Can we feed our future planet without the use of Genetically Modified Organisms?

vredeseilanden | Boeren verdiener meer

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The debate on Genetically Modified Organisms (GMO's) in the media is sometimes heavy, with researchers and seed companies arguing that GMO's offer an essential answer to the many challenges faced by Agriculture today. Feeding 9 billion mouths by 2050 will not be possible without the use of GMO's, is their statement. Opponents argue that GMO's are an environmental disaster and that patents are a noose around the neck of farmers worldwide.

What is the position of Vredeseilanden in this debate? Are we pro or against GMO's? Well, first of all we think that this is not the right question to ask. We are not pro or against any technology as such, we'd rather ask "Is this GMO-technology the best answer to Problem X?". That problem can be any of the many challenges agriculture faces today: persistent hunger, climate change, resource scarcity, etc. Up till now Vredeseilanden has never been able to reply affirmatively to this question. But that doesn't mean that we exclude each application of Genetic Engineering (GE) for agriculture a priori.

Admittedly, this might seem as a half-hearted position, which it isn't. To clarify our position, here are some of our answers to a few common GGO-claims:

1. GMO's will solve the world hunger problem

This is one of the prime arguments of GMO proponents. At Vredeseilanden however, we look at hunger from a systemic perspective. Hunger is not simply a technical problem but a socio-economic problem caused by inequality and poverty.

Today we produce enough food to feed everyone. World agriculture produces 17 percent more calories per person today than it did 30 years ago, despite a 70 percent population increase. This is enough to provide everyone in the world with at least 2,720 kilocalories (kcal) per person per day according to estimates of the FAO [1]. Yet there are still some 842 million people undernourished, mainly in the developing world but also increasingly in the developed world. The princi-

1-http://www.worldhunger.org/articles/Learn/world%20hunger%20facts%202002.htm

Photo: Jimmy Kets

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In his essay "Are you in favor of GMO's", Gunter Pauli[1] illustrates nicely how GMO's fit into the logic of quick fixes instead of "thinking in systems" and are therefore not well suited to combat hunger:

"Do you remember some 15 years ago the arrival of Golden Rice? This GMO rice was heralded as a definitive solution in the fight against blindness. It was introduced as one of the great contributions of science (...) If the purpose is to protect children from blindness we genetically modify rice to include betacarotene into the rice kernel. How could anyone ever be against this option?

When confronted with such a societal challenge like blindness, we should first ask ourselves how come that blindness is on the rise? Quickly we realize that there is a shortage of betacarotene ... obvious! Is that enough of a reason to rush and genetically modify rice to include betacarotene? I beg everyone to bear with me and think this through. Monocultures created a shortage of betacarotene, increasing the risk of blindness. How come red rice (a GMO) is the preferred solution, instead of generating more food and more betacarotene with available resources?

We should ask ourselves the question: "How come there is a shortage of betacarotene in the food supply chain around rice paddies?" Studying ecosystems we realize that micro-algae, including the blue green algae are just about always around. This is one of the first forms of life that emerged on earth. They exist for over a billion of years, and weathered all calamities. Micro-algae are known producers of betacarotene and many other nutrients. So what happened to them around the rice paddies?

We realize that there used to be a scum growing on the irrigated paddies. This scum has been removed due to the chemicals used in rice farming to boost output. That scum ... is rich in micro-algae, and very rich in betacarotene.

In earlier times, Chinese, Vietnamese, Laotian, Cambodian farmers used to put shrimps and even carps in the rice paddies. These devoured the betacarotene rich algae and secured it into the food chain so that people had enough of it, naturally using all available resources. That cultivation system is not as high in rice productivity as a monoculture, but its system generates more nutrients, providing food security, and even secures the necessary defenses against modern illnesses such as blindness. This farming system provides more disposable income, since all basic needs can be covered locally. This puts more money in the pocket to pay for school. Export crops are notorious for generating more output, and an income that fluctuates with the world market prices.

Our "modern" farming system of rice that focuses on maximizing rice, eliminated betacarotene (and much more) from the supply chain! In our drive to increase the output of one component - rice - we decreased the natural cultivation of all the essential amino acids and micro-nutrients rice alone cannot supply. However, the system does it better than anyone else. How can we accept that the solution to blindness is genetic manipulation?

If we really want to fight blindness - and if that is our genuine purpose, then we farm rice, let the scum on the water, feed it to the ducks, crustaceans and fish. Then we have a balanced intake of protein, and at the same time, we have a good supply (again) of betacarotene, while naturally fertilizing the ponds with manure. As our research demonstrates, this system produces more nutrients than intensive rice farming could ever achieve. We are not substituting blindness for famine as some proponents of GMO want us to believe.

Golden Rice does not solve any issue beyond blindness at a premium. Rather, GMO's perpetuate unsustainability in farming, both on the production side (too many inputs depleting top soil) as on the side of consumption (too much of the wrong food)."

1 Pauli Gunter : opinion on a hot topic by the author of the Blue economy. Are you in favour or against GMO's

pal problem is that many people in the world do not have sufficient land to grow, or that they lack the money to purchase enough food. Hence food security will not only depend from producing more food, but also from how we produce and consume it and from how well we can combat inequality.
The USDA, often a proponent of genetically engineered seeds, reports that "currently available GM crops do not increase the yield potential of a hybrid variety … in fact, yield may even decrease if the varieties used to carry the herbicide-tolerant or insect-resistant genes are not the highest yielding cultivars."[2]

Currently, the majority of genetically engineered crops are grown for animal feed and biofuel. The main genetically modified plants are soybeans, cotton, rapeseed (canola) and corn, and they are all modified to be herbicide resistant or to produce an insecticide. Despite 30 years of research and 20 years of commercialization, these are the only two commercialized applications today. It is difficult to see how this kind of restricted applications is useful for smallholders (i.e. the majority of people living with hunger), who often don't even have access to herbicides and pesticides and often don't have money to buy expensive inputs or seeds.

So the debate about GMO's and hunger is not a technical debate but one about the choice between agricultural paradigms or models such as an agro-ecological model versus the model of industrial agriculture. These models lead to different development paths and in a context of scarce resources, the implications of choosing one paradigm over the other leads to different implications for different groups of people. The debate about GMO's is thus in essence a debate about which socio-economic model we would like to develop.

Vredeseilanden promotes an agro-ecological model, based on smallholder agriculture. We recognize the multifunctional nature of Agriculture: agriculture provides food, fiber, income for producers, calories and nutrients for everyone, services for nature, cultural and social identity. According to us, this model is indispensable for efficiently nourishing the population, whilst offering smallholders a viable future (they can make a living with farming) without overburdening the planet (lower use of external inputs).
As the report of the European Environmental

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2 The Wheel of Life: food, climate, Human Rights and the Economy, D Barker.

It is interesting trying to imagine how the GMO-development and -debate would have evolved if there had not been the option of patents.

Excellent work for finding seeds adapted to specific contexts is done by a Belgian researcher Bram Govaerts in Mexico. Govaerts is working for CYMITT, het International Maize and Wheat Improvement Center. The center established an immense (patent free!) seed bank (with 28.000 varieties of corn and 170.000 varieties of wheat). Govaerts looks at agriculture as a SYSTEM, acknowledging the complexity of reality. The aim is not to increase the yield of one variety, but to build a resilient agricultural system that gives high but stable yields in the long run. This is done by integrating agro-ecological principles such as: soil conservation, agroforestery, crop rotation, re-use organic material, etc[1] … Such an approach offers, according to Vredeseilanden, much more potential than GE-technology for developing varieties adapted to specific contexts.

1 Goossens, Jelle: de toestand is ingewikkeld maar niet hopeloos http://www.vredeseilanden.be/nieuws/het-ingewikkeld-maar-niet-hopeloos

Agency[3] puts it: "Science based agro-ecological methods are participatory in nature and designed to fit within the dynamics underpinning the multifunctional role of agriculture in producing food, enhancing biodiversity and other ecosystem services, and providing food security to communities. They are better suited to agricultural systems that aim to deliver sustainable food security than high external input approaches".

2. GMO Plants will be needed to cultivate plants for specific challenges: e.g. for farmers in dry areas (becoming more frequent due to climate change) or salinated area's

So far, no drought resistant plant has been developed, using genetic engineering. Why is that? In theory one could think of such a GMO. However in practice this does not seem so easy to reach. Drought resistance is a complex characteristic that is not obtained easily by adding genes singularly (as is done with genetic engineering). There's a scientific consensus on the fact that genetic engineering doesn't work like lego, (inserting a blue lego-block in a yellow construction in order to transfer a specific characteristic), as it was initially often presented.

If we want to develop plants that resist drought, wouldn't it be better if we search for the best seeds, that exist in dry areas and that after millions of years of adaptation have proven to work in dry area's? That is an immediate, proven and readily available solution for farming in dry areas that does not need the expensive and time consuming research GE asks.

This idea was recently confirmed by Michel Haring, Professor Plant Physiology at the University of Amsterdam, professionally involved in genetic engineering: "genetic engineering is an interesting technology. Through my research I want to understand what genes are doing. (…) If there would exist problems that could only be solved through genetic engineering, I would be totally in favour of gentechnology. That's however not the case. All the results that we achieve here at the University via gentechnology, are also feasible without gentechnology".[4]

3. We are eating Frankenstein food without knowing

In the European Union, labeling and traceability legislation is quite strict. For consumption products, labeling is mandatory, so in theory you are able to know if your food contains GM ingredients or not (i.e. if you are reading the print letters on the label). Moreover, thanks to pressure from organizations such as Greenpeace and pressure from consumers, Belgian and European retailers and food processors have taken the option to keep GMO products off the supermarket shelves. Today most food items sold in Europe do not contain GMO's.
However, animal feed does not have to be labeled. Hence, you as an end-consumer cannot know if the meat or the egg you are eating is coming from an animal that has been fed on GMO's. Actually it has probably been raised on GMO's, since nearly all feed is GMO (-contaminated). The easiest way to be sure that the animals were not fed on GMO's, is to opt for organic food.

Health hazards due to eating products from animals fed on GMO's are unknown, and scientific research on the issue is inconclusive. However, by consuming these products we are stimulating the cultivation of GMO's in other countries, such as Latin America, where our animal feed is produced.

3 European Environmental Agency (EEA): Late lessons from early warnings. Hungry for innovation: from GM crops to agroecology , David Quist, Jack A. Heinemann, Anne I. Myhr, Iulie Aslaksen and Silvio Funtowicz

4 Genetisch gemanipuleerd voedsel: een vloek of een zegen, groene Amsterdammer 25.07.2013, Hans Wetzels

4. Everybody should have the free choice to eat or cultivate GMO's

Of course everybody agrees on the importance of free choice. The problem with GMO's however is that choosing for GMO's automatically limits someone else's choice to choose for a GE–free approach. Since GMO's are living organisms, you cannot limit them in space nor time. If a farmer starts cultivating genetically modified oilseed rape next to an organic farmer who is also cultivating oilseed rape...there's a high risk that the GMO field will "contaminate" the organic field, thus making the organic farmer loose his market. This "contamination" does not only occur during production but can also happen further down the chain (e.g. transportation, processing, ...). Although there is some legislation in place to minimize contamination (so called co-existence laws), these are not waterproof.

A good concrete illustration of how a choice for one system can hinder other agricultural systems at the level of production is BT (Bacillus Thuringiensis). BT is a bacteria that produces a toxin that is harmful for insects. It is used as a natural insecticide in organic agriculture. But BT is also used in genetic engineering to make BT plants that extract this natural toxin. Ecologists have predicted that genetically modified plants with BT will in the long run lead to BT resistance in insects, which is indeed happening today. There's a risk that BT will thus become useless as an organic pesticide, limiting the already scarcely available organic options to combat pests.

The institutional/economic framework of agriculture is such that the burden of cost is to be borne by the one who wants to avoid GMO's, since contamination is mainstreamed. This is true for the farmer but also for other chain actors such as processers, transporters, etc... To develop a GM free-chain, those wanting to avoid GMO's have to bear the costs. You don't have to be an economist to understand that a free market will give incentives to a GMO (or GMO contaminated) chain and disincentives to the GMO-free chain. Hence we can not speak of "neutral choice".

5. GMO's are an environmental disaster

There are certainly bigger threats to the environment than GM crops (e.g. climate change, loss of biodiversity, ...) but again we should question the costs versus the benefits for a certain GM application. There are two main environmental "costs" associated with GM crops: herbicide use and risk of contamination between transgenic and non-transgenic species.

More than 70% of all the corn, soy, and cotton grown in the US is now genetically modified to withstand glyphosate (roundup). At the same time nearly half of the farms in the US have problems with glyphosate resistant super weeds . Monsanto is therefore developing genetically modified plants that resist more combinations of herbicides... thus looking for a solution with more –and more toxic- chemicals. But we could of course also solve this problem in another way. In a 2012 study[1] researchers found that if farmers simply diversified their crop rotations (which typically consist of corn one year and soy the next, year after year) and included a "small grain" crop (e.g. oats) as well as offseason cover crops, weeds (including Roundup-resistant ones) could be suppressed with dramatically less herbicide use—a 6 to 10 factor less.

Source: http://www.motherjones.com/tom-philpott/2013/02/report-spread-monsantos-superweeds-speeds-12-0

1 http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0047149

Professor Swennen (University of Leuven, Belgium), who established world's biggest collection of bananas, is conducting research on bananas, and uses also genetic modification to improve banana varieties. His practise with regard to patents is very interesting because he applies the principle of humaniatarian clause, which foresees that the smallholders rights are guaranteed whereas the commercial sector needs to pay. If a third party has a patent and Swennen wants to use it for further development, the African Agricultural Technology Foundation (www.aatf-africa.org) guarantees free access to the patent. All the material that is developed by Swennen and his team at the University of Leuven, is given freely to smallholder farmers, without asking for money and without causing administrative burden. The farmer can also freely multiplicate and distribute the seed.

GMO's are living organisms. Once you release them into nature, it is not possible to "call them back". Once GMO's are cultivated in open air, the genetic information of genetically modified plants can transfer to the wild variety or to a neighbor's field … leading to "contamination"orthe creation of "super weeds" that can only be controlled by even more toxic herbicides. In fact this is already happening today, with evident environmental degradation as a consequence. (see sidebar p.5)

The European Environmental Agency concluded in a recent study: "(current) GM crops are well suited to high input monoculture agricultural systems that are highly productive, but largely unsustainable in their reliance on external, non renewable inputs"[5] . So, current GMO-applications fit within an agricultural system that is not sustainable in the long run. The green revolution which increased production tremendously, also led to an extension of monocultures, to a loss of biodiversity, to an overuse of pesticides and fertilizers. Industrial agricultural practices require on average 10 calories of energy (petrochemical production, transport, etc…) to produce 1 calorie of food (EEA).

6. Patents

One of the big issues in the GMO-debate is the issue of patents. Patenting living organisms (such as GMO's or seeds) is highly controversial. And rightly so. Companies defend the patenting of seeds as a driver for innovation. By patenting a GMO, they become "owner" of the gene construct, which means that farmers who want to use the GMO, need to buy the seed again and again. Seed saving is not allowed under patent law. Opponents of patents on plants and seeds state that patenting life will lead to a few companies monopolizing the global seed and food production. There's several examples[6] of farmers having to pay fines to Monsanto (or another big seed company) for having "used" patented seeds without paying for them. It is clear that this kind of practices is harmful for farmers in developing countries who rely heavily on re-using their seed and exchanging seed for free amongst each other.

But patents are not only harmful in developing countries. Recent studies have shown that patents are more often blocking innovation than driving it: "Modifying genotypes and capturing them as Intellectual Property through plant variety protection and patent instruments, is a far easier means of capturing financial benefits than attempting to commodify management-based innovations, such as cover crops, rotation schedules and composting, farmer-initiated training and education or small scale marketing and credit programs. When a singular, centralised and highly specialized approach to agricultural development, such as through genetic engineering, is followed, it can stifle other approaches that might produce even more desirable outcomes (EEA)".

It is interesting trying to imagine how the GMO-development and -debate would have evolved if there had not been the option of patents. Probably very different than what we see today. Patents lead to a short term profit innovation dynamic because one has to earn back the invested money. Would "open-source" GMO's have led to another innovation dynamic? To GMO's for agro-ecology for instance?

5 Hungry for innovation: pathways from GM crops to agroecology, David A. Quist, Jack A. Heinemann, Anne I. Myhr, Iulie Aslaksen and Silvio Funtowicz

6 http://www.globalresearch.ca/gmo-and-the-corporate-patenting-of-living-organisms-monsantos-patents-on-life/5324781

In conclusion,
we should avoid to narrow down the debate to the simplistic position "GMO's are good" or "GMO's are bad". The debate has been framed in this way for more than 15 years and this leads to stalemate positions where there's little place for nuance. Vredeseilanden tries to look for the best possible solution for a given problem, avoiding negative consequences, including negative side effects and negative consequences for future generations. Since the application of GMO's is irreversible in time and space, it is our conviction that we have to be extremely careful and cautious without becoming dogmatic. For the moment being, we have not yet encountered a single GMO that offers the best answer to the complex challenges agriculture faces. Conventional breeding techniques have proven to be at least as effective as genetic engineering in increasing yields or developing resistant varieties. So why then take the risk and hassle of genetic engineering?

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