The role of science and discourse in the application of the Precautionary Approach (PA)

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Ammann, K. (2004)
The Role of Science in the Application of the Precautionary Approach,. *In Molecular Farming, Plant-made Pharmaceuticals and Technical Proteins* (eds R. Fischer & S. Schillberg), Vol. 1, pp. 291-302. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim,
http://www.botanischergarten.ch/Precautionary/Ammann-Precautionary-Approach1.pdf

The thesis of this contribution is to demonstrate, that a static use of a sole, generally accepted definition of the PA will be extremely difficult, it does not meet the real needs of a "Principle" as an important legislative tool introduced in many important conventions with the goal to protect biodiversity.
The way out will be a more discursive model, a model which allows for adaptation to specific conditions and which enforces solution oriented procedures.

Let me start first with some preliminary remarks on the transatlantic divide related to GM crops:

Economic globalization has up to now not led to a convergence in the regulation of agricultural biotechnology in the European Union (EU) and the United States. While the EU has taken a precautionary approach to regulating biotech products, the U.S. has decided that these products are no different from those made using more traditional methods. Consequently, the U.S. government has implemented no novel legislation or risk assessment procedures to regulate them. These varying regulatory responses pose an interesting contrast and background for the debate on the Precautionary Approach.
It is interesting to note that agricultural biotech products were developed for highly competitive and globally integrated agri-business markets, nevertheless, biotechnology regulation has followed very different paths within the EU and the U.S.
Recently the U.S. biotechnology policy mode has shown signs of gravitating towards the EU model, with noticeable changes in the regulatory climate, hopefully also on the side of the EU (Prakash & Kollman, 2003). It will be challenging to initiate a more fruitful dialogue on the PA, since we cannot afford in the light of a difficult situation in agricultural production confronted with the urgent needs to feed a rapidly growing number of hungry people.

In other fields of the biotech debate the contrasts are even much sharper: Some NGOs like Greenpeace and Friends of the Earth are clearly abusing the PA and make out of it a weapon in their uncompromizing fight against GM crops. Patrick Moore, a former Greenpeace founder, has stated, that many environmentalists reject consensus politics and sustainable development in favour of continued confrontation, ever-increasing extremism, and left-wing politics (Moore, 2004).
On the other side, biotech companies have built up enormous activities to cope with risk assessment to a degree which makes it difficult for smaller companies to follow up. (Miller, 1996).

Discussions around the PA are usually concentrating on definitions. PA definitions are plentiful, they depend on the scientific and social background of their authors, they all are containing elements of truth and error. One of the basic problems of PA is that there is no such thing as an overall definition, the application of PA depends always heavily on the context. In my view it is of no use to solve the problems in the application of PA by achieving a generally accepted definition, since it is difficult to sharply define a principle where uncertainty is the main element. Terms and concepts like uncertainty always depend heavily on the scientific, social, cultural and economic background of people.
Problems in the application of the Precautionary Approach (PA) also have many other roots: the two most important ones are:

- The lack of knowledge of how the PA has been first defined and where it is coming from.
- The PA is too closely related to factual knowledge alone.

These two reasons also are the subtitles of the last two chapters of this contribution.

Let us have a look at the origins of the Precautionary Approach:

The roots of the precautionary approach and environmental debates
We have to realize that the PA has been first introduced in the Convention of the Biological Diversity (CBD, 1992). It was there an nearly uncontested, meaningful term, listed under Principle 15:

"In order to protect the environment, the *precautionary approach* shall be widely applied by the States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

All statements are written in the spirit, that the issue is based on facts of a deteriorating environment, an environment which obviously suffers from human activity of all kinds: There is pollution of the air, the soil, in some restricted regions even the forests suffered to a degree which was alarming. Heavy metal pollution is a reality, dioxine contamination just as well, although we have to admit that in the beginning environmentalists were exaggerating often, but it helped to bring the issue on the table. Due to the early times of exaggeration we do have a credibility gap in Europe related to the dying forest syndrome, whether we like it or not: the forests just refused to die…There was a time in the seventies where environmental debates in Europe where derailing. I think this happened when activists started to use deontic knowledge (how things ought to be) by mixing it up with factual knowledge (see below on more details on knowledge definitions).

But in the constructing period of the CBD there was no doubt that factual knowledge had to predominate in order to trigger some decisions. In the CBD paragraphs you also can clearly see a timeline: the decision had to be taken early, but on the baseline of growing hazards.

Already in the Cartagena Protocol (Montreal Protocol Biotechnology, 2000) other kinds of knowledge were debated: It focused on bracketed text allowing for review of the decision by the Party of import in the case of reasonable evidence that the decision had not been based on scientific, socio-economic, cultural or the precautionary principles. But it was Australia suggesting that exporting Parties might request review when there was reasonable evidence that the decision had not been based. Later the adoption of cultural and social issues were again deleted from the Protocol. But Article 26 has been established on grounds of all these considerations during the negociations (Cartagena Protocol on Biosafety, 2003): The draft article on socio-economic considerations proposed by the African group included taking into account the length of time before such impacts may be manifested and proposed a seven year notification period prior to export. The African group proposal contained an extensive list of

socio-economic considerations to be included in a risk assessment: anticipated changes in the existing social and economic patterns; possible threats to biological diversity, traditional crops or other products.

Finally, Article 26 was included:
1. The Parties, in reaching a decision on import under this Protocol or under its domestic measures implementing the Protocol, may take into account, consistent with their international obligations, socio-economic considerations arising from the impact of living modified organisms on the conservation and sustainable use of biological diversity, especially with regard to the value of biological diversity to indigenous and local communities.
2. The Parties are encouraged to cooperate on research and information exchange on any socio-economic impacts of living modified organisms, especially on indigenous and local communities.

Environmentalists soon brought up deontic knowledge (of how things ought to be in future), and very soon also some instrumental knowledge was developed on how to solve the environmental problems targeted. It was kind of a peaceful debate, where everybody was optimistic to solve the problems within a few years or, at the most, decades.

And then a lady with a well known name today changed all this: Rachel Carson's Silent Spring showed us, that long term effects could harm birdlife seriously: The DDT shock even made us forget the good sides of this particular pesticide, namely that it saved according to official WHO statistics hundreds of millions of peoples life by killing Anopheles (Bate, 2004; Tren & Bate, 2001)
Gradually, environmentalists started to realize that ecological problems are so called 'wicked' problems, which are not readily solved and remedy is difficult to find.

I still remember those difficult days of endless debates about flux, modelling, circulation ecology, interdisciplinary or even transdisciplinary collaboration as the best way to solve research problems and to swiftly find solutions for environmental problems. In the end we all realized that what we called interdisciplinary or even transdisciplinary research too soon just degenerated into multidisciplinary structures, structures which were unavoidable, since research money was limited and had to be divided up equitably).
Interdisciplinary work would have at least required some mutual understanding and eventual reaction to what the research partner does, and transdisciplinary work should include a planning phase in order to fix a common research goal and then try to get the necessary disciplinary groups to work together and, in the end, produce something which would be an amalgamate of all research activities – a dream I personally still nurture but today begin to understand why it is so very difficult to achieve. See also (Brier, 2000; Judge, 1995; Mitcham & Frodeman, 2003; Mittelstrass, 1994; Rittel, 1984, 1992; Rittel & Weber, 1973; Schwaninger, 2001; van Manen, 2001)

In 2003 the author has dedicated a lot of work to finish a report on the impact of agricultural biotechnology on biodiversity, it grew into a 100 pages paper with over 300 scientific citations and it can be obtained over the following link:
http://www.botanischergarten.ch/Biotech-Biodiv/Report-Biodiv-Biotech12.pdf
This report demonstrates how hugely complex the interaction between modern and traditional agriculture and biodiversity really is. There is no room for simple slogans and each case of a scientific field experiment has to be evaluated individually and with care. Please note that this report is restricted to biotechnology and biodiversity, and it does not deal with any other factors, as needed as this would be. Still, the account is complex enough.

This is all complicated further when we try to expand inter(trans)disciplinary work beyond natural sciences, including social sciences such as sociology, history, philosophy etc. When you do this you inevitably run into the trap of statistical debates and – I call it 'factualization'

of the research work of all disciplines included. This is of course a dead end and will never ever lead to solutions with a broad consensus, which will also become politically important.

The discussion about PA is too closely related to factual knowledge alone
This now seems to be a paradoxial headline after the paragraphs above. I am convinced that the moment we put factual knowledge into the proper proportion to all other kinds of knowledge and try to analyze this in a true systems approach, we will hit through the gordic knot easily.

We must realize that the problems in the discussion about the PA are ‘wicked problems’, problems with a social and cultural context.. This means automatically that linear planning will resolve nothing. This is is why it is virtually impossible tackle the problem of scientific lacunes directly, a problem intricately linked to the PA discussions.
The challenge of wicked problems is exacerbated by *social complexity*—the number and diversity of stakeholders who are part of the problem solving process. Social complexity means that the environment of a project team is populated by individuals, other project teams, and other organizations which have the power to undermine the project if their stake is not considered—if they are not at least included in the thinking and decision making process. (Conklin, 2003)

Unfortunately, also the planning problems in the field of green biotechnology have now evolved into wicked problems with complex structures and no obvious causal chains. This applies also to the PA. These problems cannot be determined totally in a quantitative and scientific way, there are no solutions existing in the sense of definitive and objective answers alone. Wicked problems have been treated mainly through formalised (linear) methods which are suitable only for the solution of tame problems.
Often solutions have been found empirically, with trial and error acceptable solutions can be found, gifted planners or regulators often develop good intuition taking into account also socio-economic factors. But deplorably, too often the linear approach working properly for tame problems ends in a fiasco when tackling wicked problems.

Systems approach of the first and second generation
Much hope has been placed in the systems approach of the first generation, which certainly had its merits (Nasa missions, toll bridges, defence systems, designing a super crop etc.). Planning goals were "clearly" defined and all decisions where oriented towards these goals.

In general it can be said that the systems approach of the first generation 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 etc. can only be considered as failures or partial failures such as the "green revolution".
The main reason 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 give cheap excuses to deviate from the path of science, when it comes to questions of safety and regulation. Or, even worse, to abuse scientific language in order to achieve an ideologically stamped agenda as certain members of the newly grown (protest or biotech) industry are doing.

Professional management tools which are based on a systems approach of the second generation should not be mixed up with "Future workshops" with their frequent and inconsiderate use of pin walls when activist groups start their "planning". Rarely those actions

have led to sustainable results, too often future-workshops (German "Zukunftswerkstätten") start with a fulminate brain storming and lots of enthusiasm and later on the participants go home to live their normal lives and they tend to forget about their big decisions taken earlier. If the workshops would be properly carried through after Müllert and Jungk, results would be certainly better.
We should also see the difference to "Collaborative Learning Workshops", which can be very delightful and thus also successful in the heads and consequently their subsequent decisions, but rarely such events achieve sustainable results either. It is exactly lacking the process of collaborative decision making. It is important to avoid a misunderstanding: Decision making is not in its basic structure a democratic process, it is a process where people genuinly involved are participating. To be even more explicit: Partners in the decision making process should have their own and genuin interest in the cause, this avoids the danger of manipulation through clever PR, through populistic and, even worse, fundamentalistic argumentation.
Consensus conferences and also citizens conferences are extremely helpful in cases of conflicts in the Public, but here again it is difficult to see that processes criticised will be changed to the better and negative trends are definitively turned around. Lets face the difficulties: How on earth can you expect a citizens group to learn about the complexity of solutions necessary within a few days of intensive briefing ?
Another kind of internal consensus conference is 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.

Despite the fact that there is a lot of effort becoming evident to design new planning and management methods negative results are predominant and are in fact part of a planning crisis, stemming from the seventies and which is still continuing today.

What is the "Systems approach of the second generation" ?
Still, it is primarily the paradox of rationality which has been severely underestimated in the systems approach of the first generation.
The more questions we are asking the more answers are possible and vice versa. Limitations of technological solutions are always hidden in the open ecological and social systems: Just compare the infamous case of DDT sprayings in the past. Constraints in possible secondary effects in ecology should be examined carefully: This is well demonstrated in the case of the Monarch larvae being killed by Bt-Mais-Pollen, the result of a highly sophisticated laboratory study where press interpretation got way out of proportion – even though the author himself warned about this. Would one have asked the farmers, they would have been able to say that feeding time do rarely overlap with pollination and that the plants the Monarchs are feeding upon are fiercly fought by them as a weed with herbicides.

In order to tackle with wicked problems you need to go through an extensive process of argumentation, also called objectification, not to be mixed up with an "objective approach" to the problem.

There is rational planning, but there is no way to start 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 useless. It is not the theory component, but rather the political component of the knowledge, which determines the vector of the action. This is the zero step so important in the publications of Horst Rittel. This is also the basis of the understanding of the term „Symmetry of Ignorance". (Fischer et al., 2002; Rittel, 1984, 1992; Rittel & Weber, 1973)
As an example: The fact, that experts can be wrong and farmers know better in certain situations in agriculture because they are better observers out in the field. After all, agriculture is especially well suited to the systems approach of the second generation.

The knowledge needed in wicked planning problems is not concentrated in a single head. It is absolutely essential to let all partners be involved in the problem solution process, which includes part of the population (mainly farmers organisations and consumer organisations), the Governmental Regulators, the Non-Governmental Organisations, the Life Science Companies and the Scientists. There is no monopoly of knowledge, no one can decide alone on the PA. Having illustrated the difficulties in solving wicked problems, we need a new approach in problem solving, in order to avoid the pitfalls of ignoring bottom up feedback's. Or, as Adam Kahane puts it: you should only let people participate who are part of the problem (oral communication 2004).

You only can keep to this rule if you are also following another important rule: All partners in the planning process have to avoid hidden agendas, which is certainly eased by a minimum amount of respect paid to eachother partner. Nobody should be criticised for speaking up in its own interest. It is wrong to perpetuate reciprocal accusations of ‘abuse of the PA for conducting a trade war’ or denigrating the PA for reasons of global unhindered trade for ones own advantage.

It is obvious in these times of growing difficulties in communicating biotech products, specially in agriculture, that all partners still have a lot of homework to do.
The Biotech Companies are populated with people who are convinced about their own products (in most cases rightly so), since they now precisely about safety standards and regulatory processes. So far so good, but these people live in a World of euphemisms and perfection, they develop with time a lack of understanding criticism from outside.
The scientists often are naïve enough to stick to factual, instrumental and explanatory knowledge alone. Many miss a very important point as Hannah Arendt put it: One of the most noble tasks of scientists is to make out of facts public opinion.
The regulators should find ways and means to cope 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 the one of the United States (and picking up in the last few years). On the other hand, this is an excellent occasion to see more clearly the geographical differences in the regulation.
Some of the big NGO's have developed into powerful protest industries and are not interested in a thorough scientific analysis, since this could blur populist argumentation, which they need to keep up in order to get more donors, which are in fact their ‘shareholders’.
The Public is often lost between the two camps and, surprisingly enough, only a minority feels the need for better education, whatever this would mean according to the two camps described above.
And what about the press? Journalists like to write stories, stories which are there to enhance the number of printed copies of their own newspaper. Consequently, they often write what the public wants to hear – and the professional science journalists, who dare to swim against mainstream, are very few, since this needs a profund knowledge, a talent for forsight and, last but not least, some courage. We should have more investigative journalism in this field.

How to Solve Wicked Problems in Biotechnology and the Environment
What we need in such cases is an action oriented approach. Risk Assessment and Management must be seen as a planning strategy of the second generation in developing a professional framework for decision making.
Strategies have to be developed to recognise the consequences of our doing on one side, and to specify our knowledge on the other side. This knowledge has to be gained step by step and case by case: If we want to clearly distinguish our present state of knowledge (or ignorance as you wish) from appropriate decisions to be made not based on our views and opinions, we need to go through the following steps.

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 5 questions asked above):
Examples given here are lumped together as simple keyword-illustrations, taken out of their context in real planning examples, they cannot be regarded as an example of a realistic situation, this would be exactly the task of a planning process of the second generation.

Factual knowledge is the knowledge of what actually happens (quantitative data or empirical, observational data).
Gene flow species by species / region by region / facts about insect resistance in agriculture.

Deontic Knowledge, the very important knowledge of what ought to be.
The knowledge about new crops which enhance agricultural production / new agricultural techniques to avoid erosion / new biological approaches to fight insect pests, imports should be segregated for Europe etc.

Explanatory Knowledge explains why things are so or why certain effects will happen. Here already you start to determine the direction of the solution.
The way Bt proteins are acting on specific pest and beneficial insects / what are the main reasons of unwelcome erosion effects / mechanisms of vertical gene flow / mechanisms of resistance development.

Instrumental knowledge on how to steer certain processes, on how to achieve certain goals, knowledge which needs to be balanced against regulation and safety.
The way how to build Bt and other genes into crops and how to stabilise them / how to avoid vertical gene flow / how to avoid unwelcome soil erosion / how to avoid early upcoming pest resistance.

Conceptual knowledge which would allow to avoid conflicts before they pop up. This is the knowledge about complex situations, taking into account all previous kinds of knowledge and also weighting them against arguments coming from open ecological and societal systems.
Concepts about transgenic crops compatible to the ideas of a sustainable agriculture. It is a matter of developing conceptual knowledge to develop visions of precision agriculture based on the best practices and based on the introduction of new techniques as well.

How to achieve such demanding planning goals ?
You need to go through an extensive process of argumentation, also called objectification, not to be mixed up with an "objective approach" to the problem. The hopes of this process are:

to forget less, to raise the right issue
to look at the planning process as a sequence of events
to stimulate doubt by raising questions, to avoid short-sighted explicitness
to control the delegation of judgement: Experts have no absolute power, scientific knowledge is always limited.

There is no scientific planning.
Solving practical problems as to develop sustainable transgenic crops cannot be dealt with by "scientification of planning". Dealing with wicked problems is always political because of

its deontic premises (means that you have to involve knowledge what ought to be). Science only generates factual, instrumental and in the best case explanatory knowledge.
The planner (here the regulator who must take decisions in PA) is not primarily an expert, but a "mid-wife of problem solving, a teacher more than a doctor. Moderate optimism and careful, seasoned respectlessness, casting doubt is a virtue, not a disadvantage of an action plan manager.
The planning process of wicked problems has to be understood as an argumentative process, it should be seen as a venture (or even adventure) within a conspirative framework, where one cannot anticipate all the consequences of plans.
Systems methods of the second generation are trying to make this deliberation explicit, to support it and to find means in order to make this process more powerful and to get it under better control for all participants.
A caveat is certainly justified here, since we are dealing not only with human beings in a discourse, but also with the environment, which has basically no voice. (Rogers, 1998).
Finally its justified to place a word on the abuse of the PA, so clearly visible in many cases of the GM debate: A blatant example is the case of US aid to states of Southern Africa, which have suffered in 2000 and 2001 from severe food shortages resulting in an estimated 14 million people facing starvation due to inadequate quantities of the staple maize. With the delivery of thousands of tons of transgenic maize without additional information in the first place (later the information gap was duly filled), many of those states where pushed into a dilemma, which was also worsened by some big NGO's with a vested interest in campaigning against GM crops even in this obvious case of desperately needed humanitarian help. Whereas Zambia flatly refused to accept the GM maize, Malavi accepted in face of severe public health challenges the desperately needed staple food, but is also calling for a better dialogue between the donors and the developing countries (Muula & Mfutso-Bengo, 2003).

Outlook
It is beyond logic and present day knowledge to predict some surprising outcomes in genetic engineering debates designed as above. Still there are some dreams and hints, which should be placed at the end of this contribution:

"Precision Biotechnology" could lead to a better design of crop seeds in future. Precision biotechnology would mean that a bag of seeds contains a great variety of different kinds of seeds related to resistance against many pest insects on one side, but all having a precisely designed genome for the product quality to be sold after harvest. Genomic research offers a great future and will greatly speed up modern breeding and add considerably to its precision. Here we also find the key of reintroducing some old concepts of getting modern agriculture closer to biodiversity again.

Organic farming needs in future go together with modern breeding methods including genetic engineering. This is in the eyes of the authors 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 which will fit to terms like

Organo- Transgenic Crops and Organic Precision Biotechnology ?

This vision would of course break up the present day harsh debate on the PA, we would at last have the possibility to develop a balanced approach to difficult PA decisions, which needs as a basis a balanced approach to risk assessment, including different kinds of knowledge just as described above.

For a more balanced view on risk

Under these auspices we will have at least a chance to make a breakthrough in the presentday PA debate – but if we continue to fight about factual knowledge alone, little hope I can envisage to solve these problems, problems which have an international impact and need to be treated according to the latest insights in management and the systems approach.

If we really want to make progress, we have to abstain to the western model of risk, which is always calculated on a formula with an intriquing logic: *Risk is hazard times probability.*

But a lot of people do not realize, that this leaves the evaluation completely on the negative side.The worst effect of the overestimation of the PA promoted as a Principle is its absolute focus on the negative aspects of biotech. has been summarized in (Miller & Conco, 2000) Elizabeth M. Whelan, president of the American Council on Science and Health, aptly sums up the shortcomings of the precautionary principle in (Miller & Conco, 2000):

- First, it always assumes worst-case scenarios.
- Second, it distracts consumers and policy makers alike from the known and proven threats to human health.
- And third, it assumes no health detriment from the proposed regulations and restrictions. By that I mean that the precautionary principle overlooks the possibility that real public health risks can be associated with [expending resources on] eliminating minuscule, hypothetical risks.

This is why we should all avocate the Chinese model on Risk, which sums up in the pictogram of risk two elements, namely hazard and chance.

With the discoursive approach, following the systems approach of (Rittel, 1992) and his long time companion Frank West Churchman, see (Verma, 1998), we have a chance to work in the complex environment to evaluate risk against chance with professional methods.

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