpretations of relevant societal biotechnology knowledge. For example, the current highly competitive biotechnology industry (valued at £70 billion globally), constructs a different mix of judgements that are reshaping the 'truth' of scientific knowledge. As a particular case, the use of DNA for criminal identification purposes, parentage and affiliation, is having a major impact upon national and legal systems around the world[4]. In the UK, a conflict between genetic truth and social truth, has emerged. Motherhood is determined by birth, not by a genetic relationship, whilst fatherhood can be dependent upon genes, but is not necessarily so. However, genetic information is viewed as an important factor, by UK courts for the purposes of constructing an individual's identity.

Acceptable biotechnology truths in society can therefore, come from ethical, competitive and strategic assumptions of states, markets and societies. As such, a methodology focusing upon impacts, must also be eclectic in nature, if an understanding of why biotechnology has presented particular difficulties in the area of social and educational impacts is to be reached.

4. Methodological Approaches and Competing Discourses

Russell and Vogler in their edited volume in 2001 on the international politics of biotechnology, underscore the conflictual and competitive nature of the differing

[4] In particular, the accuracy and assurity with which DNA can identify birth parentage and the capacity to use biotechnology skills to aid in fertilization of women, has created in the UK a new category of children: 'the fatherless'. Specifically, this is an artificial insemination by donor (AID) child, born to a married woman whose husband proves that he did not consent to fertilization. Further details can be found in the European Commission 1996 publication that examined the legal implications of genetic engineering.

discourses of the impact of biotechnology. Three grouped themes are identified and based around:

- The science, ethics and gender of biotechnology
- The International political economy, trade and the environment
- State and system security and warfare through biotechnology

These general themes, ostensibly stemming from a consideration from the international relations of biotechnology, suggest the use of Susan Strange's concept of power in international political economy (IPE), to frame the differing discourses and grasp the complex issues of technology impacts.

For Strange, power in societies and markets emerges through four mutually supporting primary structures in global political economy. These are security, finance, production and knowledge. Structural power is described as the exercise of direction and shape over one or more of these mutually interacting aspects of political economy. It is the capacity to decide how things are to be done within a given market. From our perspective though, the knowledge structure, whilst crucial to understanding the form and manner of technology as a social product, remains only generally understood[5]. As a social product, the knowledge structure according to Pownall, is entwined with both value systems and belief practices. As this paper published in 2001 argues, power in the knowledge structure lies not only with the abilities to create and propagate knowledge, but also with the capacity to deny others access to knowledge or the tools resulting from such knowledge.

Stopford and his colleagues adapted in 1991 these structures to suggest that the form and function of markets and societies is comprised of basic political and economic elements interacting richly (using the terminology of complexity theorists).They labelled this as a diplomacy model. It views the impact of a given industrial sector as an outcome of a triangular relationship addressing the inter-penetration of actors from the state, the market and firms.

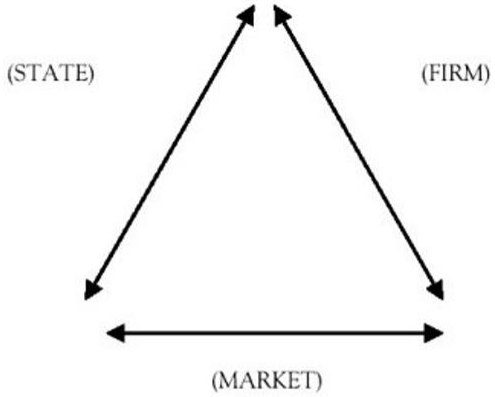

Figure 2. Stopford and Strange (1991) Diplomacy Model.

[5] Recent work by Amoore, Farrands, Russell and Hayward over the late 1990s however, have made significant advances on our understanding of this structure.

Where other actors and entities capable of creating and sustaining knowledge exist, such as in the context of the EU, Lawton developed this triangular model in 1997 into a pentagonal one. He considered the role of meta and supra levels of governance. As such, this framework more effectively reflects the increased transparency of knowledge evident in modern market systems particularly biotechnology.

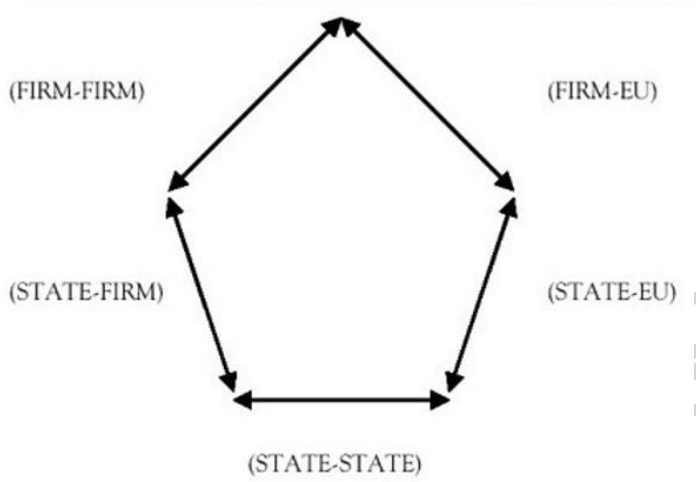

Figure 3. The Lawton (1997) Pentagonal Diplomacy Framework.

Overall by considering the interaction between different governance levels in biotechnology, the evolution and capacity of those actors to shape the development of the market can be gauged. Different environmental and biotechnology discourses address and account for the construction of the four key power structures and importantly, address their nature as social products. Supporting these core four factors are secondary issues. Following Lemaux. three key secondary issues of concern here are the public perception of biotechnology, the most relevant intellectual property regime to implement and emergent bio-safety protocols for the handling, manipulation and distribution of biotechnology sourced products. Hayward also supports the suggestion of a focus on science and technology (S&T) efforts in national societies as it is a pre-eminent focus in many advanced economies. This is primarily as funding for S&T will be in competition with other funding claims, which face intense social and political pressure.

Actors unable to effectively address the primary or secondary structures will see their capacity to effect market changes and power, curtailed. Steunenberg and his colleagues argued in 1998, that actors exhibiting structural power, will, in the course of developing the regulatory, social and economical environment of a concern, encounter little conflict or obstruction. This can for example, be measured in terms of the number of amendments and objections to the formulation and implementation of such regimes (such as legal acts or policy documents). For our purposes, this can also be interpreted as the recognition (or otherwise) of competing knowledge bases. An anecdotal look at the regulation and control of emerging biotechnology industries, stresses that this is an industry rife with conflict and concern.

Where the structural power to shape and implement the direction, pace and added value of biotechnology research resides with developed countries, the sheer cost of such secondary concerns like biosafety protocols, will inhibit development of research that may be of benefit to poorer countries. This is despite the fact that they may be the most in need of such research, as the cost effectiveness of such activities will minimize their long term development[6]. As Hayward suggests, within developed countries, states have steered difficult paths between promoting biotechnology and at the same time, developing an acceptable bio-safety regime.

Examining the social and educational impact of biotechnology in particular, the emergent discourses tend to speak in generalities. Part of the reason for this, is that there is no biotechnology industry *per se*, but as suggested at the start of the paper, the industry is more a set of enabling technologies. Deane-Drummond stresses this in 1997, by identifying with the study of biotechnology in a theological and ethical perspective. She outlines how it is common to adopt a 'middle-axiom' approach when reflecting on social issues generally. This middle axiom is the establishment of broad principles for decision making, whilst at the same time resisting any attempt to make more detailed recommendations or insights. It is a short step from this, to argue that this middle-axiom would also be applicable to the assessment of social, educational and political impacts of biotechnology, which have equally uncertain future outcomes because of the complexity of social interaction.

We are also confronted with the question of what is different about this sector, compared with other modern industries. It is almost certain that some aspects of biotechnology, are or will become part of the existing industrial structure of nations. In the modern economy therefore, the familiar forces of globalisation, regionalization and identity, may be given new meaning[7] by the biotechnology industry. The assumption therefore that the method of analysing the impact of biotechnology therefore, cannot be confined to a single issue debate such as public health, is questioned as it must also address more familiar issues such as concentration of supply or market influences (especially via appropriate consumer response systems).

For example, the public campaigns of the 1998 Swiss referendum on genetic engineering, stressed the mixed meanings and metaphors associated with these enabling technologies. In one poignant example from the campaign, one activist advertisement in April 1996 showed a child with no eyes, with the by-line of ' Nuclear energy is safe'. This had been the claim of nuclear scientists until the Chernobyl accident, who were confident that the residual risk was infinitely small. This was effectively used by Swiss anti-biotechnology campaigners to state that the current GM scientific truth, that transgenic foods and products also carry an infinitely small residual risk, are in fact, also flawed.

A key part of the process of creating acceptable specific insights for different publics

[6] This is the prime focus of the recent Novartis paper. Spillane estimates that it costs in excess of one million dollars to get a plant biotechnology product through the US regulatory system. Estimates of the cost for the Brazilian market are in excess of seven million dollars.

[7] Small biotechnology firms in the agro-food sector are rapidly being acquired by traditional large food multinational organisations.

from general observations or different truths, is sourced from the knowledge barriers established and perpetuated by experts, who tend to resent their scope of competence being invaded. When Dryzek was analysing how the UK formulated environmental policy in 1997, he observed that the UK government position on environmental and biotechnology matters tends to stress the key role of experts and proven scientific knowledge as the basis from which policy and control is determined. This provides the validity and source for any impact assessment. This is administrative rationalism and is one of the three dominant discourses Dryzek identified in 1997, for dealing with the complexity of environmental and biotechnology policies. Others outlined include democratic pragmatism and economic rationalism.

Administrative rationalism emphasises the historic status accorded to scientific knowledge in public policy. It seeks to organise technical expertise into a bureaucratic hierarchy in the service of the state. Democratic pragmatism however, focuses upon public participation in problem solving within the existing institutional structures of the governing system. Work by Klijn and his colleagues in 1988, identified that the critical foci from this perspective, are negotiations between actors and agencies, typically in informal networks. As a result, key components of this discourse involve public consultations, dispute resolution services, the creation of policy dialogue, the operation of public inquiries and the generation of right-to-know legislation. Such components therefore displace the scope and source of authority of administrative rationalism. The strong administrative rationalist idea was identified by a recent 1999 CEC report. It was observed that public participation in the policy process, in a more democratic approach, would hinder research and as a result be obstructive for the economic development of the sector as a whole. Nevertheless, some governments, such as the Dutch, have initiated discussions with interest groups, such as consumer associations[8] and in general, is an increasingly important aspect of impact assessment.

Dryzek's final discourse is economic rationalism. This focuses upon the guided deployment of market mechanisms to achieve public ends and has been popular through privatisation in a number of countries. There is no attempt at the environmental management found under an administrative rational governance system, except to the extent of designing markets. Generally this involves the use of market-type mechanisms and economic incentives to induce environmentally appropriate behaviour. All these discourses can be differentiated in terms of which actors are constructed and recognised, the form of natural assumptions, who the agencies are, their motives and the use of key metaphors and rhetorical devices in constructing both public and private policies.

The European Commission for example, stresses the role of social acceptance for shaping the direction and pace of biotechnology development. This is not a key policy consideration in the US however. In the EU, social acceptance shapes the form and reach of resultant regulatory frameworks, hence it is important for the perception of risks and benefits in the health and environmental areas of society, to be addressed.

[8] The Dutch agri-foods industry voluntarily agreed to labelling from the end of 1997.

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Biographical Sketch

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Recent publications:

"An International Political Economic view of the Biotechnology Industry", Electronic Journal of Biotechnology, August 2000, http://ejb.ucv.cl/, ISSN 0717-3458

"An International political economy perspective of administrative reform", Public Administration and Management: An interactive journal, ISSN 1087-0091, Vol.4 No.4, http://www.pamij.com/99_4_4.html,

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