RETHINKING RISK

Abstract and commentary on a new report from Andy Stirling at SPRU and Sue Mayer at GeneWatch UK on a pilot multi-criteria mapping of a genetically modified crop in agricultural systems in the UK

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A BALANCED APPROACH TO SOCIAL AND SCIENTIFIC CONTROVERSIES

Imagine you are witness to what at first seems to be a family squabble - but is really a serious, long-standing disagreement about how life should be lived. The viewpoints and expectations of the participants obviously diverge: consensus is not on the horizon. While heading for the door, you might advise the disputants to seek the services of a psychotherapist, a professional arbitration service, or a solicitor. But when controversy besets society at large – in the wake of biotechnological innovations on the scale of genetically modified (GM) crops, for instance - the search is on for viable strategies.

No wonder "environmental risk appraisal" has become an academic growth industry. Today's "market of methods" features cost-benefit analysis, environmental impact assessment and a host of other analytical approaches. Most of these techniques seek to derive a single best or optimal solution from the point of view of society at large. They purport to offer definitive answers for policy makers in search of justifications for political decisions. Yet the "analytical fix" turns out to be less promising than it might seem. Beneath the number-crunching are unacknowledged subjective assumptions, which make these approaches inflexible, narrow in scope - and, ironically, open to disputation.

New "participatory" and "deliberative" approaches such as focus groups, consensus conferences or citizens' juries escape these criticisms but are themselves open to concerns over reproducibility - how do outsiders know "what went on? There are fears that these approaches may prove to be protracted and inconclusive, with results again heavily influenced by starting assumptions. What is needed, it seems, is a balance between the artificial precision of the analytical fix and the sometimes obscure procedures of public participation .

Multi-criteria mapping offers one such balanced approach. It comes from a family of techniques developed since the Second World War that have already proved useful in public policy debates in Denmark and the Netherlands as well as Britain, in fields such as transport and land-use planning, energy policy, waste management and health care.

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Introduction

Climate change, the ozone hole, nuclear waste, pesticides, hormone disrupting chemicals, BSE, Brent Spar, genetically modified food - a host of apparently intractable risks pass in and out of the headlines at a frenetic pace. The issues quickly become polarised. There are signs that public anxieties over each successive 'revelation' of technology-induced threat are compounding into a corrosive general attitude of fatalism, disillusion and distrust.

But when people disagree, what is to be done? A new approach to a well-established technique that can provide a "map" of the debate surrounding any contentious issue could help policy-makers find better routes to decision-making. This pilot study used "multi-criteria mapping" to shed much-needed light on the furore surrounding genetically modified (GM) crops.

The prospect of genetically modified crops and foods has become a political hot potato in Britain. Food industry executives, government advisors and biotechnologists have all been caught unaware by the strength and persistence of public concern. In such an overheated political arena, how can highly polarised disputants engage in constructive debate?

This innovative pilot study showed how people with very different perspectives can participate constructively in discussion and regulatory appraisal. In this project, funded by Unilever, twelve specialists - including highly placed government advisors, biotechnologists, and representatives of public interest groups - together helped to create a "map" of the debate surrounding GM crops.

The findings suggest that multi-criteria mapping can provide an illuminating and reliable reflection of the issues at stake in any controversy.

Emerging common ground

In the pilot study, disagreements were prominent, as expected, but surprising areas of agreement emerged as well:

- Dissatisfaction with the status quo emerged as clear common ground: all the participants judged conventional intensive cultivation to be performing poorly.
- Across all perspectives, the organic option performed relatively well, not only under environmental criteria (where it performed unequivocally well), but also more broadly.
- Participants also largely agreed that a voluntary controls regime for GM crops would perform worse than other regulatory approaches.

These findings accurately reflect many established and some currently emerging trends in the debates surrounding both GM crops and organic agriculture.

What is multi-criteria mapping?

This technique is a systematic and transparent way of comparing policy options. It can tap into a wide range of perspectives and expertise, and produce an overview that "maps" the debate. It does not attempt to foreclose deliberations by coming up with a single solution, but seeks rather to foster the exploration of alternative outcomes. It carves a middle way between highly technical, purely quantitative analysis and qualitative, discursive approaches (see sidebar left). It combines the transparency of numerical approaches with the unconstrained framing of discursive deliberations, harnessing the best of each approach.

Who participated?

For this pilot study, twelve individuals were recruited, chosen to reflect a wide range of institutional interests and perspectives. Their starting points ranged from strongly favourable to strongly opposed to GM strategies. Four worked in agriculture, plant biotechnology or the food industry. Two were academic scientists and two were government safety advisors. Four others represented religious and public interest groups.

How does it work?

It's as though participants were each given a big bag of beads to distribute across alternative options, depending on what's most important to them. At every point, the participants are in the driving seat.

First, participants choose "options" or alternative scenarios - in this case, six ways that oilseed rape might be grown on farms in the UK.

An interviewer equipped with a lap-top computer and an audio tape recorder guides each participant through the appraisal process, which takes between two and three hours. Participants were asked to compare the performance of six basic alternative scenarios, and could also add six more of their own (see Table 1). These alternative scenarios are called "options". The six basic options in this exercise were organic agriculture, integrated pest management and conventional agriculture - all without GM crops - and three GM options: incorporating either segregation and labelling of the GM produce, post-release monitoring or voluntary controls on areas of cultivation.

Defining criteria

Next, participants list their "criteria": all the things they would want take into account in order to evaluate how best to fulfill a particular objective – in this case, the growing of oil seed rape.

Participants had a free-rein, and could specify up to 12 criteria. Popular criteria included the use of chemicals, the impact on wildlife, human health and safety and cost to consumers. But many other considerations also come into play - with a total of 117 criteria in all - including issues such as biodiversity, genetic pollution, social benefit, cost to consumer and weed control options. In the final analysis, these criteria were grouped into broad categories - such as environment, health and economics - to give a qualititative picture of the major issues regarded as relevant by all the participants (see Table 2).

Assigning scores

In the next step, participants judge how well the options perform in the light of each evaluation criterion.

This is the "scoring" stage. Participants were asked to assign a number in the range of 1 to 10, or 1 to 100, to each option under each criterion. For example, because no pesticides are used, the organic option will score highly under a criterion of pesticide use. Conversely, depending on technical judgements about economics, the same option will score differently under a cost criterion. Participants were also asked to give a measure of how uncertain or variable they felt matters to be by giving both an optimistic and a pessimistic score.

Adding weightings

The final step is to add "weightings": participants are asked to look at the criteria again, and rank them in order of relative importance, from most to least important.

Participants could also vary the scale, by deciding that one criterion, say pesticide reduction, is 10 times more important than is cost to consumer or vice versa. To do this they also had to take account of the difference in performance between the best and worst options under each criterion. Deep seated subjective value judgements - for instance, the importance of wildlife or landscape, compared with farmers' income or human health - come into play in this step.

The grand finale

Using a simple formula, the scores under each criterion are multiplied by the criteria weightings to produce an overall pessimistic and optimistic relative ranking for each option.

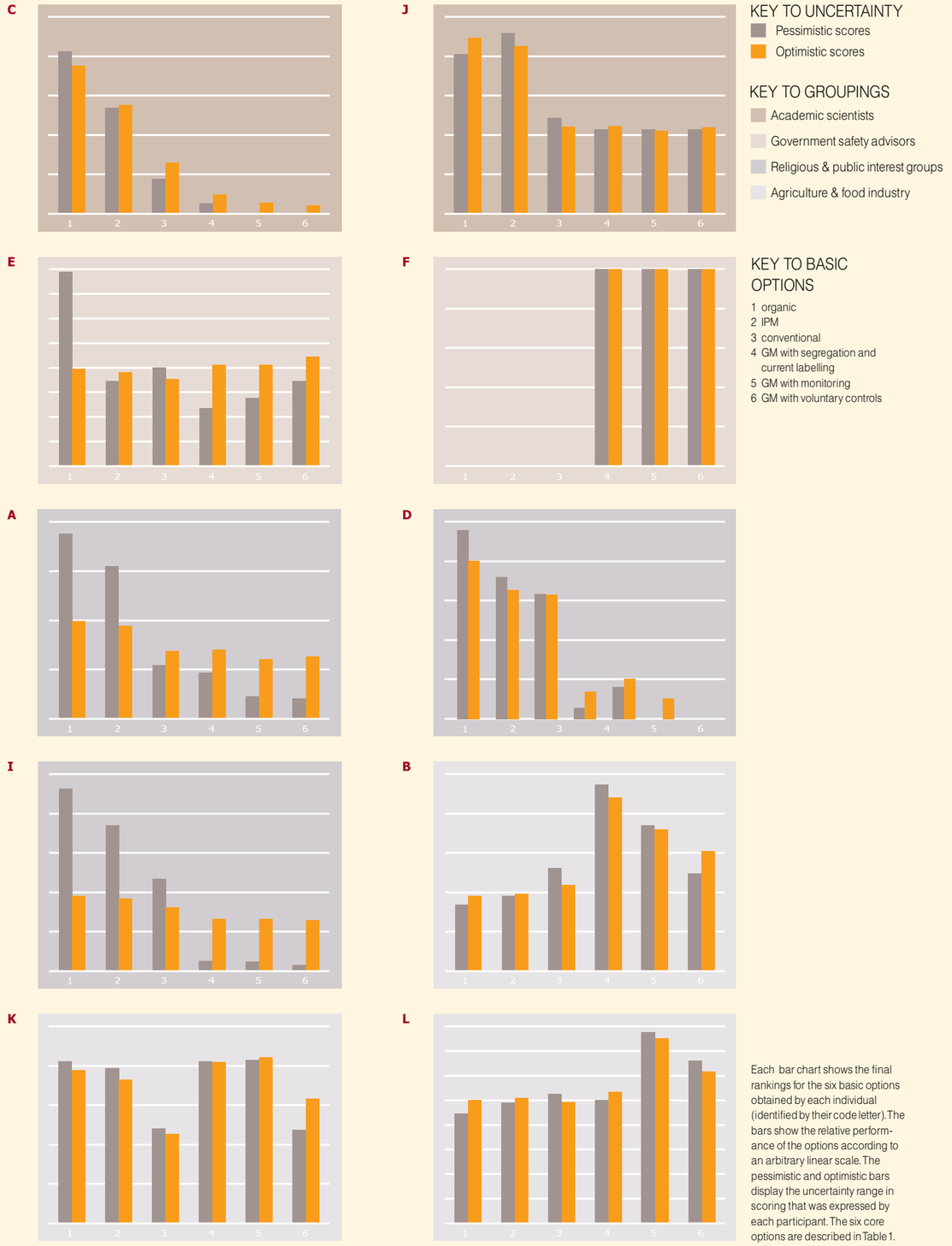
Each person's appraisals are quickly calculated on the computer and displayed in a series of bar charts (see chart right). The appraisal process is iterative and reflexive: participants were free to examine the results and decide to go back and alter weightings or include new options or criteria. The perspectives adopted at any one moment are not irrevocable, so participants are able to trust that particular weightings will not become reified, manipulated, or taken by political adversaries as hostages to fortune. Remarkably, no one wanted to tinker with their results; the technique appeared to produce a robust reflection of peoples' evaluation.

This is a powerful tool for "mapping the debate". It gives a valid picture of the range of society's concerns, so establishing a framework under which further assessments can take place. It also identifies matters of technical disagreement and provides an audit trail linking inputs, assumptions and results. The findings are robust, and can be relied upon as a useful indicator of the broader dimensions of contemporary controversies.

What the pilot study found

- **The method works well even in a hotly disputed controversy**. This approach included a diverse group of participants. In itself, this ability to secure wider trust and engagement in appraisal may count as a particular feature of this approach.
- **It brings in a broad range of perspectives**. This project drew on a wider range of specialist perspectives than do orthodox risk assessment exercises.
- **Its transparency helps builds trust**. Anyone can go back through the numbers to see how a particular outcome was reached, and alter those scorings and weightings if the outcome does not accurately reflect their judgements. There is no sleight of hand hidden in the simple mathematics.
- **Highlights areas of both disagreement and agreement**. Significantly, multi-criteria mapping is capable of producing surprises: notably, that *across a broad range of perspectives the organic option performs very well.*
- **The initial choice and definition of criteria drives the end results**. Assessments were most strongly influenced by each participant's early "framing" of the debate, rather than the weightings assigned later. This finding stresses the importance of ensuring that the entire spectrum of values and interests are represented. Yet many criteria chosen by the participants in this study lie outside the scope of official risk assessments, and for no participant is their whole range of criteria explicitly considered in the formal evaluation process of GM crops in the UK.
- **Uncertainty is acknowledged**. The technique's pessimistic and optimistic ratings indicate how confident people are about the present state of knowledge and show that uncertainty is much more of a live issue for some participants than it was for others.
- **All sides of the debate support diversity in options - not putting all the eggs in one basket**. However, GM and organic farming strategies are widely seen to interfere with each other and so appear to be mutually inconsistent. If the benefits of diversity are to be reaped, then options which compromise an ability to pursue other strategies in the future may be regarded unfavourably.

Final ranks for basic options by participant



Each bar chart shows the final rankings for the six basic options obtained by each individual (identified by their code letter). The bars show the relative performance of the options according to an arbitrary linear scale. The pessimistic and optimistic bars display the uncertainty range in scoring that was expressed by each participant. The six core options are described in Table 1.

Why multi-criteria mapping?

Conventional approaches tend to assume that decision makers can know in advance all relevant details and how important each is, and that consequences of action are always predictable. Yet usually we cannot know the future, and so forecasting is essentially subjective and unreliable. And even when information and assumptions are held in common, there is no reason to believe that there can only ever be one rational response. Multi-criteria mapping can acknowledge and take on board both uncertainty and a plurality of possible outcomes. It actively encourages the exploration of alternative solutions.

In addition, this technique can help to bring into deliberations the many disparate perspectives held by different constituencies throughout society. In the 1960s, the Nobel-prize-winning economist Kenneth Arrow demonstrated (in formal mathematical terms) that there can be no one solution to a social controversy – no uniquely rational way to resolve contradictory perspectives, divergent values or conflicts of interests. In other words, no purely analytical procedure can substitute for democratic political process. Multi-criteria mapping does not attempt to usurp the role of due political process in the resolution of technoscientific controversies. What's more, because the technique can reflect broader views and values, it has a greater potential to inform democratic decision-making than do "scientific methods" alone.

Strengths of multi-criteria mapping

- Pluralistic: it is possible simultaneously to contemplate several alternative solutions
- More realistically reflects multi-dimensional nature of reality
- Pragmatically acknowledges uncertainty and the role of subjective judgements
- Open-ended and reflexive, allowing for continual appraisal and review
- Transparent and accessible, open to independent critical scrutiny and wider public participation

What next?

Multi-criteria mapping is an aid to deliberation and reasoned judgement. It is one way of elaborating scenarios and systematically clarifying the parameters of any policy decision that has to be taken under conditions of indeterminancy in nature, ignorance in our state of knowledge and plurality of values and interests. It encourages a multiplicity of perspectives and option spaces. In a discussion paper, the secretariat of the government's Advisory Committee on Releases to the Environment recently stated that "the present legislation does not take a strategic approach to regulating GMOs" and concluded that "the mechanism which allows the best environmental options to be identified needs to be developed".

When apparently simple verdicts of "safe" or "safe enough" fail to reassure the public, multi-criteria mapping might be a boon to decision-makers seeking both political legitimacy and democratic accountability. As *The Economist* commented recently (29 May 1999, p 37), "After BSE, simply quoting scientific authority is no answer to the conundrum of public trust. What impresses the public in these matters is transparent and impartial decision-making based on wide consultation." The multi-criteria mapping technique enables politicians and civil servants to foster greater confidence that all relevant criteria have been considered at some point in any evaluation process.

This pilot project could usefully be expanded in scope in two directions. First, the technique described here could be developed to allow for *greater interaction and deliberation between the participants.*

Secondly, a dimension of public participation can be introduced by establishing *citizens' panels* selected on a regional basis, by age, sex or some other basis to bring different lay perspectives into the debate. The panels can identify additional options, criteria and weightings themselves, and also invite a variety of specialists to score criteria under various options. Such further studies that include wider publics are needed to identify any contrasts with the specialist arena and to confirm and enrich the map of the overall GM debate.

Industry and government bodies may find multi-criteria mapping to be a useful tool in a variety of different contexts. It can provide an important input to the "expert review" stages within regulatory processes, or enable companies to explore the implications of alternative R&D directions. At an early stage in development it could play a useful role in many aspects of the innovation process, as a way of identifying the broader social implications of new products or new technologies.

Of course, tools like multi-criteria mapping can only ever be a part of the solution to the difficulties of social decision making over technological risk. However, this technique does bring to the technology appraisal process a combination of the benefits of inclusive and deliberative approaches and the discipline and transparency of quantitative techniques. Such an approach may now be important in helping to garner widespread public support for decision-making in the political arena on new technologies like GM crops.

Table 1 - Basic options and those added by participants

BASIC OPTIONS
No GM crop, organic agricultural system
No GM crop, integrated pest management system
No GM crop, conventional agricultural system
GM crops, with segregation and current system of labelling
GM crops with post-release monitoring
GM crops with voluntary controls on areas of cultivation
ADDITIONAL OPTIONS
Labelling and/or other controls
GM crops with segregation, current labelling and post-release monitoring
GM crops with segregation, full labelling and post-release monitoring and legally binding growing contracts
GM crops within controlled sectors (compulsory control)
GM crops with legally binding threshold for gene transfer to non-GM stream
GM crops with segregation and labelling according to means of production and source of gene, plus post-release monitoring
GM crops with segregation, comprehensive labelling based on process and generic restrictions on some classes e.g. in centre of origin
GM crops with segregation, full labelling and post release monitoring
Agricultural system
GM crops, IPM system
GM crops, organic agricultural system, plus segregation, labelling and other regulations as required
GM crops, IPM system
No GM crops conventional and organic as now
GM crops in conventional and organic systems
Assessment criteria
GM crops with assessment of indirect agricultural impact and assessment of need
GM crops with quality traites
Other
Complete public control over choice
GM crops only in USA
No GM commodity crops

Table 2 - Criteria Groupings

ENVIRONMENT:	
12/12 participants had at least one criterion addressing issues of:	
sub-groupings:	biodiversity chemical use genetic pollution secondary or broader effects unexpected effects ethical, aesthetic and visual
AGRICULTURE:	
10/12 participants had at least one criterion addressing issues of:	
sub-groupings:	weed control food supply stability agricultural practice
HEALTH:	
11/12 participants had at least one criterion addressing issues of:	
sub-groupings:	allergenicity toxicity nutrition unexpected effects manageability
ECONOMIC:	
10/12 participants had at least one criterion addressing issues of:	
sub-groupings:	consumer price benefit farmers' or commercial users' benefit society benefit
SOCIAL:	
8/12 participants had at least one criterion addressing issues of	
sub-groupings:	individual choice, need, benefit and participation institutional demands social need, benefit and trajectory
OTHERS:	
4/12 participants had at least one criterion addressing issues of	
sub-groupings:	ethics knowledge base

Table 1 - KEY TO GROUPINGS

- Academic scientists
- Government safety advisors
- Religious & public interest groups
- Agriculture & food industry