Chapter 53. **Factors Influencing Public Policy Development in Agricultural Biotechnology**

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Abstract

It is obvious, that agricultural biotechnology is one of the center points of the recent debate. If we focus on the most neuralgic point, it is genetic engineering as a tool for modern plant breeding. It is clear that lay people are anxious regarding the new developments, and it is not only ignorance which makes them fearful. There is a big divide between lay people and scientists and between politicians and citizens, to name just two major divides. The important question is, how can we overcome divides of this dimension and what do we want to set as new policy goals in the appropriate time scales?

Integral: the word means to integrate, to bring together, to join, to link, to embrace. Not in the sense of uniformity, and not in the sense of ironing out all the wonderful differences, colors, zigs and zags of a rainbow-hued humanity, but in the sense of unity indiversity, shared commonalities along with our wonderful differences: replacing rancor with mutual recognition, hostility with respect, inviting everybody into the tent of mutual understanding. Not that I have to *agree* with everything you say, but I should attempt at least to *understand* it, for the opposite of mutual understanding is, quite simply, war.

(Wilber, 2002), Boomeritis, p. 15

53.1. The Wider Picture

'Public policy' is a complex term for a complex situation. The temporal and spatial complexity of public policy is the result of the multitude of factors influencing it, such as the opinions of vocal minorities and majorities, and its embedded position in the overall development of human culture, science and art.

It may now be stated as a matter of fact that biotechnology, which has developed rapidly due to the recent upsurge in the molecular sciences, has become a major factor in everybody's life. Biology, which not long ago was still the romantic science of rare animals and beautiful plants, has now definitely lost its innocence and needs to be looked at not only with a spirit of belief in the great potential to be gained from understanding life and life processes but also with some concern.

If we want to work towards a positive transition from global inequality to a generally more humane world, we will ultimately need to improve the dialogue on knowledge, science and society in order to provide a more positive social trend in a world of ever-growing potential for conflict. Knowledge is understood here as value-laden long-term dimensions of cultural and social knowledge.

For example, it is obvious that discussions on agricultural biotechnology have been the centremost in recent debates. A major focal point in these discussions has been genetic engineering as a tool for modern plant breeding. It is clear that many lay people have developed a fine-tuned anxiety about the new developments in this field, and it is not only ignorance that makes them fearful. There is a Range public divide on this matter, not only between lay people and scientists but also between politicians and voters. The important question is, how can we overcome divisions of this size and, given appropriate time scales, what do we want to set as new policy goals in this area?

Recent developments have clearly shown that there are tight connections between economics and the resolution of conflict. Terrorism is an element of society that has always been present, but it has now become a global problem since technology has facilitated new organisational structures and forms of violence on all sides. The Third World War will be fought without frontiers, and it is not certain whether or not it has already begun. Opinions about this are numerous and each side has its own arguments, but here we want to look forward in a constructive way.

53.1.1. Science and the Public Trust: The Present State of Error and the Way Out

The divide between science and moralities (including, for example, public trust, value-laden knowledge) is growing dramatically, and there seems to be no control over the process any more. It is no longer possible to continue the scientific education of the public with the old didactics of the anonymous '*it-language*' of science (Wilber, 1998). It is naïve to assume that 'If the lay people knew more, they would not be afraid of future technological developments'. Resistance does not come primarily from the unwillingness of people to learn; it stems from their unease when experiencing science as the sole explanatory ideology in modern life. Many people have a distinct feeling that biotechnology will intrude into all areas of their personal life without anybody asking them whether they want that or not. The debate about transgenic food is a classic example of this—people feel threatened by the fact that in many countries consumers do not have a free choice between genetically modified (GM) and non-GM food. This 'enforcement' could be a major reason for the public reluctance to accept the fact that genetic engineering is taking over in modern breeding. There is actually no reason why modern plant breeding should not profitably use all kinds of molecular methods, including genetic engineering. But with this uneasiness underlying many people's thinking, individuals are all too easily convinced by protest bodies that there is something inherently wrong with GM food, although the facts tell us the contrary. The problem here is that many people correctly sense that scientific facts are not the only element in the debate, and facts alone, without any social or cultural context, cannot be an ultimately convincing argument. In addition, people are aware that facts can be filtered and manipulated. Actually, when it comes to finding solutions we should *all* obey the rule of the 'symmetry of ignorance' (Fischer, 2001; Fischer *et al.*, 2002; Rittel, 1984), especially when taking into account people's emotions and vested interests. Conversely, 'symmetry of ignorance' can also be defined as 'asymmetry of knowledge'.

When involved in such debates, how dare we pretend that experts know more than lay people? Particularly when those experts are imprisoned in their 'it-language' cage. This is the point at which we have to recognise, and admit to, our common 'symmetry of ignorance' when we are tackling social issues.

We, therefore, desperately need to develop, new forms of dialogue that take into account the concerns of both sides using ‘it- and we-language’ in the various problem fields and between participants. If scientists do not learn to respect the realms of non-scientific knowledge, they will indirectly build up a public resistance to the very science that they are preaching, the irony of this situation is somehow hilarious and tragic at the same time. A functional dialogue between incompatible languages in the spheres of science and moralities in modern and post-modern times needs to start from basics, which are well defined in some important terms.

In order to bridge the gap between those spheres we have to attempt to integrate truth (science) and meaning (moralities) in society. At the same time we have to understand both the good and the bad news of modernity and post-modernity, particularly if we want to use the social history of the last two centuries to support our efforts.

The good features of modern life include: liberal democracies; emancipation; democratisation of knowledge; higher standards of living and steadily increasing life expectancy, due to the highly successful fight against disease. Conversely, the bad features, which cumulatively lead to neglect through affluence, include: the widespread loss of meaning in social and personal life (Spretnak, 1997); an increasing loss in the quality of life, both social and cultural; a general brutalisation of daily life; the loss of family love and an escalating drug problem.

The good news of post-modernity indicates the new importance of the role of interpretation in human understanding, a renaissance of the ‘we-language’, developed in art and now hopefully implemented in social structures, such as engaging in help for developing countries. Contrasted with this is the bad news that there is nothing else but interpretation, and, as a result, we can dispense with the objective component of truth altogether. Science is routinely questioned and people feel more and more reluctant, therefore, to accept progress in technologies that stem from that science.

If we really want to bridge these growing gaps in both understanding and action, we must try to initiate a considered and constructive debate on decision-making processes, which does not mix the languages of science and moralities, but brings them together by means of a procedural language.

It is fruitless to debate in a hostile atmosphere, where opponents clash in an incompatible ‘dialogue’, yet refuse to accept that a common platform has still to be developed. The deplorable alternative is parallel preaching, fights and accusations, resulting in a match without a winner and a lack of pleasurable creativity.

53.1.2. Towards a New Common Platform Between Opponents

A new ‘common language’ between the spheres of science and morality must be found step by step, without mixing factual and deontic knowledge. In the context of planning, knowledge is bridging theory with reality in a particular context. There is no third and miraculous pathway to solve this problem. What we need to do is develop a new way of coexisting through the use of a reconciliatory process that aims at developing a new ‘common language’. This ‘new common language’ is the metaphor for a procedural language that gives us the chance to reconcile contrasting cultures and interests.

53.1.2.1. Discursive Processes Illustrated by the Example of Traditional Versus Scientific Knowledge

We must make it clear right from the start that polarity in debates often stems from the wrong use of language. For example, patenting (or protection of knowledge) has a different background in various cultures. Intellectual property rights (IPRs) in the first world have their own legislation language, while shamans, on the other side, try to protect their own knowledge by quite different ways and means, all of which is reflected in language. An excellent example of this is provided by the different kinds of plant nomenclature used by Amazon Indians, based on medicinal and spiritual use (Wicker oral communication), and western taxonomists, based on morphology and genetics. In a world with a growing global vision of survival, successful attempts to find common goals start by learning about differences, then proceeding to choose a common platform that enables joint decisions to be taken that, inevitably, lead to solutions.

We must conduct a debate about inequality. This will provide the capability to generate new knowledge (and hence new intellectual property). We have to accept that these issues will involve the area of inequity in human capabilities.

53.1.3. Motivations, Drivers and Incentives for Tackling Science and Technology Problems in the Future

It is very important to review the motivations of the major players in this global debate. It is also indispensable to invite to discussions all the major interested parties who undertake professional work initiated as a result of their own motivations. Government representatives (regulators, legislators and executives), professional representatives of the civil society sector and scientists, all of whom have a direct interest in getting together and debating the topic of IPRs, should be ready to go through an iterative process, in an effort to find common ground in innovative processes which lead to new solutions. We need to develop a common understanding of the differences in power systems in the developing world, indigenous populations and the western world—power systems that are reflected in the differences within the respective health services, to give just one example. It is the various healing strategies, the different medical philosophies and multiplicity of technologies behind these which need to be respected—and it is from there that we will be able to make common ground and achieve a world view with enough room for human, cultural and spiritual diversity and values.

53.1.4. Can We Direct Science and Technology Development in Order to Create a Better World Where a New IPR Concept can Play a New and Important Role?

The real issue is hidden by inequalities in the use of existing information, especially where such information is under IPR protection. Here there are two issues. The first relates to the capability of using available knowledge (whether protected or not), and the second is access to patented knowledge under conditions that do not compromise the incentives provided to promote the creation of intellectual property in the first place. If we want to achieve new solutions concerning IPRs we need to question both scientific progress and the institutions producing it.

There is no room within the four topics discussed above for a division or fruitless debate about dependent or independent research, a concept which harps back to the old-fashioned Marxist views. We should concentrate instead on the question of whether such research is of high quality and useful for reaching the ultimate goals: goals which have been defined within the decision-making process, and which might result in real surprises.

Is it really true, for example, that research supported by the private sector is less creative, more linked to shortsighted goals and under heavy commercial constraints? And what about the presentday system of scientific publication—does it guarantee quality in scientific research? Can we still allow basic research to be absolutely free and completely separate in its outcome from societal needs and ethics? Do we need novel public and private financing concepts? For many successful scientists patenting is not the solution. There are other functional mechanisms for measuring scientific merit, which then lead to better positions within the scientific workplace. Patenting in life sciences needs to be adapted to the facts of life—living organisms' genetics and unique ability to reproduce. How can the needs of developing countries be included in the development of new technologies? What about IPRs and the absolute need to feed additional billions of people in a few decades?

This is the crucial part of any debate, where we need to build common ground, which will hopefully evolve into the idea of IPR clearing houses, such as have been proposed by various civil groups in accordance with the big life science companies.

53.2. Some Insights in the Public and Scientific Debate

After having discussed the general picture we now need to go into more detail about the debate on GM crops and agriculture. We need to have a closer look at some of the more important players participating.

53.2.1. The Scientists

Scientists still tend to see the world through fact-tinted spectacles. This is understandable since they are dependent on high-quality publications in order to start and maintain a good scientific career. They live in a world of facts, and this world has been quite successful in producing progressive and successful new technologies. It is also a world of reductionism, experimentation and clean conclusions and, naturally, there are only a few thoughts given to follow-ups and social responsibility. It is usually a world of laboratory experiments. It is only recently that field ecology caught up with computer models, strict statistical discipline and quantitative analysis. It is good to remember what Karl Popper said about scientific data—he took *falsifiability* as his criterion for demarcating science from non-science (Popper, 1972). In the fight for scientific truth, with opponents who often indulge in unscientific populist slogans, scientists tend to focus entirely on rectifying facts in fighting for the good cause. In a deplorable way, this leads to a strong belief in scientific facts alone and, even worse, it becomes difficult to keep the balance and admit to lacunae in knowledge.

53.2.2. The Corporates

Industry representatives and scientists working within companies often live in an euphoric atmosphere, believing in the good cause of their product development. It is a world of deontic knowledge (planning knowledge, the knowledge what ought to be) and there is little space for other kinds of knowledge, other than scientific and deontic. In the best scenario, this can lead to a clash with business-oriented colleagues who have to deal with the shareholders and, furthermore, who need to keep the company on an economic course which will allow future development. Industrial scientists experience a conflict between their desire for both scientific and deontic knowledge, because the latter may be at odds with the strategies of the companies they work for. A clash helps to recognise contrasts, and this can be very helpful for developing future creative processes. It is also true that there is a certain stress in developing products with market potential but, as in academic science, in the commercial sector sustainability of work quality is the best guarantee of long-term career success. The idea of corporate scientists being forced to produce and validate opinions that do not necessarily match with good science is too simplistic. It is known that in both academic and corporate science some scientists develop dubious ethics and produce flawed results on purpose. In both cases, many pressures relating to career as well as finance can be the reason for this. It is certainly better to distinguish between good and bad science and to have a certain, if limited, confidence in the peer-review process.

53.2.3. The Non-Governmental Organisations

The Non-governmental Organisations (NGOs), or civil society representatives, as they are called today, play an important role in our risk-minded society. It is not widely known that the big NGOs are powerful organisations on a global scale, well organised and supported by numerous members. NGOs still portray a 'David' image when comparing themselves to the 'Goliath' global companies. However, when one compares the PR budgets of both, these images are hardly accurate nowadays. Nothing can be said against the power of the NGOs; in fact we need to see powerful organisations of this type in the debate, but there are details that should not be overlooked. First, these organisations are neither elected nor accountable democratically. Second, they are often not internally structured in a democratic way. Third, and worst of all, they are more interested in making money (and attracting members) by the use of populist slogans—they are far less keen to solve problems by means of hard field work. Of course, this sweeping generalisation is not true for hundreds of small NGOs, and dozens of important ones utilise problem-solving strategies to carry through plenty of professional projects, often learning the hard way, just as corporates, scientists and governments do.

53.2.4. The Regulators in Governments

Regulators are the neutral stakeholders who care for public health and well-being. In preparation for their regulatory activity, they must be excellent scientists who keep themselves up to date with progress in technologies currently being honed for implementation. This is an extremely sensitive task, since they need to maintain a central position in the debates, and must listen to both sides of the argument. This is all the more difficult if the debate has been driven into emotive realms and thus strongly influences both opinion making and the drafting of new regulatory structures. In Europe, it is a sad fact that regulators' offices are not only notoriously understaffed and unsupported by strong regulatory rules but also, which is even worse, that their work is considerably hampered by politics. This is a result of the present dramatic lack of trust in European governments due to their dubious treatment of scandals such as HIV blood contamination and BSE. Consequently, the public, along with many politicians, believes that in the GM debate the corporations and scientists developing those promising technologies just lie in order to justify them. It is not easy for regulators to work and fight for the truth in this climate of mistrust. Regulators need more harmonisation, more biosafety research documentation and, certainly, more support in all areas of their work.

53.2.5. The Journalists

Journalists serve the public by providing impartial reports. Despite the daily battles to fill columns and attract readers, these should contain basic facts, straightforward interpretations, supported, if possible, by extensive documentation. In the best cases, both sides of the argument should be clearly presented.

Good journalism attempts to separate documentation from opinion as a comment, but these days more and more we see articles with a strange mixture of both. As we all know, sensationalism is an important marketing tool for all newspapers, although it is often camouflaged by terms like 'good stories', 'lively reporting', and so on. The Monarch butterfly story is a typical example. The first sensationalist publication in *Nature* was picked up and reported immediately, but when six extensive publications in the *Proceedings of the National Academy of Science* appeared some months later, because there was no story about the killing of innocent butterflies by the evil toxic plants produced by global corporates, the subject was no longer news and was reported in only a few papers (Sears, 2000; Sears *et al.*, 2001).

But this is only part of the story. Today we have to cope up with an unfortunate media-driven public mix of anti-global, anti-corporate, anti-business and anti-technology attitudes, which is a great problem as far as the GM debate is concerned.

53.2.6. The Population

It is difficult for the man in the street to follow this intellectual debate and to see through the fog of true filtered and alas, false arguments presented. The difficult choice of whom to believe or disbelieve is often an emotive one. It is also true that the public has a fine-tuned sense of anxiety and many have realised—maybe even earlier than the researchers did—that the biological sciences have lost their innocence. This comprehension should act as a strong motivator, driving people to go deeper into the matter, to get educated, to understand the details, but more often they encounter a contrary attitude. Instead of getting involved in this debate, one of the most historic of the 21st century, many people just turn away. It is baffling to see how, on the one hand, people are ready to learn swiftly and seriously about computing and the many other technologies related to mobility and communication while, on the other hand, biology—the very subject of life itself—hardly seems interesting enough for them to study. This trend is deplorable and needs to be reversed. We need scientific communication of the highest standard, with plenty of investment. Even more, we need to be able to trust in the ability of the public to learn about, and to discuss, the difficult and complex issues involved, and the potential benefits that they confer.

53.3. The Way Out

The solution to this problem will not be easy. We must find a way to influence the various factors involved in this public debate. This will be a long and arduous process, which will need to be adapted to the problems and solutions envisaged and will also require professional moderation. It needs a ‘new approach’, which will provide a paradigm for the treatment of socio-ecological systems. In this, teaching methods and decision making must be given equal weight. The conceptual framework of this approach has five questions that correspond to five-fold knowledge. This new framework helps the individual to develop self-respect and, through a better appreciation of his/her own strengths and weaknesses, to recognise false theories (Papazova, 1986, 1991).

We shall now give an example of how to use a precautionary approach to tackle the problem. The text that follows is mainly based on the writings and thoughts of Horst Rittel and Frank West Churchman (Rittel, 1992; Verma and Churchman, 1998); however, the extensive account published within UNED should also be consulted (Hemmati, 2001).

The thesis of this section is to demonstrate that the static use of a single, generally accepted, definition of the precautionary approach (PA) will be extremely difficult. Although an important legislative tool, introduced in many important conventions with the goal of protecting biodiversity, the PA does not meet the real needs of a guiding principle. The way out of the dilemma will be a more discursive model, a model which allows for adaptation to local conditions, and which enforces solution-oriented procedures.

Discussions concerning the PA usually concentrate on definitions. PA definitions are plentiful, but they depend on the scientific and social background of their authors and they all contain elements of both truth and error. However, because there is no such thing as an ‘overall’ definition, the application of a PA always depends heavily on the context. In our view, there is no point in trying to solve problems in the application of a PA by achieving a generally accepted definition of it, since it is difficult to sharply define a principle where uncertainty is the main element. Terms and concepts such as uncertainty always depend heavily on the scientific, social, cultural and economic background of the people involved.

Problems in the application of the PA have many other roots, the two most important of which are:

1. A lack of knowledge on how the PA has been first defined and where it is coming from.
2. The debate about the PA is too closely related to factual knowledge alone.

These two problems are discussed further below, but let us first look at the most important characteristics of the PA.

53.3.1. The Roots of the Precautionary Approach and Environmental Debates

The PA was first introduced in legislation when the Convention on Biological Diversity (CBD, 1992). And, after all, in the course of the introduction of genetic engineering as a new method in biotechnology, there is a convincing example of the application of a precautionary approach: the moratorium imposed on genetic cloning as discussed and implemented at the Asilomar Conference 1975 (Berg *et al.*, 1975). At that time it was a nearly uncontested, meaningful ‘principle’, based on the facticity of a deteriorating environment: an environment which was obviously suffering from human activity of all kinds. There was air pollution, soil pollution and, in some restricted regions, alarming damage to natural forests. Heavy-metal pollution was a reality, along with dioxin contamination. Although we have to admit that, in the beginning, environmentalists were often exaggerating, this nonetheless helped to bring the issues to the debating table. However, due to this early ‘factual enhancement’, we now have a credibility gap in Europe, for example in relation to the dying-forest syndrome—whether we accept it or not, the forests just refused to die. During the 1970s, the environmental debates in Europe were derailed. We believe that this happened when activists started to mix up deontic knowledge (how things ought to be) with factual knowledge (how things actually were).

However, during the constructive period of the CBD, there can be no doubt that factual knowledge had to predominate in order to trigger decisions. It is true that some elements of the PA contained other kinds of knowledge right from the beginning, but the real nucleus of the ‘principle’ was always factual. Soon, environmentalists began to include deontic knowledge (of how things ought to be in future), and before long some instrumental knowledge was developed on how to solve the environmental problems being targeted. It was a form of peaceful debate, where everybody was optimistic about solving these problems within a few years or, at most, decades.

This complacency was jolted by Rachel Carson's *Silent Spring* (1962). This work showed us all the long-term environmental effects that could seriously harm bird life. Indeed, the shock of the disclosure of the harmful side effects of DDT even made us forget the positive aspects of this particular pesticide, namely that it saved, according to official World Health Organization statistics, the lives of hundreds of millions of people by killing the malaria-carrying mosquito *Anopheles* (see Tren and Bates, 2001). Gradually, environmentalists started to realise that ecological problems were not simple problems, which could be readily solved, and that remedies for them were going to be difficult to find.

We can still remember those difficult days of endless debates about flux, modelling, circulation ecology and interdisciplinary, or even transdisciplinary, collaboration as the best way to solve research problems and to find swift solutions to environmental problems. In the end, however, we all realised that what we called interdisciplinary or transdisciplinary research very soon degenerated into multidisciplinary structures: structures which were unavoidable, since research money was limited and had to be divided up logically.

At the very least, interdisciplinary work should have required some mutual understanding of, and eventual reaction to, what one's research partner was doing. Trans-disciplinary work, moreover, should include a planning phase in order to fix a research goal for the various groups to work towards together, with the eventual aim of producing a solution that would be the result of the amalgamation of all their research activities. This latter outcome, although very difficult to achieve, is a dream that many scientists still nurture today.

These difficulties are further complicated when we try to expand inter- or transdisciplinary work beyond the natural sciences, to include the social sciences, such as sociology, history and philosophy. This approach almost inevitably leads to the trap of statistical (and epistemological) debates and what can be termed the 'factualisation' of the research work in all the disciplines included. This is, of course, a dead end that will never lead to solutions with a broad consensus, which can become important politically.

After the last few paragraphs, the second problem mentioned previously, 'the discussion about PA is too closely related to factual knowledge alone', now seems to be a paradoxical headline. We are convinced, however, that the moment factual knowledge is treated in correct proportion to all other kinds of knowledge and analysed by means of a true systems approach, we will cut through the Gordian knot easily.

We have to realise, of course, that the problems involved in discussions about the PA are 'wicked problems' (Rittel and Weber, 1973). A 'wicked problem' is one where each attempt to create a solution *changes* the understanding of the problem. Wicked problems cannot be solved in a traditional linear fashion because the problem definition evolves as new possible solutions are considered and/or implemented. These problems always occur in a *social context*, the wickedness of the problem reflecting the diversity of the problem stakeholders. This is why it is virtually impossible to attack the problem of knowledge lacunae in a direct and linear way. It can only be solved by a discursive process, using a second-generation management strategy (for more information see Conklin, 2003). As Laurence J. Peter said, 'Some problems are so complex that you have to be highly intelligent and well informed just to be undecided about them' (Peter, 2003).

53.3.2. How Can We Move from Knowledge to Action?

Some years ago the introduction of genetically engineered crops into the environment or the handling of living modified organisms (LMOs) in international trade would have been seen as tame problems to be solved by executives in a few sessions. The plan would then have been handed over to professional PR people, and everything would have been solved within a few months. It would have just been a matter of presenting some comprehensive scientific data and the solution would have been defined almost automatically.

Unfortunately, planning problems in the field of green biotechnology have now evolved into wicked problems with complex structures and no obvious causal chains. Such problems cannot be totally determined in a quantitative and scientific way; there are no existing solutions in the sense of definitive and objective answers alone. This applies equally to the PA.

Unfortunately, wicked problems have mainly been treated in two ways: First, through formalised (linear) methods, which are only suitable for the solution of tame problems. Second, solutions have often been found empirically. Acceptable solutions can sometimes be discovered by trial and error. Gifted planners or regulators often develop good intuition when also taking into account socio-economic factors. But, unfortunately, too often the systems approach, which works well for tame problems, ends in a fiasco when tackling wicked problems.

53.3.3. First- and Second-Generation Systems Approach

Much hope has been placed in the first-generation systems approach, which certainly had its merits (for example NASA missions, toll bridges, defence systems, designing a super crop). Planning goals were 'clearly' defined and all decisions were oriented towards them.

However, in general it can be said that the first-generation systems approach has been followed by an era of disappointment, since it has not yielded what was expected of it. A number of large and complex projects such as urban renewal, improving the environment, tackling the nutrition problems of mankind, or the 'green revolution' can only be considered as failures or partial failures.

The main reason for this is the fact that the classic paradigm of (rational) science and technology is not applicable to the problems of open ecological and/or societal systems. It is very important to realise that problems in biotechnology are not solely problems of science, but also problems of society. This does not mean that risk assessment should not be science based. On the contrary, it would be a big mistake to assume that the involvement of open structures in ecology and human society would allow cheap solutions to deviate from the path of science, when it comes to questions of safety and regulation. Or, even worse, to abuse formal scientific language in order to achieve an ideological agenda, as certain members of the newly grown protest industry are doing.

Professional management tools, which are based on a second-generation systems approach, should not be mixed up with the 'future workshops' of activists groups, with their frequent and ill-considered use of pin walls for 'planning'. 'Action' of that kind has rarely led to sustainable results. All too often 'future workshops' start with a noisy brain-storming session and a lot of enthusiasm, but later on the participants go home to live their normal lives and they tend to forget about the big decisions they took earlier. If such workshops were properly carried through, following the procedures of Jungk and Müllert (1987), results would certainly be better.

We should also note the difference between management tools and 'collaborative learning workshops', which can be very enjoyable, and thus also, in the heads of the participants at least, successful. These events, however, even if they have an effect on attendees' subsequent decisions, rarely achieve sustainable results. They lack the process of collaborative decision making. It is important to avoid a misunderstanding here. In its basic structure, decision making is not a democratic process, it is a process where the people participating are genuinely involved. To be even more explicit, participants in the decision-making process should have their own genuine interest in the cause: this avoids the danger of manipulation by clever PR exponents, utilising populist or, even worse, fundamentalist arguments.

'Consensus' and citizens' conferences are extremely helpful in cases of conflicts with the public, but here again it is difficult to believe that the processes criticised will be changed for the better or negative trends be definitively turned around. Let's face the practical difficulties—how on earth can you expect a lay group to learn everything necessary for the comprehension of both the problem and the solution in a few days of intensive briefing? Another kind of internal consensus conference has been designed by the promoters of the

‘Syntegrity approach’, which brings together corporate people in order to analyse internal dynamics and processes and to discern negative effects, and seems especially appropriate in crisis management (Hagelstedt and Persson, 2000).

Despite the fact that a great deal of effort is being put into designing new planning and management methods, negative results are predominant and they continue to form part of a planning crisis stemming from the 1970s that is still continuing today.

53.3.4. What is the ‘Second-Generation Systems Approach’?

It was primarily the paradox of rationality that was severely underestimated in the first-generation systems approach. The more questions we asked, the more answers were possible, and vice versa. The limitations of technological solutions are always hidden in open ecological and social systems, for example, as in the infamous case of DDT. Constraints due to possible secondary effects in ecology should be examined carefully. This was demonstrated in the case of the Monarch larvae being killed by Bt maize pollen, the result of a highly sophisticated laboratory study where the press interpretation got way out of proportion—even though the author himself had warned about this. If the farmers had been asked, they would have been able to say that caterpillar feeding time and pollination rarely overlapped and, moreover, that the plants the Monarchs fed upon were considered as weeds by them and treated with herbicides.

In order to tackle wicked problems you need to go through an extensive process of argumentation, also called objectification, which should not be confused with an ‘objective approach’ to the problem.

There is rational planning, but there is no way to begin to be rational. One should always start a step earlier, since there are important trends and facts which will make straightforward rational thinking and acting in solving wicked problems pointless. It is not the theoretical, but rather the political component of knowledge that determines the vector of the action. This is the ‘zero step’ that is so important in the publications of Horst Rittel. It is also the basis for understanding the term ‘symmetry of ignorance’ (Rittel, 1984). As an example let us mention the fact that experts can be wrong and that farmers can know better in certain agricultural situations because, as daily practitioners, they are often better observers in the field. After all, agriculture is especially well suited to the second-generation systems approach.

The knowledge required to solve wicked planning problems cannot be found in a single person. It is absolutely essential for all the participants involved to join in the problem-solving process. This includes representatives of the general population (mainly farmers’ organisations and consumer groups), government regulators, NGOs, life-science companies and scientists. There is no monopoly of knowledge, and no single person can decide on the PA. Having illustrated the difficulties encountered in solving wicked problems, we now need to develop a new problem-solving approach in order to avoid the pitfalls of ignoring bottom-up feedback.

You can only go through a successful decision-making process if you implement the important rule that: ‘all partners in the planning process must avoid hidden agendas’. Naturally, the enforcement of this will be somewhat eased if the partners display a certain amount of respect towards each another. Nobody should be criticised for speaking up in their own interest. It is wrong, for example, to perpetuate reciprocal accusations of ‘abuse of the PA for the purposes of conducting a trade war, or to denigrate the PA to one’s own advantage in unhindered global trade.

As the difficulties involved in communicating biotechnological information grow, especially in agriculture, it is obvious that all participants in the process still have a lot of work to do. The biotechnology companies are populated by people who are convinced about the efficacy of their own products, since they have precise knowledge about safety standards and regulatory processes. This is all very good. However, these people live in a world of euphemisms and perfection, and over time they develop a lack of understanding of outside criticism. On the other hand, scientists are often naïve enough to stick to factual, instrumental and explanatory knowledge alone. Many of them miss the very important point that, as Hannah Arendt (1975) put it, 'one of the most noble tasks of scientists is to manufacture public opinion out of facts'. The regulators have to find ways and means of keeping up with the growing speed of new developments. One of the main reasons why things in Europe turn sour is the fact that European regulation is way behind that in the United States. On the other hand, this provides an excellent opportunity to see the geographical differences in regulation more clearly. Some of the NGOs have developed into powerful protest industries and are not interested in thorough scientific analysis since this could blur populist argumentation, which they need to promote in order to get more donors, who are in fact their shareholders. Meanwhile, the public often becomes lost in the fog generated by the two warring factions, and, not surprisingly, only a minority feels the need for better education on the matters under dispute.

53.3.5. How to Solve Wicked Problems in Biotechnology and the Environment

What we need in suchcases is an action-oriented approach. In developing a professional framework for decision making, risk assessment and management must both be seen as second-generation planning strategies. Strategies have to be developed to recognise the consequences of our actions, on the one hand, and to specify our knowledge, on the other. This knowledge has to be gained step by step and case by case. If we want to separate clearly our present state of knowledge (or ignorance) from inappropriate decisions not based on our views and opinions, we need to go through the following steps (Rittel, 1992):

- What is the problem?
- What do we want?
- What are the alternatives?
- How do we compare them?
- How can we reach the solution?

All participants need to keep in mind that there are various types of planning knowledge (arranged according to the five questions above). The examples that follow are lumped together as simple keyword illustrations, taken out of their real planning context. They cannot, therefore, be regarded as examples of a realistic situation, as this would be exactly the task of a second-generation planning process.

53.3.5.1. Factual Knowledge

This is the knowledge of what actually happens (quantitative data or empirical, observational data). For example: gene flow species by species or region by region; facts about insect resistance; and environmental benefits in agriculture (Ammann *et al.*, 2001; Carpenter *et al.*, 2002).

53.3.5.2. Deontic Knowledge

This is the very important knowledge of 'what *ought* to be'. For example: knowledge concerning new crops which enhance agricultural production; new agricultural techniques that avoid erosion; new biological approaches to fighting insect pests; and the segregation of European imports (Food and Agriculture Organization, 2002; Pinstrup-Andersen and Pandya-Lorcha, 2001). In 2001, more than 900 people from both the public and private sectors met in Bonn for three days to discuss goals, solutions and the actions necessary to end hunger within the next two decades.

53.3.5.3. Explanatory Knowledge

This explains why things are as they are or why certain effects happen. Here it is possible to begin to determine the correct direction of the solution.

For example: the way Bt proteins act on specific pests and/or beneficial species; what the main reasons for unwelcome erosion are; the effects/mechanisms of vertical gene flow; and the mechanisms of resistance development (Sears *et al.*, 2001).

53.3.5.4. Instrumental Knowledge

This is about how to steer certain processes, or how to achieve certain goals, and needs to be balanced against regulation and safety. For example: how to build Bt and other genes into crops and how to stabilise them there; how to avoid vertical gene flow; how to avoid unwelcome soil erosion and how to avoid the early development of pest resistance (Ammann *et al.*, 1999; Traynor and James, 1999; Trevavas, 2001).

53.3.5.5. Conceptual Knowledge

This allows us to avoid conflicts before they begin. It is compound knowledge about complex situations, which takes into account all the previous kinds of knowledge and weighs them against arguments generated by open ecological and societal systems. For example: concepts about transgenic crops compatible with the ideas of sustainable agriculture (Swaminathan, 2001).

It is necessary to go through an extensive process of argumentation, also called 'objectification', not to be mixed up with an 'objective approach' to the problem. Hopefully, the use of this process should enable us to:

- forget less;
- raise the right issues;
- look at the planning process as a sequence of events;
- stimulate doubt by raising questions;
- avoid short-sighted explicitness and
- control the delegation of judgement (experts have no absolute power; scientific knowledge is always limited).

53.3.6. There is No Scientific Planning

Solving practical problems, such as the development of sustainable transgenic crops, cannot be undertaken by the 'scientification of planning', which means that planning cannot be steered by scientific facts alone. Dealing with wicked problems is always political because of their deontic premises (which means that you always have to involve knowledge of 'what ought to be'). Science only generates factual, instrumental or, in the best cases, explanatory knowledge.

The planner (here the regulator who must take decisions concerning the PA) is not primarily an expert, but more a problem-solving 'midwife'; a teacher more than a doctor. Useful attributes are moderate optimism combined with a careful, seasoned lack of respect (casting doubt is a virtue, not a disadvantage in an action-plan manager).

The planning process for dealing with wicked problems has to be understood as an argumentative one. It should be seen as a venture (or even an *ad*venture) within a conspiratorial framework, where one cannot anticipate all the consequences of plans. Second-generation systems methods attempt to make this deliberation explicit, to support it and to find a way of making this process more powerful, while at the same time getting it under better control for all the participants.

53.4. Outlook

It is not logical, given the present state of knowledge, to attempt to predict the outcomes in genetic-engineering debates designed as above. However, there are some 'dreams' and 'hints' that can be usefully listed here.

53.4.1. Precision Biotechnology

This could lead to better designs for crop seeds in the future. Technology of such preciseness would allow for the provision of a great variety of different kinds of seeds imbued with resistance to many insect pests, on the one hand, but all having a genome specifically designed for final product quality, on the other. Genomic research offers a great future and will greatly speed up modern breeding and add considerably to its precision. It also provides the bonus of reintroducing some old concepts for getting modern agriculture closer to biodiversity again.

53.4.2. Organic Farming

In the future, organic farming needs to work in combination with modern breeding methods, including genetic engineering. In our opinion, this is not only an absolute need but also a very difficult thing to achieve, since the transgenic crops of the first generation are either not made for the strategies of organic farming or, even worse, they work against such visionary strategies. Maybe we need some newly designed products and processes, such as 'organo-transgenic crops' and 'organic precision biotechnology' (Ammann, 1999).

53.4.3. Organo-Transgenic Crops and Organic Precision Biotechnology

This vision would, of course, break up the harsh present-day debate on the PA. We would at last see the possibility of developing a balanced approach to difficult PA decisions.This would also need a balanced approach to risk assessment, including the different kinds of knowledge described above.

Under this situation we would at least have the chance to make a breakthrough in the current PA debate. Conversely, if we continue to fight about factual knowledge alone, there is little hope of solving these problems—which have an international impact and need to be treated according to the latest management insights and systems approaches.

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