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Commercial use of GM crop technology: Identifying the drivers using life cycle methodology in a technology foresight framework

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Abstract

The complexity and advanced nature of modern biotechnology, and its extensive implications for society regarding prosperity, risk and ethics, make a view of the future that is comprehensible and transparent to society desirable. The objective of this feasibility study was to investigate methodologies for strategic planning and regulatory decision-making in technologies involving genetically modified (GM) crops. The planning and regulatory decisions of both the biotechnology industry and public authorities are considered. In the study, knowledge and opinion about a well-defined problem complex are systematically brought together in the consultation of a larger number of stakeholders and experts representing as many major perspectives as possible. On the basis of a test case on the development of a GM-ryegrass, this paper suggests a methodological approach to the uncertainties faced by the biotech industry and public authorities when GM crops are commercialized. The method used was a technology foresight (TF) framework, using a life cycle inventory (LCI) to define the problem complex, a stakeholder panel to identify drivers (of change) that influence the direction of future developments, and weighted stakeholder questionnaires to prioritize these drivers. Once quantified, the weighted stakeholder opinion generated a clear criterion for prioritizing drivers that were judged to be important in the future development of a GM-ryegrass but whose precise impact was uncertain. The four drivers prioritized were: being the first to market the GM-ryegrass, an efficient

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network on biomolecular know-how, public dialogue and participation in regulation procedures and utility value.

Keywords: Technological foresight; Controversial technology; Biotechnology stakeholder panel; Strategic planning; Regulatory decision-making

1. Introduction

Technologies are becoming more and more complex, largely as a result of the modern world's endeavor to increase productivity. One result of this complexity is a new type of uncertainty about our future [1], an uncertainty whose distinctive feature is disagreement among experts about the future consequences of present-day technological innovations. Where experts disagree, policymakers find themselves in an uncertain position [2]. The decisions they are required to take cannot be based solely on scientific objectivity, because the criteria of risk acceptance have to be judged in a political process that includes broader issues such as ethical, social and cultural matters. However, the long-term planning of technological development is of paramount importance for society, and therefore a way of handling these uncertainties about the future is needed. Such planning is especially necessary in controversial areas such as the commercialization of genetically modified (GM) crops, since the relevant benefits and risks here have an impact on society, the environment, policy questions, agricultural management and the economy. Issues also arise here, of course, for the biotechnology industry, where many companies are poised to prosper from GM crop technology. However, the so-called "biotech companies" often remain silent in the public debate, and only a few have taken steps towards developing tools to manage the potential risks and uncertainties that GM crops involve [3–5]. This reluctance will only postpone a sustainable development and judicious application of the technology.

Increasing public skepticism towards GM crops is an example of a problem complex in which experts, scientists and the general public disagree. In the European Union (EU), the political solution to this problem has involved the adoption of the "precautionary principle" on the deliberate release of gene modified organisms (GMOs) (see EU directive 90/220). This principle is a political and value-laden instrument that withholds the implementation of the technology until its uncertainties are understood, and has let to a de facto moratorium on GM crops within the EU [6].

It has been suggested that public skepticism towards GMOs can be overcome by a combination of consumer education and the establishment of scientific credibility for companies engineering GM crops. However, the Eurobarometer surveys [7] have shown that increased knowledge about biotechnology fails to promote a more positive attitude. In the case of populations with higher education levels and information provision, the proportion remains agnostic—the "do not know" group is reduced, but the distribution of positives and negatives is unaltered. The same surveys indicate that public trust not only within the industry but also among experts and authorities is worryingly low.