Gene Technology and Developing Countries

Swiss Ethics Committee on
Non-Human Gene Technology
(ECNH)

A contribution to the discussion
from an ethical perspective

1 Introduction

Swiss Ethics Committee on Non-human Biotechnology

The Swiss Ethics Committee on Non-Human Biotechnology (ECNH) monitors the effects of non-human biotechnology and gene technology and advises the Federal Council and authorities on ethical matters related to legislation and enforcement. It can also independently address topics of ethical relevance. The ECNH is also responsible for informing the public about the issues it deals with, and promoting public debate on the benefits and risks of non-human biotechnology and gene technology. The Committee was appointed by the Federal Council on 27 April 1998.

While supporters of gene technology welcome its promotion as a means of fighting hunger in developing and newly industrialised countries, detractors warn against the negative consequences of this technology in such countries. Both camps regard themselves as advocates of people in the "South".

For the purposes of this document, the term "developing and newly industrialised countries" refers to the poor countries of the "South," which differ not only from the industrialised countries of the "North" but also from each other in terms of the level of economic, social and technological development. Not all countries and regions are equally affected by poverty, hunger and malnutrition. Developing and newly industrialised countries range from important agricultural producers (such as Argentina) and countries (such as several in Central America) rich in genetic resources, to countries (particularly on the African continent) with extremely limited resources. Conditions vary widely, not only from country to country but also from region to region within the individual countries.

By launching a discussion on the implications of gene technology for developing and newly industrialised countries, the ECNH aims to throw light on what it views as the central ethical aspects of this complex topic, and to contribute to shaping Swiss policy from an ethical standpoint. The ECNH is aware that its contribution to the discussion does not cover the full complex range of the effects which gene technology may have on developing and newly industrialised countries. An assessment of these effects is largely dependent on the context in which GM plants are cultivated: climatic and ecological conditions; water supplies; infrastructure; economic, political and social factors; and not least the status of regulations governing biotechnology in the relevant country. Among developing and newly industrialised countries, these factors vary strongly from one country to another. In this context the role of the ECNH is to examine what it views as the underlying ethical values, as a basis for assessing the implications of gene technology. These fundamental values are universally valid throughout countries in the South as well as in the North. However, in this document the ECNH focuses on the discussion and evaluation of the arguments which are of most relevance to developing and newly industrialised countries.

The first part provides a brief outline of the discussion basis, with current

statistics on agricultural applications of genetically modified organisms (GMOs), and outlines the most important boundary conditions for the political context of the discussion. Using this as a basis, the discussion examines the question of fairness or justice, i.e. the obligations which citizens of the "North" have towards people and countries in the "South". Following on from deliberations on justice, the third chapter examines and discusses the ethical aspects. In the following chapter, the ECNH assesses the situation and outlook for the future, and makes recommendations. The last chapter formulates some general recommendations which are relevant across all aspects.

In view of the diversity of the topic, special attention was accorded to the involvement in internal discussions of experts, who placed themselves at the disposal of the ECNH as speakers and discussion partners. Special thanks go to Katharina Jenny (Swiss Agency for Development and Cooperation SDC) and Matthias Meyer (State Secretariat for Economic Affairs seco) for their support and willingness to share their knowledge. The ECNH would also like to thank Jørgen Schlundt (World Health Organization WHO), Hansjürg Ambühl (SCD) and François Pythoud (Swiss Agency for the Environment, Forests and Landscape SAEFL) for their valuable input and contributions to the discussion.

2 Background

2.1 Increase in commercial GMO applications

Since 1996 there has been a massive increase in the commercial application of GM plants. Even if the original expectations of the economic productivity of these plants have not yet been fulfilled, a marked rise has been observed in acreage of GM crops around the world. In 2003, GM crops were grown on more than 65 million hectares in 18 different countries. To date, genetically produced characteristics have focused on resistance to herbicide and pests, while other GM characteristics have been accorded virtually no economic relevance.

Some 7 million farmers, including a large number of resource-poor smallholders, were involved in the cultivation of GM plants in 2003. Of these, only about one-third are cultivated in the South (primarily in Argentina, Brazil and China but also in South Africa and India). The USA and Canada account for most of the remaining two-thirds. Only a few products – soy, maize, cotton and rapeseed oil – are traded on a large scale as GMOs. GM soybeans account for 51% of the global market, maize for 9%, cotton 20% and rapeseed 12%. With the exception of maize, which is a staple food in eastern and southern Africa, these plants play a subordinate role in the diet of people in developing countries. In industrialised countries, most GM soy and GM maize crops are used as animal fodder.

The situation with regard to green gene technology is slightly different in China, where – in contrast to other countries – gene technology research into plant cultivation is exclusively funded by the state. Here the range of GM plants is broader: in addition to GM cotton, which now accounts for more than half of the Chinese cotton harvest, GM tomatoes and green paprika are cultivated. Well-advanced field trials are also being conducted on chillies, Chinese cabbage, melons, maize, papaya, potatoes and rice.

Green gene technology

Gene technology covers methods for the artificial isolation, propagation, characterisation, modification or recombination of genes or parts of genes of different origins. In the medical and pharamaceutical fields, specific manufacturing and application procedures are now in widespread use. Other areas in which gene technology is applied include agriculture, food production and environmental technology. This brochure focuses on the application of gene technology in the cultivation of agricultural plants: so-called "green gene technology".

Cotton

Cotton is primarily grown for the seed capsules, which are used to obtain cotton fibres (lint) as the raw material for textiles, and seed kernels for the production of cottonseed oil for human consumption. The capsule hulls are used for animal fodder and bedding, or fuel. In 2003, cotton was grown on 32 million hectares in industrialised countries around the world as well as in 71 developing and newly-industrialised countries. 66% of the 57 million tonnes of seed capsules was harvested by these countries.

World-wide cultivation of Bt-cotton

Bt-cotton is a genetically engineered cotton with an inserted gene from the soil bacteria *Bacillus thuringiensis (Bt)*. This makes the plant highly resistant to common pests (particularly the butterfly caterpillar) which destroy seed capsules, and helps to reduce requirements for chemical or biological pesticides. In 2003, GM cotton was planted on 7.2 million hectares in 9 different countries. This corresponds to 49% of the total cotton cultivation area in industrialised countries, and 12% in developing countries.

Bt-cotton in India

As in many other developing and newly-industrialised countries, a Bt-cotton variety developed by Monsanto in the USA was crossed with locally adapted varieties in India. In 2002, following field trials, three Bt-cultivars of this type were released for cultivation in southern and central India. Since 2003, 7 additional cultivars have been developed, of which several have already been granted a 3-year permit for commercial farming in the South and field trials in the North. In addition to these private-sector developments, the Indian Council of Agricultural Research (ICAR) initiated a public research network at the end of 2003 with a view to developing transgenic properties in 12 crop plants. These activities include risk research and monitoring of associated crops.

While Bt-cotton was planted on only 1.5% of the entire cotton-growing acreage in 2003, the cultivation of certified varieties has been accompanied by a trend towards extensive, uncontrolled farming of cheaper, uncertified Bt-cotton varieties. For small farmers with limited resources, growing certified Bt-cotton entails an inherent economic and financial risk. These varieties are highly sensitive to growing conditions, and unless these demanding conditions are met, small farmers cannot offset the high price they paid for seeds against poorer quality and still achieve a profit through higher yields. If , however, unforeseen events arise such as drought, blight arising from other pests, or plant diseases, they need to spend even more in the bid to ensure a profitable harvest. The economic risk of Bt-farming is only acceptable if the location-dependent variability of the crop can be reduced through irrigation and if harvest yields can be stabilised at a higher level.

Monsanto Bt-plants are also crossed with local varieties as a basis for cheaper, uncertified seeds. This cross-cultivation has spread through propagation and barter trading, and has been crossed with other varieties, resulting last year in the emergence of at least a dozen new illegal hybrids.

Harvest yields and quality

According to a report published by the Central Cotton Research Institute (CCRI) in spring 2002, the first approved varieties exhibited good resistance to all the main pests. Compared to local varieties, however, they were more vulnerable to locusts and increased stress such as drought or plant disease. Yield statistics are generally the subject of controversial discussion. Unlike the approved Bt-varieties, uncertified Bt-varieties have lower ecological requirements and produce good yields even under unfavourable environmental conditions.

Evaluation of further developments

The Bt-cotton varieties developed in India appear to be spreading rapidly and, to some extent, out of control. Some varieties are expected to offer local advantages. However, deficient management of the risks inherent in illegal farming i.e. the potential development of Bt-resistant pests, could bring development to a halt and also endanger non-GM cotton farming, since Bt-toxins are commonly sprayed on crops as a pesticide. Moreover, the uncontrolled spread of transgenic varieties entails the risk that farmers will lose their freedom of choice.

2.2 Political context

A range of international obligations determine the political context of the discussion on the effects of gene technology on developing countries. Controversies related to aid shipments of GM foods in disaster regions are also influencing political and public debate. The following section discusses the Cartagena Protocol on Biosafety, the agreement on Trade Related Aspects of Intellectual Property (TRIPS) and the World Trade Organization's "Agricultural Dossier" as well as current examples of aid shipments for disaster relief.

2.2.1 Cartagena Protocol on Biosafety

Agenda 21, adopted in 1992 at the United Nations Conference on Environment and Development in Rio de Janeiro, saw in modern gene technology the potential to increase agrarian production, improve food security and contribute to the development of environmental technologies. However, at the same time as GM crops began to gain a foothold on the global market, the use and consumption of GM products was increasingly being criticised in view of the possible long-term effects on health and the environment. Consequently, most countries (including Switzerland) formulated regulations governing the handling of GMOs and, in particular, introduced strict permit procedures regarding the use of GMOs in the environment.

As many industrialised countries began to adopt legal regulations, developing countries became concerned that projects for the release of GMOs into the environment would be shifted to their region, since they had no suitable mechanisms of their own to assess or safeguard against the effects. Moreover, both developing and industrialised countries worried that the spread of GMOs could become uncontrollable as they gradually took over a larger share of the global market. In this context, the fact that most developing countries traditionally use part of the harvest for seeding is of key importance.

Against this backdrop, a protocol on biosafety was drawn up as a supplementary agreement to the Convention on Biological Diversity. The protocol was adopted on 29 January 2000, ratified by Switzerland on 26 March 2002, and came into force on 11 September 2003. The protocol governs the transboundary movement of GMOs with the aim of ensuring the safe transfer, handling and use of GMOs that may have adverse effects on biodiversity. The following requirements are central elements of the protocol: GMOs can be imported only by prior approval and if the affected State is in possession of the facts. Such GM imports must be accompanied by appropriate documentation. Access to institutionalised national GMO information centres – *Biosafety Clearing Houses* – must be guaranteed. The protocol is being implemented in Switzerland under national law in the course of 2004, and the requisite structures are being set up.

2.2.2 Convention on Trade Related Aspects of Intellectual Property Rights (TRIPS)

The convention of 15 April 1994 on TRIPS *(Trade Related Aspects of Intellectual Property Rights)* was drawn up in conjunction with the World Trade Organization (WTO) and, together with the conventions on goods and services, forms one of the three WTO pillars whereby members of the organisation undertake to observe relatively rigorous minimum requirements governing the protection of plant species. Such protection must be guaranteed either through patent protection or a functioning *sui generis* system, or a combination of both. Signatory states are free to choose the system; the sole requirement is the effectiveness of the system for plant species protection. The convention must be implemented by all WTO member states, including Switzerland, by 2006.

There are several major international agreements on crops which include regulations governing patents and the rights of farmers and indigenous populations, but the TRIPS convention plays a pivotal role. Before its introduction, countries were free to decide whether and in what form they wished to grant patent protection for agricultural products. While the USA permitted the patenting of plants and European countries developed an alternative means of protecting plant species in the form of a law on the protection of plant varieties, most developing countries opted not to grant protection in this area. The TRIPS convention obliges all member states to introduce a mechanism for protecting plant varieties either by means of patent protection or *sui generis* protection.

2.2.3 The WTO "Agricultural Dossier"

Nowadays, even among developing countries, there is no such a thing as a self-sufficient national economy that operates independently of the global market. Changing trends on the world market, such as those currently observed in the production of cotton, sugar and cooking oils, have a major impact on developing countries. Whereas these products were formerly grown primarily by developing countries, now, as a result of state subsidies, they are increasingly being cultivated in industrialised countries. This puts developing countries at a disadvantage, since it forces them to compete with subsidised produce on the global market. Against this backdrop, therefore, it is necessary to discuss the effects of a protectionist approach to Swiss agricultural policy, as reflected for example in the country's export subsidies.

2.2.4 Food aid in disaster regions

During the crisis in southern Africa in 2003, the governments of Zambia and Zimbabwe refused GM food aid shipments. Their refusal may have been prompted by a wide range of factors. It was argued that such GM shipments could entail health risks or adverse effects on biodiversity, since there was no way of excluding the possibility of shipped grain being used as seed. At present, these countries have neither adequate control mechanisms nor the technical facilities to test GM shipments themselves. Such self-testing is necessary since these countries differ from donor countries not only in ecological terms, but also due to their specific food situation e.g. widespread malnutrition and food scarcity. The effects of a diet consisting mainly or exclusively of GM food may differ from the effects of consuming GM food in an environment where a variety of foods is available.

Moreover, the attitude of African countries may also have been influenced by fear of losing their share of the European market if their own exports are no longer GMO-free. The refusal to accept GM aid shipments could also have been an expression of the trade conflict between the EU and the USA. GM supporters and opponents in countries of the North have criticised each others' views. Donor countries which supplied the GM foods accused the EU of obstructing the opening of the African market for green gene technology through their negative attitude, as well as causing unnecessary uncertainty among African states and thereby being instrumental in depriving many people of food. In turn, the states which provided GM food aid were, by providing aid in kind rather than monetary aid, accused of fobbing off needy countries with GM products which are difficult to sell on the world market, thereby illicitly offloading national surpluses and forcing countries in need to rely on GMO imports.

In another case reported by the media, non-governmental organisations in 15 African countries accused the UN World Food Programme (WFP) and the American government aid organisation USAid of illicitly exerting pressure. Sudan and Angola, where millions are suffering from hunger, were faced with the choice of accepting GM food or doing without aid shipments altogether. The Angolan government was also reportedly asked to either revoke its requirement for GM maize to be milled before delivery, or to accept curtailments in aid. Angola believes that milling GM maize is necessary in order to prevent it being used as seed. The same approach is enshrined in a law approved in 2003 by the US Senate, which renders financial aid for the fight against AIDS dependent on the acceptance of GM foods by the beneficiary country.

Governmental and non-governmental aid agencies face additional difficulties in this sensitive area. While GM food is readily available for immediate shipment as aid in kind, GM-free foods are becoming increasingly scarce and hence more expensive on the world market. The heat treatment that is frequently required, or the milling of GM grain shipments to prevent their use as seed, add to the cost.

With this in mind and in keeping with the WFP, Switzerland is aiming to respect the sovereignty of individual states and to offer GM food aid only if the recipient country has given its informed consent. Countries without regulatory mechanisms will receive GM-free food aid. Switzerland makes additional funds available for the milling of GM foods. It also supports the WFP in its efforts to promote analysing capacities in recipient countries so as to enable them to test GMOs independently on a context-specific basis. Additionally, efforts to provide monetary aid rather than aid in kind are welcomed. Since food crises are generally caused by distribution problems and sufficient food is often available in the region, purchasing aid shipments locally can boost the local market and prevent future disasters.

3 A question of global justice

3.1 Background

At present, almost half of the world's population is living below the poverty line defined by the World Bank. More than 1.2 billion people are forced to survive on half of this minimum. Every year, some 18 million people die from the consequences of poverty. Around the world, there is a glaring discrepancy between the demands arising from the entitlement to justice and equality on the one hand, and actual conditions on the other. People are treated with hugely disparate degrees of respect, and there is a marked inequality in their income. For the vast majority of the world's population, the opportunity to enjoy the conditions required to live in dignity remains a pipe dream.

By entering into obligations vis-à-vis countries in the South within the framework of the above-named international agreements, Switzerland guarantees the citizens of such countries a certain degree of protection. From an ethical standpoint, such obligations are a commitment to justice.

3.2 The dimensions of justice

As an ethical concept, justice plays a critical role in interpersonal relations as well as in society and politics. At the social and political level, justice governs not the actions of individuals, but the structure of institutions and the standards observed by them. A political or social order is therefore regarded as fair and just if it treats each of its members in accordance with his or her rights, needs and merits.

As a political concept, justice covers several levels. A central aspect of any just community is the granting and effective enforcement of basic rights. But the way in which a society's material and non-material goods are distributed also determines whether it is just. Moreover, justice – in the sense of procedural justice – requires individuals to participate in the social consensus-building and decision-making processes.

All three dimensions of justice are inseparably linked to equality. People who are in essentially the same situation must be treated as equals, and people in essentially different situations must be treated differently. This rule may be broken only if justified by the facts. Equality is also a key factor in the distribution of social goods. In the current discussion on ethics, opinions are divided as to whether an unequal distribution of social goods is unacceptable *per se*. There is, however, consensus on one point: One essential criterion for human existence and evolution is that basic human needs such as shelter, food and clothing must be met. There is universal agreement on the individual's needs at this fundamental level, despite major differences on other aspects. The discussion on equality focuses in particular on the question of how comprehensive the rights of the individual are: The greater the gap between the poor and the rich, the more a life in poverty is regarded as a violation of the right to dignity.

A community is regarded as just if it respects the special nature and uniqueness of every person and treats him or her accordingly. Every member of a community must be granted equal opportunities to live a life in dignity, occupy an acceptable position within the society, and participate in processes that build the political will.

The question of justice becomes particularly controversial when it comes to defining the right of the individual to have a share in social goods. Because, at the community level, the moral or legal right of the individual becomes a

moral or legal obligation to serve. And for the community to meet this obligation, it must demand an appropriate contribution from the wealthy.

Consequently, for many years social rights were accused of not being genuine rights since they failed to bestow any directly enforceable entitlements on the individual. Nowadays, however, social rights are enshrined in Swiss national law as well as under international law, and have a normative impact at various different levels. On an initial level, they grant a hard core of minimum rights which are essential to ensuring the dignity of human existence. Moreover, within their defined scope, they protect individuals against discrimination and allow the community to fall below an achieved standard only under restrictive conditions. At this level, social rights can be directly claimed and enforced by the individual. On a second level, they are geared to state organs but do not grant the individual a directly enforceable right. They oblige the courts and administrative authorities to formulate the laws enforced by them as far as possible in keeping with fundamental social rights. Legislators are under an obligation at all times to implement, at the legal level, social rights beyond their status as minimum guarantees.

There is no order of rank between rights to defend against attack on the one hand and social rights on the other. Admittedly, ensuring the minimum material resources is a prerequisite for allowing individuals to exercise their right to freedom of opinion or religious freedom. But the ability to communicate with others is also essential to human psychological and spiritual development, and the associated right to freedom of opinion is just as fundamental. Since negative rights to defend oneself against attack and positive rights to service and protection are mutually dependent, they can no longer be separated under contemporary rules of law.

3.3 The effects of gene technology as a matter of global justice

All technological applications must be examined from the standpoint of justice. This brochure is primarily interested in examining ways of assessing, from the standpoint of justice, the effects of gene technology on developing and newly industrialised countries. A key factor in this context is the manner in which the use of such technologies impacts the extent to which the following four fundamental rights are upheld:

1 The basic right to life and personal integrity imply a moral **right to food,** i.e. **access to an adequate, healthy diet through food security**.

   An ethical evaluation of gene technology must assess the opportunities and risks posed by gene technology for food security. This evaluation must be made based on available data and careful estimates.

2 The principle of human dignity implies the right to self-determination (autonomy). This includes the concept of **food sovereignty**. At the level of the individual, food sovereignty refers to the freedom of the individual to make his or her own decision on how he or she wishes to be nourished. On a collective level, sovereignty is about the right of countries to decide, on their own, how they wish to govern trade in agricultural produce i.e. access to markets. Moreover, this collective level also implies the moral right of communities to feed themselves in accordance with their own traditions and cultures.

   An additional aspect of food sovereignty is the right of developing and newly industrialised countries to participate on an equal footing in the legal integration of gene technology at the international level. The structures whereby the associated international agreements are negotiated must also be measured by whether or not they permit developing and newly-industrialised countries to have an equal say with economically dominant nations. Although this does not pose any specific problem in terms of international regulations on gene technology, such agreements bring the situation into sharp focus.

   In view, in particular, of the ongoing obstacles to the participation of developing and newly industrialised countries in the international legislative process, it is essential to conduct a normative evaluation of the underlying systems in this process. Regu-

lations governing the protection of intellectual property or investments, provisions governing the restriction and opening of international trade, or agreements on the use of natural resources must therefore be measured according to the criteria of justice.

3 The concept of justice also means ensuring that future generations enjoy the same life opportunities as are currently in place. To this end there is a moral **obligation to provide a sustainable lifestyle**. The protection of biodiversity constitutes an integral part of this obligation.

To obtain a meaningful evaluation of the effects of gene technology on developing and newly-industrialised countries, it is necessary to determine, on the basis of available experience, whether the use of gene technology poses a risk to biodiversity.

4 Finally, the **right to social peace** is incontestably an essential requirement for food security, food sovereignty and the long-term securing of natural resources.

At the national as well as international level, the willingness and ability of parties to resolve conflicts peacefully is an essential criterion in any legal system. This willingness is, in turn, dependent on the existence of fair rules governing co-existence. Peaceful co-existence can be threatened by serious violations of elementary basic rights and gross economic inequality. In the international context, therefore, a normative evaluation of gene technology must also focus on the objective of peace security.

4 Concrete ethical deliberations on gene technology and developing countries

Against the backdrop of the current discussion on the effects of gene technology on developing and newly-industrialised countries, the ECNH focuses on individual, ethically relevant aspects in the following four sections. The same methodology is used to address each aspect: A description of a specific problem area is followed by an outline of the key fundamental value for the purposes of ethical evaluation. The arguments discussed by the ECNH are then further discussed and illustrated by means of examples. These arguments are then evaluated and specific recommendations are formulated for each aspect.

4.1 Food security

4.1.1 Problem: lack of access to sufficient sources of healthy nutrition

According to a report published by the UN Food and Agriculture Organization (FAO), 842 million people around the world are chronically hungry. By far the greatest number – 798 million – live in so-called developing countries, and 34 million in newly-industrialised countries. It is generally agreed that various factors (e.g. continued rise in population and climate change, which have an adverse effect on food production and particularly on crop farming) will render the problem of malnutrition even more acute over the next few years. The FAO Report on the State of Food and Agriculture 2003/2004 estimates that an additional 2 billion people will have to be fed over the next 30 years. This situation is exacerbated by an increasingly fragile pool of natural resources. Moreover, the demand for grain is rising in order to meet the equally sharp rise in demand for animal feed for the meat production industry.

To ensure that the right to sufficient sources of healthy nutrition is granted to all, every means of bringing the world closer to this objective must be investigated. In concrete terms, this means examining the contribution which gene technology can make to food security. This is an empirical question, the answer to which is of major importance for an ethical evaluation.

4.1.2 Fundamental value: food security

The fundamental value of food security provides the basis for the right to sufficient food as well as the right to a nutritious, healthy diet. Since people in the North generally have enough to eat, more emphasis is accorded to health aspects or the nutritional quality of food. In many developing countries, the main objective is to gain access to sufficient volumes of food to ensure even short-term survival. As a result, health and quality aspects are necessarily accorded less priority. However, both elements are equally important everywhere in the bid to ensure food security.

Food security can be achieved not only by domestic food production; it can also be achieved indirectly through income, by means of which people have the possibility to buy food. It is therefore important to ensure that the discussion on food security does not focus solely on ways of promoting agricultural self-sufficiency.

4.1.3 Arguments on the effects of gene technology on food security

a The potential of gene technology

Gene technology can be used to transfer selected genes from one organism to another, allowing unrelated organisms to be combined in ways which do not occur naturally. Applied to agricultural crops, gene technology can open up new opportunities which conventional cultivation and farming methods are unable to offer.

For example, gene technology could be used to accelerate conventional cultivation programmes. It can help to create plants which are resistant to disease and pests, thus doing away with the need for toxic chemicals which are harmful to human health and the environment. The quality of basic foods could be improved, for example by enriching crops with nutrients and raising their nutritional content. Chronic malnutrition could be alleviated and human health improved. Added to this, developments in gene technology could help to create drought- or salt-resistant plants which could increase production levels in regions where the arable land is poor due to climatic or ecological factors.

Drought- and salt-tolerant plants

Plants which can tolerate water scarcity or higher concentrations of salt adopt a number of adaptive strategies: They have deep roots; their above-ground parts are protected by a thin layer of wax; they close their stomata on the underleaf even during the day, to reduce condensation; they store water in their tissue, etc. Plants with a high salt tolerance can increase the salt content in cells to maintain an equilibrium between internal and external salt concentration. Alternatively, plants discharge salt through special glands. As a rule, the stress tolerance of plants is based on interactions within a network of different genes.

Research into transgenic drought- and salt-tolerant plants

Most research to date has been conducted on individual components of complex attributes. A few examples:

– **Osmoprotectors:** These are proteins with osmotic attributes that protect the plant from drying out. A number of trials have shown that transgenic plants with a gene for producing an osmoprotector exhibit a higher tolerance to drought or salt.
– **Protection factors for macromolecules:** Proteins formed, for example, under heat stress, protect large plant molecules against drying out. The transgenic transfer of such a protein raises the tolerance of rice to drought and salt.
– **Cell membrane proteins:** Proteins in the cell membrane regulate the pressure of water on plant cells. In tomatoes, the expression of such a protein can be transgenically increased to achieve a higher salt tolerance. While the salt concentration remains low in the fruit, the transgenic plant stores the salt in the cell vacuoles of the leaves. Contrary to the widespread belief that stress tolerance can only be achieved in plants by changing several characteristics, a high level of salt tolerance is achieved in this case by modifying a single attribute.
– **Detoxification** enzymes: In plant cells, excessive heat, or lack of water result in the production of toxic reactive oxygen combinations. Various enzymes play a part in eliminating this toxin. Field trials with transgenic cotton plants which produce such enzymes demonstrated that such plants have significantly higher yields in dry locations than conventional plants.
– **Transcription factors:** Transcription factors help to regulate DNA. Approximately 20 mutations for such heat stress transcription factors have been found in tomatoes. This means that the answer to harmful environmental effects is to be found in an extraordinarily sophisticated regulatory mechanism which requires higher-level coordination.

Research into drought- and salt-tolerant plants without gene technology

– According to the **register of varieties** for drought- and salt-tolerant rice strains, the small Indian state of West Bengal alone has recorded 78 varieties which have been modified

to cope with arid conditions. Salt-tolerant rice varieties are also grown in many regions of India.

– On examining a Thai **seed bank** containing some 7000 indigenous varieties of rice, scientists at the National Centre for Gene Technology Research in Bangkok found four varieties that can survive in salty seawater. These are being further analysed.
– In 2001 the South African Ministry of Agriculture authorised the use of a new **variety of maize** which produces up to 50% more yield than the traditional varieties farmed by smallholders in South Africa. This variety of maize is on sale commercially.
– In Australia, a **variety of wheat with high water efficiency** has been cultivated. The variety is extremely resistant to all the main grain diseases and produces a high-quality harvest. This variety is also on sale commercially.
– The *International Crops Research Institute for the Semi-Arid Tropics* (ICRISAT) in India has grown chickpea varieties which mature in only 85-100 days. The **shorter maturing time** ensures that crops are harvested before the annual Indian drought at the end of the growing season.

Evaluation of further developments

Drought- and salt-tolerance are complex properties in plants, involving a number of different genes. While transgenic drought- and salt-tolerant plants have already been developed with the aid of gene technology, they are not yet being commercially farmed. Only a few transgenic plants have been tested in field trials. Most trial data are based on greenhouse tests. Stress-tolerant GM plants are not expected to reach the application stage for another five to ten years. Given the current monogenetic approach, opinions are divided on the contributions which gene technology can make to the development of drought- and salt-tolerant plants.

Even with classical cultivation techniques, it is difficult to modify individual plant properties. Nevertheless, several commercial permits have already been issued as a result of using new cultivation methods on locally modified varieties. The genetically complex properties of drought- and salt-tolerance can probably be more successfully achieved by methods based on classical cultivation techniques.

The view that gene technology can help to increase the production of basic foods and thereby play a key role in the fight against hunger and malnutrition is of major importance. This would be of particular relevance for small farmers in developing countries. Higher yields mean higher income and a better food situation.

b Complex causes of hunger and malnutrition

Hunger and malnutrition are not merely a question of deficiencies in food production; they are caused by a variety of factors. In August 2003 the FAO listed 38 countries which are dependent on food aid: 23 in Africa, 8 in Asia, 5 in Latin America and 2 in Europe. According to the FAO report, the food crises in many of these countries were closely linked to the AIDS epidemic and the associated lack of manpower for the production, processing and distribution of food. Other causes of human origin were also important crisis factors: Civil war or refugee movements within and between countries were responsible for 50% of registered food emergencies in Africa and in both the European countries. Between 1992 and 2003, political conflicts and economic problems were the cause behind one-third of all food crises. In Central America, the international price war in the coffee industry has been posing a threat to food security over the past few years.

In addition to specific regional or national factors such as climate and the availability of raw materials, general political, economic and social conditions play an important role in determining whether or not people have access to sufficient food and a healthy diet.

c Differences between the green revolution and the "gene revolution"

The contribution made by gene technology to reducing hunger is often compared with the contribution made by the "green revolution", and is referred to as the "gene revolution". Last century the green revolution brought about a dramatic rise in agricultural production as a result of developments in agricultural technology.

By the same token, hopes are being pinned on gene technology as a means of triggering another development drive: High-yield varieties, plant products with new attributes, and plants modified to survive in unfavourable climatic or ecological conditions could at least contribute to the reduction of hunger and malnutrition.

Nevertheless, it should be noted that green gene technology differs from the green revolution in various ways. International research programmes conducted by public research institutes and organisations such as the *Consultative Group on International Research* (CGIAR) played an important role in the green revolution. By contrast, GM products currently emerging on the market are primarily the result of privately-funded research conducted by a handful of seed companies. Privately-funded research has a different agenda to the one followed by public research. Accordingly, in contrast to the green revolution, scarcely any developing country has yet benefited from a direct technology transfer. The fact that the success of a new technology depends on its compatibility with local conditions is still accorded too little importance in green gene technology.

Public organisations and local research institutes are also active in a number of gene technology projects. These research activities focus on crops such as papaya, rice, bananas and cassava, which are of relevance to developing countries, are better suited to local conditions, and are capable of growing in arid conditions and have a high nutritional value. But none of these gene technology projects is commercially relevant as yet, and developments of potential products still have some way to go.

d The potential of alternative solutions

In 1998 Abdul Kalam, a scientist and the then President of India, presented his vision of India up to the year 2020 and came to the sobering conclusion that the main advantages of biotechnology were in the processing industry. He believed that the impact of gene technology on food security was negligible. Six years later, his views may have changed, but the argument that other measures are much more relevant for food security, i.e. measures that help to reduce massive harvest losses due to the lack of storage facilities in some regions, still holds weight.

Other studies of development projects in the South also conclude that an agricultural industry that follows the rules of biological or integrated production can bring about a dramatic increase in yield or calories per surface unit, and achieve diversity in food production. According to the findings of a major study by Jules Pretty and Rachel Hine, covering 208 programmes followed by 9 million farmers in 52 countries in Africa, Asia and Latin America, a substantial rise in yield per hectare can be achieved by switching to this type of farming. Increases of 5–30% have been achieved for irrigated rice, 100% for millet, and 20–200% for maize. Polyculture e.g. irrigated rice and fish in rice fields bordered by vegetables and fruit trees, results in increased protein and vitamin production and guarantees a balanced diet. Thus it may be seen that conventional agriculture without the use of GMOs can lead to significant increases in production in developing countries.

The 2003 FAO report on the Status of Food Security in the World is predicated on the fact that harvest yields can be significantly increased in many drought-affected countries by means of efficient water management alone.

Green revolution

From the mid-1950s, as a result of the growing population explosion and a strong disregard of agricultural development, developing countries became heavily dependent on imports and aid shipments for food. The "green revolution" was the technical and economic response to this food problem. A radical modernisation of the agricultural sector brought about a shift away from traditional cultivation methods which had hitherto been practised. When it was found that seeds from the North did not necessarily produce higher yields under different climatic, social and economic conditions in the South, international research programmes turned to ways of modifying local varieties. The key elements in this development were a rise in the targeted use of chemical production agents such as fertilisers, pesticides and weed-killers, coupled with a growth in the use of diesel and electrical pumps.

While this agricultural paradigm shift resulted in massive increases in production, it also led to a sharp rise in monoculture, the use of pesticides and a reduction in water supplies for other purposes such as drinking water. As a result, there is now a general effort to reverse some of the trends brought about by the green revolution.

4.1.4 Evaluation of the arguments

a Gene technology as a "technological fix"

It is understandable, given the complex causes of hunger and malnutrition, that the plan to use gene technology is often accused of delivering a "technological fix": in other words, an attempt to solve a problem by technical means, with no consideration of the complex web of social factors involved. The result of this narrow focus is that other solutions are ignored.

The Committee unanimously agrees that the belief that hunger and malnutrition can be solved by gene technology is an unjustifiably narrow view of the problem. In the opinion of the ECNH, the contribution which gene technology can make to alleviating hunger and malnutrition is exaggerated. Given the prevailing conditions for achieving food security, cost-effective farming methods adapted to local conditions appear more suitable for developing countries

b Gene technology as one factor among many

Agriculture – and, by extension, food security – depends on a variety of factors: political conditions, available infrastructure, farmers' rights of co-determination, the mechanisms by which communities function, public sector structures, and global economic developments. Gene technology (and technical development in general) is only one factor among many. Even if gene technology could at times help to increase food production in the South, this would not automatically reduce poverty and under-nourishment. Hunger and malnutrition are generally not caused by a lack of food, but by lack of access to food.

The importance of gene technology in solving this complex problem is frequently over-estimated. Gene technology is neither a cure nor a curse. Both views place too much emphasis on the influence which technology has on problems in developing countries. The ECNH therefore believes it is wrong to present gene technology in the public discussion as if it offered the **only** solution to the problems at hand. Equally, however, it would be wrong to deny that gene technology has any potential whatsoever.

c Difficulty of estimating potential

One of the main problems in estimating the potential of gene technology is that, because it is a relatively young science, discussion must be based largely on speculation in the absence of long-term experience. The ECNH therefore places emphasis on the fact that its evaluation of gene technology is based on the knowledge currently available.

Taking into account the technical, political and social conditions in developing countries, the overwhelming majority of ECNH members believe that it is not possible at present to estimate the contribution made to food security by green gene technology. A minority of members believes it is possible to

Genetically modified maize in Africa

Maize is cultivated all over the world, mainly for use in its entirety as animal fodder. The kernels are also processed for a variety of foods and industrial products. In 2003, 636 tonnes of maize were harvested on 141 million hectares around the world. Developing and newly-industrialised countries accounted for 46% of this global production volume.

Global cultivation of GM maize

Bt-maize was developed for large-scale intensive farming in temperate zones. By adding and expressing a gene from the soil bacteria *bacillus thuringiensis* (Bt), the maize was made more resistant to the common corn borer. In 2003, GM maize was cultivated on 15.5 million hectares in 11 countries, equivalent to 11% of the global surface area accounted for by maize crops. The main producers of GM maize are the USA (where it accounts for of 42% of all maize crops), followed by Canada and Argentina (where it accounts for 40%), and South Africa (where it accounts for 10%). The trend in these countries is towards a growth in the proportion of maize accounted for by GM maize. Spain, Bulgaria, the Philippines and Honduras each have fewer than 50,000 hectares devoted to experimental GM crops, while all other countries have only small areas on which experimental GM crops are grown.

GM maize in Africa

To date, South Africa and Kenya are the only African countries which have developed GM maize varieties. Only South Africa has authorised GM maize for commercial farming. One of the two GM maize varieties commercially grown in South Africa is approved for human consumption.

The findings from experiments in Kenya are revealing. The *Insect Resistant Maize for Africa Project* (IRMA) developed GM maize in Kenya from local varieties of maize. The project was coordinated by the *Kenyan Agricultural Research Institute* (KARI), supported by the *International Maize and Wheat Improvement Center* (CIMMYT) in Mexico, and financed by the Syngenta Foundation for Sustainable Agriculture. The GM varieties tested to date exhibit insufficient resistance against native corn borers. By contrast, the project successfully tested conventionally grown maize varieties with higher resistance against the corn borer, whereas previously no interest had been shown in further developing naturally resistant varieties. The IRMA II programme is currently being set up. During the second phase between 2008 and 2011, Bt-maize as well as varieties with natural resistance are to be developed for commercialisation from local varieties.

The average maize harvest in African countries is often much lower than in industrial countries. This is primarily attributable to difficult local conditions such as a high incidence of pests and weeds, aridity or soil erosion, lack of resources and know-how, as well as socio-economic and political problems such as inequality of ownership, civil wars and inadequate infrastructures. Poor harvests caused by corn borer infestation are subject to severe fluctuations in pest pressure, and are therefore difficult to scientifically record and statistically evaluate. Statistics on harvest failures in South Africa vary from only 10% loss to total loss. By contrast, field trials with Bt-maize in Kenya achieved a 13% increase in yield.

Evaluation of further developments

Developing pest-resistant GM maize varieties can be of use in specific agricultural situations in developing and newly-industrialised countries. However, the example presented here demonstrates that the intensive farming methods practised for growing maize in industrialised countries cannot simply be transferred to the production conditions in developing and newly-industrialised countries. Developing GM varieties based on modified local varieties by means of gene technology or by crossing them with a proven Bt-gene is a lengthy and by no means foolproof process. The increased yield which is the objective of such developments will make a difference only if local production conditions are optimised in advance. Priority must therefore be given to efforts to improve conditions for agricultural production in developing and newly-industrialised countries. The use of gene technology must be considered as a possible long-term option.

estimate this contribution and expects gene technology to have an adverse effect on food security.

4.1.5 Recommendations on food security

Based on its estimate of the potential of green gene technology, the ECNH makes the following recommendations:

In the current situation, it would be wrong to promote gene technology research alone as a means of ensuring sufficient food and a healthy diet. Quite apart from the direct positive or negative effects on developing countries, a unilateral decision in favour of technological solutions may prove problematic if, in the process, other potentially more promising solutions are ignored. In other words, a comprehensive ethical evaluation of the effects of gene technology on developing countries must, in addition to direct effects, take into account the possibility of indirect effects – in this case the damage caused by neglecting alternative solutions.

Due to the complex and varied nature of the causes of hunger and malnutrition, Switzerland must examine a broader context when evaluating potential solutions. This includes examining its own role on the global market, since changes in this respect are of major importance for developing countries. In particular, it is important to examine Swiss export subsidies for agricultural products and assess their effect on food security in developing countries and hence against the backdrop of international justice.

The ECNH supports the efforts of the SDC in providing financial aid rather than aid in kind in famine situations. Aid organisations can use the money to purchase food in regions adjacent to the disaster area or, if necessary, on the global market at favourable conditions. Purchasing food locally boosts local food security. By contrast, aid in kind is used as a means whereby donor countries can offload their surplus produce, and can put developing countries at an additional disadvantage on the global market.

4.2 Food sovereignty

4.2.1 Problem: potential restrictions on food sovereignty

Six multinationals currently control 98% of the market in GM plants and 70% of the global pesticide market. They are: Monsanto, Syngenta, Bayer Aventis, DuPont, BASF and Dow. More than 90% of transgenic seeds are distributed by Monsanto. Three companies – Syngenta, Monsanto and DuPont – dominate the seed market in Africa. The possibility of patenting GM seeds is increasing the danger of monopolisation even further.

The risk of food sovereignty being constrained by other countries or market-dominant companies is particularly high among developing countries. Witness the reports on disasters in countries such as Zimbabwe, Zambia, Angola and Sudan, where the countries were faced with the choice of either accepting aid shipments of GM food or receiving no aid at all.


4.2.2 Fundamental value: self-determination in food issues

It is necessary to distinguish between food sovereignty and food security. The latter is predicated on a sufficient supply of healthy food for everyone. Food sovereignty, on the other hand, means the autonomous right of people to decide about the type and content of their diet. If people are denied the right to make their own decision, they become victims and recipients of charity. This would be an expression of an inadmissible paternalistic attitude.

Food sovereignty is important on several levels: At the national or other communal level, food sovereignty refers to the ability of countries or communities to regulate the food sector independently and in a manner which they choose. Individual food sovereignty entails the individual's right to choose what he or she eats. For farmers, food sovereignty is the right to make independent decisions on how they grow and market their own produce.

4.2.3 Arguments on the effects of gene technology on food sovereignty

The ECNH takes the view that food sovereignty at the national and individual levels is an important criterion alongside the right to sufficient food and healthy nutrition. It is an expression of human dignity and justice. It is therefore necessary to determine the importance accorded to food sovereignty by developing and newly-industrialised countries and their citizens in their approach to gene technology.

a Growth of monopolies

It is now possible to patent GM seeds. If, in a situation where the balance of power is unequal, farmers declare themselves willing to buy new seed every year, this can only be considered an autonomous act to a limited extent. If farmers are not fully free to make their own choice of seed, this constitutes a dependency and hence a constraint on food sovereignty. The more patents are granted to quasi-monopolies, the greater the dependency becomes.

b Emergence of two separate markets

One of the reasons behind the dispute in the Zimbabwe and Zambia crises is the recent emergence on the global market of two separate markets with two separate trading channels for food and seeds: one for GM products, and the other for GM-free products. Developing and newly-industrialised countries are now obliged to decide which market to sell their produce on. If they decide on green gene technology, the GM-free market is closed to them. If they decide against gene technology, they close their own market for GM imports and expose themselves to other problems such as those experienced by Angola and Sudan. (Section 2.2)

c Lack of context-specific safety assessment

Countries in the South have good reason to set safety standards other than those of industrialised countries. Different dietary habits, different farming methods, different climatic and ecological conditions result in context-specific risks.

Not all the findings of risk research in the North can be transferred to the southern context. For instance, plants can behave differently under tropical conditions than they do in temperate zones. Insufficient findings exist in this area. The effects of the consumption of Bt-maize on the health of people in poor countries, whose calorie intake is primarily accounted for by largely unprocessed foods, have not been examined. No Bt-varieties have been developed or tested for suitability in this context. The risk of allergies to such foods in hunger and malnutrition situations is unknown. The widespread human consumption in the South of cotton-oil, which is obtained from the seed-capsules of the cotton plant, provides another example of the importance of context-specific risk analyses. When the effects of using Bt-cotton were determined in the North, little thought was given to the way in which the South uses cotton seeds.


4.2.4 Evaluation of the arguments

The ECNH believes that, in terms of the effects on food sovereignty in developing countries, the emergence of separate markets is of no particular significance at present. However, the situation must be closely monitored.

The Committee is unanimous in the belief that a context-specific safety assessment of GM plants in developing and newly-industrialised countries is of major importance.

ECNH members also unanimously agree that any evaluation of the safety of GM plants in developing and newly-industrialised countries must be context-specific.

ECNH members are unanimous in the belief that the emergence of monopolies and the associated risk of restricted food sovereignty constitute an important argument. Given the fact that, even now, many farmers have few options regarding the agricultural use of the soil, their choice may well be further limited through the application of gene technology.

Irrespective of whether a monopoly is created through the use of gene technology or by other means, it must be viewed as a relatively negative development in view of its widespread impact. If one believes that food is closely linked to cultural identity and personal integrity, then a monopoly situation in this context must be regarded as particularly harmful. It is this close relationship between food, nutrition and personality, rather than the special nature of gene technology, which dictates that monopoly situations in this context should be avoided wherever possible. The majority of Committee members accord major importance to the anthropological significance of food, and a minority of members at least moderate importance.

4.2.5 Recommendations

The ECNH supports the policy which Switzerland already practises, which gives due consideration to food sovereignty even in actions of a charitable nature.

The ECNH unanimously agrees that farmers' and breeders' privileges should be fully guaranteed in order to safeguard against unfair monopolies.

In the opinion of the ECNH, unmodified genetic resources should not be patented. Since breeding new plant varieties and animal races is dependent on the free exchange of genetic resources, such resources should remain accessible to all. However, it must be emphasised that not only breeding in the field of agricultural technology should be free of patent restrictions; it is also particularly important in the case of plants which are considered essential to global food security. The ECNH believes that important steps in this direction have been made by the FAO's International Treaty (IT) on Plant Genetic Resources for Food and Agriculture, the extension of the research privilege to include the field of breeding, and the EU's efforts to introduce a relatively broad-based farmer's privilege in its patent guidelines. In this context, the ECNH also supports the current revised draft of the Swiss law on patents.

Here, too, there is an imbalance between industrialised and developing countries. The ECNH believes that this must be rectified through targeted research in countries in the South. The ECNH recommends that Switzerland adopt *Capacity Building* measures with the aim of strengthening support in existing projects, and promoting and increasing knowledge and findings on the effects of gene technology in the specific ecological, economic and social context of recipient countries.

Farmer's privilege
The farmer's privilege entitles farmers to use seeds harvested from a patent-protected variety for propagation of the next year's crop without having to pay a fee. This privilege covers plants as well as animals.

Breeder's privilege
The breeder's privilege allows breeders to use protected varieties as the basis for new breeds without having to pay a licence fee.

4.3 Biodiversity

4.3.1 The problem: declining biodiversity

Biodiversity is being threatened by a wide range of factors such as soil erosion, drought and flooding, climatic change, deterioration of water quality, declining soil fertility due to salination and over-fertilisation. Moreover, more and more crop plants are disappearing from arable lands. Monocultures threaten the biodiversity of agricultural plants. The genetic basis of crops currently farmed is growing ever smaller, increasing the danger of massive harvest failures due to plant vulnerability to pests or disease.

A decline in biodiversity, and in agrobiodiversity in particular, was observed even before gene technology was introduced into agriculture. While its supporters argue that gene technology can help to sustain biodiversity, opponents argue that it is additionally reducing the basis for biodiversity. Gene technology must therefore be assessed, among other things, by the extent to which its use helps or hinders sustainable biodiversity, and agrobiodiversity in particular.

4.3.2 Ethical obligations and requirements: Protection of natural resources, responsibility towards future generations, and respect for non-human nature

The long-term securing of natural resources is based on biodiversity. Protection of biodiversity is also a requirement predicated on the principle of inter-generational justice: Future generations have a moral right to a life comparable to ours. Moreover, respect for non-human nature and the dignity of the creature require a sustainable lifestyle.

4.3.3 Arguments on the impact of gene technology on biodiversity in developing countries

a Increase in monocultures
Traditional agricultural systems based on plant diversity not only secure the immediate survival of farmers in developing countries, but also ensure long-term natural resources. The farming of mixed cultures with large-scale genetic diversity also guarantees a relatively assured yield even where selection pressure is high; it supports the local ecosystem.

There is concern that the use of gene technology in developing and newly-industrialised countries encourages the expansion of industrial agricultural production. The associated increase in monocultures is linked to an additional genetic reduction. Negative experiences with the so-called green revolution are cited. While the green revolution led to a dramatic rise in ag-

ricultural production, there was a simultaneous sharp rise in the farming of monocultures, water consumption and the user of herbicides and pesticides. This affected biodiversity, soil fertility, water levels and water supplies.

b Domination of high-yield varieties

Genetic diversity in crop plants has drastically declined as farming methods become ever more intensive. The majority of today's products come from a few high-yield varieties with a small genetic base. There are growing indications that reduced agrobiodiversity is making agricultural production more sensitive to climatic and other environmental effects. The risk of large-scale harvest failures is growing as plants become more vulnerable to pests and disease. This is undermining the stability, sustainability and productivity of established agricultural systems. And poor countries will be the first to suffer the negative consequences of this trend. Such concerns are accorded additional weight through the observation that, to date, only a few commercially interesting plants have become the object of biotechnological and gene technology interests – a fact which could accelerate the decline in biodiversity.

c Danger of resistance development

One major fear is that the spread of GM crop farming could promote the development of insecticide resistance in some pests. Such a development would affect all plants – non-GM and GM alike. One example used in conventional farming is the Bt-toxin, an

Biodiversity and the risks of reduced biodiversity

It is almost impossible to find a simple, comprehensive definition of **biodiversity** that does justice to the complexity of the subject. For the purposes of this document, biodiversity means the entire range of living organisms within their complex ecosystems. The term covers the diversity of ecosystems, species, diversity within species and diversity on a genetic level.

Within the context of the current discussion, the term frequently also refers to **agrobiodiversity** i.e. the diversity of crop plants and cultivated plants. **Cultural diversity** goes hand in hand with agrobiodiversity. Breeding and farming methods practised by local communities have given rise to agrobiodiversity with the associated large variety of locally adapted strains. The cultural and social context of these communities plays a key role in maintaining and promoting agrobiodiversity.

Irish famine

In the 19th century, the fungus *Phytophtera infestans* virtually destroyed potato crops throughout Europe. The subsequent famine hit Ireland particularly hard. At that time, the potatoes originated from a handful of plants from the Andes and their genetic base was very small. Once the blight had broken through the barrier and affected one potato, it was able to rage rampant throughout Europe, since all potato plants shared virtually identical genes.

Chinese mixed-rice culture

In the Chinese region of Yunnan the blight *Magnaporthe* grisea used to cause massive damage to rice crops. Nowadays, farmers always plant two sorts or rice instead of the former monoculture: one Variety A rice and one Variety B. As a result, the blight has virtually disappeared and harvests have almost doubled in volume. Research scientists now believe that various mechanisms have contributed to this successful outcome: Thanks to mixed-variety farming, the physical distance between plants of the same variety is larger and hence more difficult for the blight to overcome. In addition, this encourages the propagation of benign insects which feed on the blight.

insecticide which is sprayed only a few times during the growing period. By contrast, it is expressed in Bt-plants over a long period. This exposes pests to higher selection pressure, and could accelerate their resistance development. To prevent or delay this process, a special form of farming management is applied in many countries: Bt-fields are surrounded by a belt of plants to isolate them and prevent their genome being genetically modified.

d Risk of wild population through undesirable crossing of genes

The effects of GM plants on wild populations, which in turn form the basis for the future stability of ecosystems and sustainable agricultures, are the subject of controversial discussion. The concern is that, precisely in countries with the greatest biodiversity, genetic material could flow from cultivated plants to wild plants *(genetic flow)*, thereby contributing to an erosion of genetic resources.

e Enhancing agrobiodiversity through gene technology

Others argue that intensive farming is a fact of modern agricultural life and that the trend was observable even before gene technology. It is worth noting that not only traditional agricultural systems rely on biodiversity, but gene technology too. High-yield varieties modified to cope with new environmental strains such as drought, flood, salinated soil, extreme climatic changes etc., remain dependent on a large gene pool. Gene technology, for example, could be used to transfer genetic material from indigenous varieties to high-yield varieties. By the same token, high-yield characteristics could be transferred to locally adapted varieties. In this way, gene technology could help to increase agrobiodiversity.

4.3.4 Evaluation of the arguments

It is difficult to determine the extent to which negative effects on biodiversity are attributable specifically to the use of gene technology and then to the direct use of transgenic plants in developing countries' agricultural sectors. On the one hand, micro-ecosystems vary from one location to another, and interactions between the various components with systems are dependent on a great many factors. On the other hand, there is a lack of evidence since no long-term studies have yet been conducted. Nor are there even any findings on which to base any estimation of possible damage and effects.

The majority of ECNH members are concerned that, under present conditions in developing and newly industrialised countries, the use of gene technology in agriculture is contributing to the reduction of biodiversity. The minority of ECNH members believes that the extent to which green gene technology influences the decline in biodiversity cannot be determined at present.

4.3.5 Recommendations

The ECNH is of the opinion that the protection of biodiversity is an essential requirement for any application of green gene technology. Transgenic plants must be measured by their negative or positive impact on sustainable biodiversity.

The ECNH recommends that the protection of biodiversity be incorporated in future agricultural strategies. By unanimous consent, the ECNH believes that centres of origin of cultivated plants should be given special protection. In view of the ongoing changes in the climate, these centres are essential as a gene pool for future breeds. Modern plant breeding also relies on these original plants. To prevent crossovers to related wild plant varieties, GMOs should not be released in such centres. Nor should GMOs be released in regions of particular ecological sensitivity.

With a view to protecting biodiversity, the ECNH supports capacity building projects and measures to promote cultural diversity such as fair trade and the granting of micro credits to farmers.

The ECNH also unanimously supports gene bank projects aimed at the conservation of cultivated or crop plants in their natural habitat *(in situ)* as well as outside their natural habitat *(ex situ)*. It supports all efforts which help to ensure the free exchange of genetic resources for breeding and research.

International efforts to protect biodiversity

Gene banks
International efforts are being pursued to prevent any additional loss of biodiversity by building gene banks in situ (in the plants' natural habitat) and ex situ (outside the natural habitat). While developing countries are frequently centres of biodiversity, they are often not in a position to perform in situ biodiversity conservation on their own. In the interests of global equality of distribution, therefore, it is necessary to develop and implement concepts for the sustainable and economically fair use of biodiversity, which also address the needs of people in developing countries.

International Treaty of the FAO on Plant Genetic Resources for Food and Agriculture (IT)
The aim of the IT is to prevent food scarcity resulting from failed harvests. World food security currently depends largely on the supply of wheat, rice, maize and potatoes. Of these, however, only a few varieties are farmed with a very limited genetic base. This increases the risk of massive harvest failures due to disease or climatic change. The Treaty aims firstly to support the conservation of genetic diversity. Secondly, it aims to promote the breeding and further development of a broader diversity of crop plants. The third central element of the treaty aims to facilitate access to plant genetic resources for food and agriculture and to oblige those who benefit from them to distribute their profits. However, the treaty does not cover all the plant genetic resources which are important for food and agriculture.

Global Crop Diversity Trust (GCDT)
A financing strategy is to be drawn up with a view to implementing the provisions of the IT. Currently being set up outside the framework of the IT, the GCDT is acknowledged as an important financing mechanism for the objectives of the IT. The primary aim of the GCDT is the global conservation of the most important gene banks for food security and sustainable agriculture, as well as ensuring public access to these resources.

4.4 Social peace

4.4.1 The problem

Conflicts also exist in developing countries between supporters and opponents of agriculture based on GMOs. Indian farmers burn fields with transgenic cotton. At universities in Indonesia, disputes on the use of gene technology in agricultre are creating mounting tension. Land seizures, legal disputes and police actions are visible indications of a broken or precarious peace.

4.4.2 Fundamental value: social peace

Social peace exists when all social groups are willing and able to resolve conflict peacefully. Social peace is an essential prerequisite for law and order, and a necessary component of survival and economic development. Social and cultural conflicts can pose a serious threat to economic recovery and sustainability.


4.4.3 Arguments on the effects of gene technology on social peace in developing countries

a Access to information

Access to a broad base of information that fairly outlines the advantages and disadvantages of new technologies is a prerequisite for the acceptance of such technologies, for populations to trust in the government and civil society, and for social peace to reign. Access to information is much more problematic for broad segments of the population in developing and newly-industrialised countries than for people in countries of the North. Access to information is blocked by corrupt journalists and (regional) politicians, rendering any fair exchange of arguments impossible and thus impeding the process whereby joint solutions might be arrived at.

b Prevention of cultural-religious tension

In many developing countries, farming is not simply a means of managing the soil but, as the name implies, an agri-culture. It is enshrined in religious, mythical and cultural concepts and values. In many parts of Asia, rice is much more than a food or trading commodity. Rather, it is a synonym for deities and is associated with a great many rites. To be applied successfully, technological innovations must take account of such cultural dimensions if they wish to avoid endangering social peace through cultural-religious tensions. Dialogue with religious communities in areas where new technologies are to be used is therefore essential.

c Armed resolution of conflicts

Conflicts in developing countries are also resolved militarily, either by state, paramilitary or private armed intervention. Agricultural policy objectives must not be achieved through military means if social peace is to be guaranteed or brought about.

4.4.4 Evaluation of the arguments

While the arguments discussed here apply not only to the use of GMO in agriculture but also to all technological developments, they must also be applied when examining the use of gene technology in the agriculture of developing countries. In the opinion of the ECNH, these socio-cultural aspects are often ignored in favour of economic and ecological arguments. It is essential for these aspects to be addressed in order to formulate a viable solution that serves the interests of social peace. Participative arguments over new technologies in the agricultural sector are at least as important in developing countries as in industrialised countries. The criteria for such arguments are: adequate freedom of the press/media, collaboration of cultural and religious bodies, and a decline in corrupt permit practices.

4.4.5 Recommendations

To enable and enhance the opportunities for an in-depth examination of non-human gene technology in developing countries, and ensure the participation of such countries in the international dialogue, the government must promote citizen participation within the framework of its development cooperation activities, and set up expert committees to address this aim.

The government, as well as companies and private aid agencies active in developing and newly-industrialised countries, must campaign for an open, fair exchange of information on the use of gene technology, and for the associated democratic processes of participation and authorisation.


5 Conclusions

5.1 Synthesis

Many observations on gene technology are limited to food security and therefore only examine the opportunities provided by gene technology and the possible risks to human health. This is too narrow a perspective. Other aspects such as food sovereignty, biodiversity and social peace must be equally addressed. An overall assessment of the effects of gene technology on developing and newly-industrialised countries can be considered meaningful only if it takes all the relevant factors and elements into account.

Based on the above discussion and evaluation of all arguments, the overwhelming majority of ECNH members conclude that the effects of gene technology on developing countries cannot be estimated with sufficient certainty at present. Consequently, wherever the advantages are clearly visible, they should be promoted. However, where serious adverse effects are observable, the use of gene technology should be prohibited or strictly controlled. A minority of ECNH members concludes that, due to the impossibility of estimating effects and, in consideration of the priority accorded to the negative prognosis and a strong interpretation of the precautionary principle, it would be wiser to forego the use of gene technology at present. A further minority of members believe that the effects can be estimated and anticipates negative consequences for developing countries. It therefore advises against the use of gene technology in such countries.

5.2 General recommendations

Since little data is available at present about the potential of green gene technology in developing countries, it is necessary to promote **public-sector research** in this area. Such research should also be intensified internationally and coordinated better than at present.

Since the results of risk research in the North cannot simply be transferred to farming conditions in the South, **context-specific risk research** should be promoted. Besides taking into account climate and ecological differences, any assessment of the impact of green gene technology should also address the country-specific health, social and economic conditions.

Technological solutions run the risk of ignoring the complex social interrelationships in which they are situated. This is also true of gene technology. The ECNH therefore places major importance on the **promotion of alternative solutions**, some of which have, to date, produced more efficient and better results. From an ethical standpoint, it is inadmissible to use research money to pursue a unilateral technological approach without examining the complex socio-cultural environment in which the results will be applied. This is emphatically true where the effects of developing technologies are still difficult to ascertain.

The sovereignty of developing and newly-industrialised countries must be respected. Such countries should be left to make up their own minds about green technology. Many of these countries have neither the financial nor the technical wherewithal to accurately assess technology and its applications on their own. The ECNH therefore supports all measures that **promote Capacity Building in these countries**.

Genetic resources secure the basis of global food. The ECNH therefore supports all initiatives that aim to guarantee **free access to and exchange of genetic resources for breeding and research**.

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List of abbreviations

Bt — *Bacillus thuringiensis;* bacteria that produces a protein harmful to some insects. Bt-plants are genetically modified to autonomously express insect toxin.

CBD — United Nations *Convention on Biological Diversity* dated 5 June 1992

CCRI — Central Cotton Research Institute

CGIAR — Consultative Group on International Agricultural Research: a consortium of countries, international and regional organisations and private foundations that supports 15 international centres of agricultural research which cooperate closely with national centres of agricultural research, the private sector and non-governmental organisations. CGIAR applies the latest findings in agricultural research to reduce poverty, sustainably improve human nutrition and health, promote agricultural growth, and contribute to environmental protection.

CIMMYT — International Maize and Wheat Improvement Center

DNA — Desoxyribonucleic acid

FAO — United Nations Food and Agriculture Organization

GCDT — Global Crop Diversity Trust

GM — Genetically Modified

GMO — Genetically Modified Organism

ICRISAT — International Crops Research Institute for the Semi-Arid Tropics

IRMA — Insect Resistant Maize for Africa Project

IT — International Treaty of 3 Novemer 2001 on genetic plant resources for food and agriculture

KARI — Kenyan Agricultural Research Institute

TRIPS — Convention of 15 April 1994 on Trade Related Aspects of Intellectual Property; Appendix to the World Trade Organization Agreement

UPOV — International Convention of 2 December 1961 on the Protection of New Varieties of Plants, revised in Geneva on 10 November 1972, 23 October 1978 and 19 March 1991 (UPOV 1991)

WFP — United Nations World Food Programme

WTO — United Nations World Trade Organization

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