Global Modern Food Biotechnologies: Risks and Benefits of Using an Ethical Matrix for Participatory, Holistic Developments of Policy and Practice

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Abstract

Sound science and regulatory measures in risk assessment appear to be insufficient to address the public's disquiet regarding genetically modified foods. In response, international organisations such as the World Health Organisation and the Food and Agriculture Organisation (FAO) of the United Nations have begun to embrace a more holistic approach that now considers the scientific, regulatory and local requirements as well as the social and ethical impact of modern food biotechnologies.

One enduring difficulty in incorporating ethical and social issues in policy development has been its procedure. Of particular concern is the question of how to manage an exploration of often complex and controversial topics in such a way that the different voices and social and ethical norms of citizens and stakeholders are taken into account without unduly stifling or endangering good policy development and decision-making.

This paper discusses the benefits and risks of one emerging framework that can be constructed around four mutually supportive, universal ethical principles set out in an ethical matrix. A systematic approach can lead to deliberations that are rational and inclusive, while being at the same time open and collaborative. Such a framework might compare well with existing scientific risk management practices.

Taken together, an integration of both the scientific and the ethical-social could be of paramount importance for a modern food biotechnology that has global ambitions, but which can easily be fractured by local or social incompatibilities without public participation and support.

Keywords

Biotechnology, public participation, ethical matrix, public policy development, Global Code of Ethics for Modern Food Biotechnologies

Introduction

From its inception, the introduction of modern food and crop biotechnologies into local, national and global markets has been controversial. Initial research indicated that citizens did not reject genetically modified plants and crops because they lacked scientific understanding and sophistication as was assumed by the industry and governments. Instead, rather than being ignorant of the science (Cook et al. 2004), the various publics were discontent with the "dominant scientific and policy institutions and their behaviours" (Wynne 2001, p. 473), and believed that not enough attention was directed towards the ethical and socio-economic impacts of specific product developments. In response, many governments introduced measures such as scientific risk analyses, the establishment of regulatory bodies, the labelling of GM foods, and even a code of ethics (Department of Innovation and Information Economy 2001). Although these moves did not markedly change attitudes, they might have assisted in making people aware that they can influence outcomes by participating in decision-making. The shift to participatory governance in policy decision-making is not confined to developed regions such as Australia and Europe. It is also an emergent element in many Asian countries and in Africa (Birner and Alcaraz 2004). Indeed, Article 23 of the Cartagena Protocol on Biosafety, which came into force on 11 September 2003, requires that countries engage their citizens in decision-making both for policy development and for decisions "regarding life modified organisms".

Community engagement in ethical decision-makings

Public participatory mechanisms allow divergent actors to articulate and explore particular issues and mediate differences. While the aim of such approach is apparent, namely to deliver more holistic and harmonious outcomes for modern food biotechnologies (and other emergent technologies), the path to such outcomes is less clear. A number of options for participatory community engagement exist. The more common ones are public consultations, which invite the community to either submit written comments or present their views at public meetings; small focus groups, at which participants take part in structured discussions and are interviewed on specific issues; public fora, where citizens are presented with detailed information about a given issue by experts and invited to provide comments and suggestions; or quantitative surveys where a cross-section of society is contacted and asked to fill in a detailed questionnaire, the answers of which are subsequently analysed and evaluated by experts.

These options are institutionalised approaches with an ethical dimension. They are loosely structured information exchange and information gathering devices and are directed towards the scientific domain of product development. Generally, they do not create sufficient space for the various publics to deliberate on the possible ethical and social impact of the development or to effectively influence the direction of the enterprise. Ethical deliberations need a different kind of framework, namely one that is able to accommodate diverse value systems and that can address highly complex issues. One emergent approach is the Ethical Matrix, first developed by Mepham (2000), who suggested it for the ethical analysis of novel foods.

The ethical matrix

The ethical matrix is guided by ethical principles as described by Beauchamp and Childress (1979, 1994, 1999, 2001) or their modifications. It presents as a structured framework for rational ethical deliberations and decision-making. In its mechanics, the matrix is a grid of cells that identifies all stakeholders and is headed by a set of agreed upon ethical principles. The ethical matrix allocates prima facie moral status[1] to human and non-human actors. The consequences of a particular technology are investigated for each of the identified stakeholders and transcribed into their corresponding cells (Mepham 2000, Table 1). Once every cell has been filled in, stakeholders consider all consequences so as to arrive at an ethically acceptable position. From a theoretical point of view, the principles-based framework combines deontological and consequentialist aspects and is grounded in the 'common morality' as outlined by Beauchamp and Childress (1979, 1994, 1999, 2001). It makes abstract ethical principles particular to different groups of actors and concrete in terms of the issue at hand.

Table 1. The original ethical matrix (Mepham 2000)

Respect for:	**Wellbeing**	**Autonomy**	**Justice**
Treated organism	e.g. Animal welfare	e.g. Behavioral freedom	Telos
Producers (e.g. farmers)	Adequate income and working conditions	Freedom to adopt or not to adopt	Fair treatment in trade and law
Consumers	Availability of safe food; acceptability	Respect for consumer choice (e.g. labelling)	Universal affordability of food
Biota	Protection of the biota	Maintenance of Biodiversity	Sustainability of Biotic populations

If required, the various impacts could be weighed against each other and ranked in order of importance to reach an ethical decision.

Advantages of an ethical matrix

One of the major benefits of an ethical matrix is that it is able to separate out complex, sometimes interconnected issues into their respective components. When analysing specific cases, the visual representation and the ease and clarity with which the matrix can be read assists stakeholders to remain aware of the divergence of interests per principle. In order to illustrate Mepham's (2000) original matrix by example, the principle 'wellbeing' — a combination of Beauchamp and Childress (1979, 1994, 1999, 2001) principles of beneficence (doing good) and non-maleficence (not doing harm) — is being analysed with respect to four different stakeholders: the genetically modified organism itself, the producers, the consumers and other biota.

Taking the principle of 'wellbeing' (benefits and harms) as an example, two possible positive impacts affecting the modified organism itself are identifiable, namely firstly, the GM plant does not have to compete with weeds for water or soil nutrients and secondly, infestations with pests are reduced. However, there are also potential harms in that the destruction of weeds may reduce the habitat for various non-target insects and invertebrates. For producers, one possible impact could be financial. For early adopters of the application (first-mover advantage) growing a particular GM crop and building up experience may be an investment in a lucrative future. Financial benefits could also accrue from having to spend less on a pesticide or herbicide spraying routine. There are non-financial benefits, too, in that less spraying could protect farmers, their families and communities from possible harmful exposure to a variety of chemicals. On the other hand, early adopters may find that the modified seeds cannot be saved for subsequent plantings, because they might have been made sterile. This could negatively affect genetic diversity. Furthermore, the special pesticide/herbicide recommended for use with the GM crop may cause its own health hazards. From the point of view of the consumer, the fact that a given gene technology regulator determines the GM food to be safe to eat might in itself be a benefit. However, negative outcomes could also be possible. For example, scientific risk assessments may only test for isolated molecules and not for any long-term in vivo impacts on human health, where molecules constantly interact with each other. Lastly, when analysing the possible impacts on biota, a given novel GM crop may lead to a reduced overall use of pesticides or herbicides, thereby minimising the potential harmful load to the environment. On the negative side, however, it may also accelerate the appearance of resistant strains.

These hypothetical impact assessments per stakeholder need to be repeated for the other two ethical principles above. It would be almost impossible to recall all possible consequences for all stakeholders. Therefore, in complex situations such as GM modifications, the shorthand, highly structured overview makes decision-making rational and more manageable. A further, secondary, benefit is the educative potential of the matrix, in that it is able to make other stakeholders aware of issues outside their own horizons.

Kaiser and Forsberg (2001) were the first to apply Mepham's (2000) model to ethically assess Norwegian fisheries for the year 2020. Their project was not only very complex, it was also future-orientated and had to deal with substantial scientific uncertainty, increasing complexity many times. The ethical matrix is further mentioned by Kaiser (2003) in the FAO/WHO expert consultation on GM animals in Rome and has become part of a major study in Europe presently underway to assess “the value of an ethical matrix in the decision-making process and the outcomes of their use” (Kaiser et al. 2004). In their initial analysis of using an ethical matrix in a participatory process, Kaiser and Forsberg (2001) found that the conceptual device is liberal in approach, transparent, able to respect problems and arguments, capable to contrast stakeholder interests, and useful for making abstract concepts concrete for participants. But they also reported some disadvantages.

The disadvantages of an ethical matrix

While the benefits of working with an ethical matrix are evident, both Mepham (2000) as well as Kaiser and Forsberg (2001) point out its substantial limitations. Since the duties described are prima facie duties, meaning that some duties and obligations must come before others, conflict of interest situations between different duties and obligations will frequently arise, requiring compromises (Mepham 2001, p. 169). If the matrix is used to facilitate a participatory event (Kaiser 2004), stakeholders themselves will discuss what the most relevant moral features are of a given issue in relation to a particular principle and fill the cells accordingly.

We contend that while an ethical matrix is appealing in its visual simplicity and reductionism, using this ‘tool’ as starting point for discussions on ethical issues does not represent the complexity of life and the complexity of issues at hand. Indeed, it is our conviction that a matrix would *prevent* a holistic, in-depth, critical analysis of assumed values and facts, risks and benefits, alternatives and choices. The ethical matrix can lead to the exclusion of stakeholders and important issues, can lead to a distortion, even misrepresentation, of outcomes and manipulation of participants. It is argued here that the utility of the matrix lies in its usefulness as *policy* tool, rather than as an ethics “tool”. As ethics “tool” it is too restrictive for a number of reasons. In the remainder of the paper, we will explore two of these aspects.

Problem 1: Capacity differentials and differences in values

Two realities of public participation events are the inequity in capacity of stakeholders coupled with their diversity of values, both of which influence potential outcomes. Since stakeholders are affected differently by a given technology, a careful balancing and weighing up of one cell against another is essential. This presents a major problem. Not only in terms of differences in value and standardisation of weighing, but also in terms of differentials in capacity.

For example, one of the most stated reasons for pursuing modern food biotechnologies is to increase food security. A secure food system is one in which foods can be grown in a continuous way with existing ecological resources and minimal damage to present and future environments.

Globally, we have areas of severe malnutrition but also areas of over-nutrition, both of which lead to alarming public health problems. In areas of malnutrition, provided certain conditions can be met and provided the growing areas are appropriate, modern biotechnological methods may, for example, improve yield, or the level of vitamins, or the fatty acid composition of foods, all aiding nutrition. It might be possible to genetically engineer further benefits. For example, one could grow plants with less input of fertilisers, herbicides and insecticides. One could also modify plants for optimised shelf life to counter post-harvest losses. For our example here, the genome of plants could be modified in such a way that they can cope with poor growing conditions, like marginal lands, where soils may be depleted of nutrients, in soils with high salt content or other poor environmental conditions. However, other farmers living in the same area might disapprove of the intensive farming of marginal lands, believing that ecologically stressed environments and biota may become even more fragile. When considering these points under the principle of ‘wellbeing’, the matrix would show two opposing views. Which of the two views should be retained: farming marginal lands or not farming marginal lands? Which one should be excluded? Would it be justifiable to exclude legitimate issues?

This could become especially problematic in cases where there is a substantial difference in capacity amongst stakeholders and a lack of experience in participatory engagement. In the face of hunger and malnutrition, some African countries may welcome biotechnology-driven, large-scale agricultural plantings, because the change in practice may promise better and more reliable crops. On the other hand, the new practice may cause harm, because it may affect the traditional structures of society build on rural tradition and a more individualistic small-holder farming system. In many of these countries, public policy development is largely top-down for a number of reasons: a high percentage of illiteracy amongst rural populations; ignorance of political and civic processes; a lack of participatory mechanisms and experiences; or financial constraints (Ushewokunze-Obatolu 2003). Under these circumstances, inequality in capacity would demand a high degree of integrity from the more powerful participants during deliberations about future biotechnology developments.

In conflicting or inequitable situations, differences in capacity can affect the outcome of deliberations. In the context of modern food biotechnologies, biotechnology providers, funding bodies, representative scientists and regulators could be regarded as the capacity-stronger participants. They not only possess scientific expert knowledge, they are also accustomed to public arenas and well versed in public communication. They present their views authoritatively and rationally. Their effective use of language can become a key determiner of power and positioning. Further bias can be created by a powerful stakeholder’s unwillingness or incapacity not to present their issues to non-experts in the language of the expert scientist. Such oratorical devise could indeed be used strategically to intimidate and manipulate the listener(s), introducing yet another layer of bias into the discussions.

In their capacity as biotechnology recipients, farmers, retailers, and consumers are more likely to belong to the less powerful and practised group. This could create additional tension between already polarised parties. Capacity-neutral or poor groups might have an equal opportunity to represent their view, but whether their voice is heard might be a different matter. They might feel intimidated by the conduct, language and perceived impatience of more powerful stakeholders. In other cases, their particular belief system and cultural background might endanger equality and equity in participation. Although leaders may be anxious for less powerful groups to participate in deliberations, a basic commitment to fair procedures is also needed, which could impose some guidelines *prior* to the discussions to establish the norms of conduct and conditions of discourse (Taylor 1999). When dealing with minority groups, other mechanisms have been recommended (Foundation on Inter-Ethnic Relations 1999).

These measures can be further supported by ethical guidelines steering conduct and expected standards. In 2001, Queensland became the first state in Australia to establish a code of ethics for biotechnology to guide researchers and industry operating in Queensland (Department of Innovation and Information Economy 2001). Other Australian states, such as Victoria, are currently considering their own code of ethics for biotechnology. Since modern food biotechnologies increasingly become global in distribution and application, Gesche et al. (2004) have proposed an ethical framework led by a special 'Global Code of Ethical Practice for Modern Food Biotechnologies', when operating across nations. Abiding by its suggested principles of beneficence, non-maleficence, justice and fairness, and choice and self-determination during meetings would help avoid that differences in power or conflicts of interest[2] overshadow the participatory event.

Problem 2: Selectivity of content

The ethical matrix can be used in a number of ways (Kaiser et al. 2004). It is the nature of an ethical matrix to draw attention to positive and negative aspects of a given product development relative to a principle or with regards to a stakeholder. This offers an opportunity for a comparative weighting of impacts, which could be regarded as critical for making an ethical judgement (Kaiser et al. 2004). If weighting is the aim, the framing of issues per stakeholder per cell is critical. In order to illustrate problem 2, Table 2 presents a more elaborate matrix with different ethical principles and with the biotechnology provider included.

Table 2. A recent ethical matrix for GM foods and crops (Gesche et al. 2004)

General ethical matrix for GM foods and crops	**Beneficence**	**Non-maleficence**	**Justice and Fairness**	**Choice and Self-determination**
Biotech Industry	Increase shareholder value and profits; capacity building	Barriers to trade; restrictive environments for innovations and creativity	Fair regulations and legislations; protection of intellectual property/licensing; fair distributions of risks and benefits	Freedom to access and grow markets; progression of research and development
Producers (farmers)	Secure income and sustainable agri-practices	Dependence on strategies of biotech corporations; loss of traditional landraces	Fair treatment in trade and law; respecting local values and traditions	Freedom to adopt or not to adopt
Consumers	Food and nutritional security	Food safety; unintended effects on human and environmental health	Access and affordability; public participation in decision-making	Labelling Access to alternatives
Biota (animal and plant life)	Maintaining and protecting biodiversity	Detrimental impact on health and environment; conservation	Sustainability; protection of natural resources; respecting the intrinsic and inherent value of non-human life	"Behavioural freedom", "respect for natural capacity"

When operating with an ethical matrix, it is expected that each principle will have no more than one or two expected unique outcomes per stakeholder in order to keep the matrix manageable. Each outcome would have been shaped by the stakeholders' values. Some of these values could have been more unified than others. While the biotechnology provider is more likely to promote one value and one culture, namely, the cultural values of one organisation, the values of producers and consumers will not be as uniform, they may even contradict each other as we saw earlier, when we introduced the example of two groups of farmers considering marginal land use. If two impacts conflict within a cell, how is one to choose or rank each one? If one expands the matrix and separates out those conflicting parties, little changes, because one view will still have to be regarded as more important than another. This may result in a somewhat diluted position and weaker stakeholders might find themselves disadvantaged. Often no synthesis of positions might be possible. In these cases, the matrix would either have to make it clear that the content is a compromise position, or it would have to offer a range of different perspectives. If the latter is to be avoided, an interim exercise, such as a multi-criterion mapping exercise (Stirling and Mayer 2000), might be asked for.

Other issues can exacerbate the dilemma, such as how much influence is exercised by the more powerful or financially stronger parties at ranking. While an ethical matrix may appear to be catering for different value systems, it actually may present a filtered reality that may exclude a number of equally valid choices. How an issue is framed and expressed in the matrix is critical for decision-making. Therefore, it seems that the time spent determining which issue(s) to include in the matrix is more important that the matrix itself. The matrix might be a synthesis of different views and knowledges, giving a filtered view of positions and requiring considerable integrity of all involved in the decision-making. These factors may make judgments to be far from what we think it is.

Using an ethical matrix for policy development

The ethical matrix lends itself as a policy development tool, especially in situations where many societal attitudes, values and interests need to be accommodated. For policy development, a number of public participation opportunities exist, such as when developing a national biotechnology policy document or when developing a regulatory framework for genetically modified organisms. In these instances, governments may invite public comments and may also solicit information about the level of agreement and disagreement with particular points or positions. According to Glowka/FAO (2003):

> "Opening decision-making processes up to the public may help to ensure that decision makers have the best information at their disposal in order to evaluate the benefits and risks that modern biotechnology could present. Public participation could also help to ensure better transparency and accountability in decision-making."

When subsequently processing the information in order to arrive at a just decision, an ethical matrix would be useful to facilitate the process of dialogue, mutual learning and just decision-making by displaying the 'plurality of legitimate perspectives' (Funtowicz and Ravetz 2003, p. 8) for recollection and perhaps ranking.

Even at this late stage, however, bias can still creep into the process. It is worth noting that without collecting accurate and objective data, policy decision-makers may become prisoners of their own worldview and use of language. According to Cormick (2003) many policy decisions in Australia are based on public attitudes towards certain applications of gene technology and may also emerge from second-hand information channels and anecdotal and undifferentiated evidence. This means that if powerful stakeholders (e.g. biotechnology providers) would not be accessing accurate and objective data and information, they might not be aware of the actual 'heteroglossia of voices' and of other dimensions of the wider discourse (Cook et al. 2004, p. 444).

Conclusion

Emerging technologies require us to rethink strategies in risk analysis. While scientific risk analysis has seen many beneficial changes at the interphase of biotechnology industry and the publics, it is now urgent to find a framework with which to adequately and systematically analyse some of the ethical and social issues that may arise. Such undertaking would need to respond to the demands of the public for greater participation in decision-making by moving beyond public consultation processes and other top-down, expert-driven communication pathways towards participatory frameworks that are more accessible, inclusive, accountable, open, multi-directional and interdisciplinary. The ethical matrix could be one of those frameworks. An explicit open communication system would bring a number of benefits. In the first instance, it would protect the reputational framework of the biotechnology provider and regulator and preserve their bottom line. Furthermore, enhanced community engagement during all phases of product development would project a mature attitude towards farmers, retailers and consumers (and, through them, the environment). Moreover, it could encourage a wider cross-section of society to offer fresh and innovative ideas and their background knowledges to policy makers and create avenues to assess and evaluate any suggestions for improvement, thus also benefiting the biotechnology industry.

While we believe that the ethical matrix is more suitable for policy development than for ethical decision-making because of some serious shortfalls, it could be used for both purposes, albeit with different intents.

A thorough evaluation of ethical decision-making frameworks is currently underway in Europe and will provide valuable answers.

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[1] The term *prima facie*, literally means “at first glance”. It was introduced by W D Ross (1877–1940). Ross thought that consequences do not make an action necessarily right or wrong. Instead, he believed that it is more important to consider the consequences in making certain moral choices. Ross listed several prima facie duties, such as duties of justice, beneficence and nonmaleficence (noninjury), which Beauchamp and Childress (1979) were to take up years later in their ethical principles. If two principles conflict, Ross believed to always act in such a way that the stronger prima facie duty takes precedence over the weaker one. Ross W D 1930, *The Right and the Good*, Oxford University Press*,* New York.

[2] A conflict of interest arises when a person is influenced by factors that inhibit their ability to act impartially. It is foremost an ethical issue, because it can result in wrong decisions causing harm. It is also unjust, because it might favour one stakeholder over another. Furthermore, it prevents stakeholders to act impartially, thus limits their choices. Conflict of interest can lead to intentional, sometimes subtle, biased behaviour. For example, when stakeholders are influenced by the presence of other stakeholders, who provide the capital for research or commercialisation. In cases where a conflict of interest may arise or may exist, it should be disclosed to all other stakeholders so as to preserve the integrity of the participatory process.