An analytical approach to the implementation of genetically modified crops

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Public scepticism towards genetically modified (GM) crops is increasing. To address this, the risks and benefits of GM crops must be examined across scientific disciplines, and be discussed with the authorities, the agricultural industry and the consumers. In a feasibility study we have systematically analysed the challenges of the development and marketing of GM crops in Europe. A life-cycle inventory was used together with established technology foresight techniques in an interdisciplinary and empirical framework. The approach taken in this study established a dialogue between stakeholders and provided a framework for discussions about the future direction of GM crops.

The strong public scepticism that the commercialization of genetically modified (GM) crops already faces in Europe might soon spread to other parts of the world. Therefore, it is timely to examine the consequences of GM crops from the perspective of society as well as of industry. In this article, we suggest the use of technology foresight (TF), which is a prospective and transparent framework, to analyse the future use of the rapidly progressing scientific field of GM crops. TF is the process and dialogue involved in systematically attempting to look into the longer-term future of science, technology, economy and society, with the aim of identifying areas of strategic research. TF is concerned with the infrastructure necessary to recognize and exploit technological opportunities as they emerge. This framework cannot predict the future but it does enable an organization to learn, adapt and enrich the ongoing strategic discussion.

Public acceptance

The prevailing presumption made by the biotechnology industry is that the public hesitancy about the use of GM crops can be counteracted by consumer education and the establishment of scientific credibility for companies engineering GM crops. However, this assumption is probably erroneous. First, increased knowledge of gene technology and its risks and benefits are not likely to affect ethical concerns or anxiety about the potential monopoly of multinational biotechnology companies. Second, the establishment of scientific credibility is not likely to ease consumer concerns because uncertainty will be deliberately sought out and maximized by experts on each side of areas of conflict.

The reason for the public scepticism towards GM crops is an uncertainty about the longer-term risks and consequences of growing GM crops. This creates uncertainty for the biotechnology industry and the authorities because they lack clear signals about whether or not society will accept the technology. It is a political responsibility to express a standpoint and to make decisions on these uncertainties on behalf of the consumers and in accordance with the common understanding of societal risk acceptance. However, society, politicians and the responsible authorities have difficulties in reaching a consensus about the coverage and application of risk assessments concerning GM crops.

Society and risk analysis

When analysing risks today, we face a new type of uncertainty about our future. New technologies, such as genetic engineering, and their possible consequences pose new challenges to our foresight. Scientists do not agree about their consequences to ecosystems, health and the environment, and, where scientists disagree, policy makers find themselves in an uncertain position to take decisions about the future. A central issue in a prospective study related to genetic engineering is the risk and uncertainty aspects related to the GM crops. Two prominent social theories have been shaping the discourses of environmental politics during recent years: the risk society theory and the theory of ecological modernization.

Ulrick Beck’s risk society theory uses gene technology as an example of the nature of risk we face today. He argues that the focus is more and more on hazards which are neither visible nor perceptible to the victims; hazards in any case may not even effect within the life spans of those affected, but instead during those of their children; hazards in any case require the “sensory organs” of science – theories, experiments, measuring instruments – in order to become visible or interpretable at all. Modern industrial societies are changing from being based on the distribution of “goods” (materials, products) to being based on the distribution of “bads” (risks). The authorities are no longer able to guarantee safety from risks because genetic engineering (for example), in contrast to early industrial risks, cannot be limited in time or place and are not accountable to established rules of causality, blame and liability, and cannot be compensated for or insured against.

By contrast, the theory of ecological modernization outlines a hyper-rational strategy for correcting the ecological flaws of contemporary production and consumption practices. Ecological modernists emphasize the role of strict governmental regulations in promoting...
innovation in environmental technology. The key element in executing this transformation is switching over to the use of cleaner, more efficient and less resource-intensive technologies through a process of ‘super-industrialization’. Ecological modernization relies on the implementation of anticipatory planning practices (the precautionary principle). The successful execution of this approach depends on the organizational internalization of ecological responsibility. Cohen has attempted to formulate the risk society and ecological modernization perspectives into a unified theory of social transformation9.

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The different methods used in the stepwise process of analysing the marketing of a genetically modified (GM) crop in a technology foresight framework. First, a life-cycle inventory (LCI) is constructed to define the boundaries of the GM crop system; if the crop is hypothetical, this can be done by analogy with a similar conventional crop. Then, experts identified in the LCI participate in an expert panel to find the driving forces involved. Finally, scenarios are built using these driving forces in an attempt to find out which forces are the most important and what the most likely outcomes are.

The LCI gave an overview of the grass-field system and identified a complicated network of stakeholders and experts who could be consulted later in the process. The main problems were to determine boundaries that limited the complexity of the system without losing the holistic perspective and to obtain sufficient information to give adequate input into the scenario analysis. The ‘experts’ who participated in the panel were selected on the basis of the network identified in the LCI and were representatives of key constituencies. These experts need to be able to extend their knowledge into the uncertainties of the future, and they have to be imaginative. Identifying the right experts is crucial if the analysis is to be a success. In this study, the LCI was an adequate tool but, in a larger study, an iterative process might be necessary in which the initial group of experts is asked to identify further individuals to ensure that all issues are covered.

**Building a scenario**

Scenario analyses have been successfully used to explore options for future crop protection. These scenarios consider the wider implications of future decisions, such as changes in the structure of industry sectors, political decisions, consumer acceptance, substitute technologies and so on. To build scenarios, it is necessary to find major driving forces. This was done by letting the expert panel brainstorm over trigger questions related to distinct phases from development to marketing of the GM grass. For example, a trigger question in the marketing phase could be ‘which issues could make the marketing of the GM grass a success or a failure?’ The brainstorm revealed a number of driving forces and, from these, the panel chose 26 that were believed to have the greatest impact on the future direction of the GM technology.

These 26 driving forces were then evaluated in a larger forum of Danish experts and stakeholders using a questionnaire (31 out of 49 returned the questionnaire). The respondents were asked to evaluate each driving force’s influence on the future demand for GM
pursues multiple strategies using extensive resources until the future becomes clear; and
(4) a gambling strategy in which the strategy is selected by gambling on the development of other futures in which it produces more than proportional returns.

A trend scenario, which describes the development of the present from certain trends, could also be useful.

From a more general perspective of the public acceptance of GM crops, the combined industry must collaborate with the authorities in developing threat and conflict scenarios (worst-case scenarios), which can elaborate on possible concerns and their causes. We will not describe the scenario process in detail here but Schwartz has given a guide to scenarios and the process of creating them.

Conclusions

The overall experience from this exercise is that the TF process assists a dialectical debate by reducing the comprehensibility gap between different scientific disciplines and between different stakeholders, in a learning process. Moreover, TF identifies who has the responsibility of taking the appropriate decisions, considering both scientific and ethical matters. It thus prevents the erosion of public trust in established institutions, science and the biotechnology industry. Finally, the study reveals the societal necessity to reach a consensus about coverage and application of risk assessment on GM crop technology.

References