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Golden Lies: No credibility for Golden Rice campaign

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Content

[1] This briefing is partly based on reports that were previously compiled for the German consumer organisation foodwatch (Then, 2009 and Then, 2012)

Summary

After many years of development, Golden Rice is still not on the market. Initially it was thought that the commercial cultivation of Golden Rice would start in 2012. However, in 2013 this plan was once again postponed for several years. In 2013, the International Rice Research Institute (IRRI) coordinating the project admitted for the first time in public that crucial data for risk assessment were still missing. The current delay might have been triggered by a scandal involving Chinese school children: Chinese scientists were sacked and families received financial compensation after neither the children nor the parents were informed about a trial in which the school children were fed with the genetically engineered rice.

Nevertheless, some well-known advocates of the Golden Rice project such as Ingo Potrykus, one of the inventors of the rice, are still pushing for immediate market authorisation. In the meantime, the advocates of this product appear to have divided opinions. Some have gone as far as to say that government agencies and critics will be complicit in instigating a “Holocaust” (Chassy, 2010) or a crime against humanity[2] if they prevent the introduction of Golden Rice. To speed up market approval and limit expenses, they are campaigning for a general lowering of standards for the risk assessment of genetically engineered plants (Potrykus, 2010).

This report shows that those involved in the Golden Rice project have demonstrated a complete lack of regard for necessary scientific accuracy and precision. Over many years they have used propaganda which was unacceptable from an ethical point of view. In doing so, they have sought to use the project to increase the pressure on regulatory authorities and accelerate the introduction of agricultural biotechnology.

It is still not possible to judge whether or not Golden Rice is even technically able to combat vitamin A deficiency. No data has been made available on the degradation rate of its carotenoid content (in particular during storage), nor on its real bioavailability. Any risks posed by the cultivation or consumption of Golden Rice have been largely ignored. Virtually no data are available on unintended new ingredients and changes in the metabolism of the plants or the reaction of the plants to changing environmental conditions. So far not a single feeding study on the rice has been published. In spite of all this, the trial with Chinese school children still went ahead.

It is highly likely that the commercial cultivation of Golden Rice will lead to the irreversible entry

2 http://www.allowgoldenricenow.org/crimes-against-humanity

of this genetically engineered organism into the environment and to its crossbreeding with local rice varieties. It is not scientifically possible to predict the long-term ecological consequences.

Various reports refer to the significant progress that has been made in the fight against vitamin A deficiency in developing countries over the past 10 years. Efficient and low-cost programs that enjoy and offer a high degree of acceptance and reliability, and that can also be very precisely implemented, do exist. The scheduled market release of Golden Rice is therefore by no means without an alternative.

1. Introduction

The creators of this genetically engineered rice, which is able to generate carotenoids, precursors of pro-vitamin A, named it Golden Rice because its altered metabolism makes the polished rice grains take on a yellow hue. The human body can convert carotenoids and use them as a source of vitamin A. Golden Rice is intended for use in the fight against vitamin A deficiency (VAD), which is particularly prevalent in developing countries.

1.1 Vitamin A deficiency and possible solutions

The aim of the Golden Rice project is to combat widespread vitamin A deficiency, which is a problem in many developing countries. Among other things, this form of malnutrition can lead to eye and skin diseases, to disorders of the immune and reproductive systems, and cause growth deficiency in children. Even mortality is attributable to vitamin A deficiency. The World Health Organization (WHO) estimates that some 190 million children suffer from vitamin A deficiency worldwide, although the range of acute health hazards varies. Children in Africa and Southeast Asia are the most severely affected (WHO, 2009). According to estimates published in 2008 (Black et al., 2008), every year vitamin A deficiency claims the lives of some 670,000 children and causes more than 250,000 children to go blind.

According to a UN report (UNSCN, 2010), the reduction of vitamin A deficiency rates in several regions of the world has come close to the millennium development goal of halving the number of people affected by malnutrition by 2015. Encouraging progress has been made, especially in North Africa, Central and South America, in eastern Asia, and in the Caribbean. However, significantly more effort must be put into reducing deficiency rates in southern and central Asia, and in southern and central Africa. The report considers the vitamin fortification of foodstuffs such as sugar to be a particularly effective strategy in fighting vitamin A deficiency. All experts and institutions involved agree that a mix of measures tailored to regional conditions are necessary to combat vitamin A deficiency: these include breastfeeding, the local cultivation of vegetables, the use of palm oil, raising fish in rice paddies, fortification of Vitamin A in staple foods such as sugar, and the distribution of Vitamin A supplements.[3] Thanks to conventional breeding techniques, new varieties of plants such as cassava and maize with improved vitamin A content are available and also promise to be successful.[4] The Golden Rice project was first presented to the public in 1999. But contrary to initial expectations, it has only just started to t deliver solutions. Conditions surrounding the fight against vitamin A deficiency have greatly improved since the project was first launched. Efficient and cost-effective programs exist that have been proven to work in practice, so there are several alternatives to the genetically engineered rice.

1.2 Scandal with Chinese pupils and postponement of market introduction

When the news broke in February 2009 that the managers of the Golden Rice project had carried out tests with Chinese school children, a public debate was triggered especially in Britain. The issue was whether it was ethically and medically responsible to conduct such tests on humans without previous animal feeding trials.[5]

At a school in the region of Hunan, 68 pupils aged from six to eight were involved in the experiment, 23 of them received the genetically engineered rice with their school food, although it had never been r tested in any feeding studies on adverse effects on health (Tang et al., 2012).

Representatives of the Golden Rice project denied any wrongdoing and flatly rejected demands for further risk assessment. Adrian Dubock, Golden Rice project manager and formerly an employee of Syngenta, was quoted in the British newspaper the Daily Mail as saying:

> *The Golden Rice contains the food colours found everywhere in coloured natural foods and the environment. There is no possible way the trials could do any harm to the participants.*

Other scientists and advocates voiced similar opinions in a letter to the Daily Mail which could be found for a while on the Golden Rice website (http://goldenrice.org/):

> *The experiments were no more dangerous than feeding the children a small carrot since the levels of betacarotene and related compounds in Golden Rice are similar. Contrary to the*

[3] See e.g.: http://www.who.int/nutrition/topics/vad/en/

[4] See e.g.: http://www.vanguardngr.com/2010/10/stakeholders-plan-release-of-vitamin-a-cassava-in-nigeria/

[5] http://www.dailymail.co.uk/news/worldnews/article-1147635/British-scientists-condemn-using-children-GMfood-trials-unacceptable.html

assertions published in the Daily Mail, betacarotene itself is safe to consume at levels far in excess of those present in Golden Rice. The objections to these studies make as much scientific sense as objecting to giving the children a vitamin pill.

The experts quoted compared the potential health risks thatcould result from the consumption of genetically engineered rice to the risk posed by eating a carrot. Without ever having presented a comprehensive analysis of the substances contained in Golden Rice, or having conducted animal feeding trials, these experts claimed it was not necessary to assess health risks, because they did not exist.

In August 2012, the results of the experiment with Chinese pupils were published. At this time the public debate also emerged in China. It became apparent that neither the children nor their parents had been informed about the trial with the genetically engineered rice in the school food. Parents were quoted as saying that they had just been promised free food which consisted of "rice, spinach and tofu"[6]. The scientists involved even denied that genetically engineered rice was used at all.[7] After becoming public, three Chinese scientists involved were sacked and each of the families received financial compensation of $12,800 US from regional authorities.[8]

This scandal is very likely also to have influenced the position of the International Rice Research Institute (IRRI) and in consequence the postponement of market introduction in the Philippines in 2013. As it was announced by the IRRI in February 2013, that environmental risk assessment still needed to be conducted. Further it still needs to be shown whether the daily consumption of Golden Rice actually does improve the vitamin A status of people who are vitamin A deficient.[9] But other well-known advocates of the Golden Rice project such as Ingo Potrykus, who is one of the inventors of the rice, are still pushing for immediate market authorisation. At the moment, the advocates of Golden Rice appear to have very divided opinions.

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6 CHINA OFFICIALS TO PROBE STUDY THAT FED GOLDEN RICE TO HUNAN PRIMARY PUPILS South China Morning Post, ChinaStephen Chen http://www.scmp.com/news/china/article/1031148/china-officialsprobe-study-fed-goldenrice-hunan-primary-pupils, 07.09.2012

7 GOLDEN RICE LEAVES BITTER TASTE Economic Observer, China Anchalee Kongrut, http://www.eeo.com.cn/ens/2012/0921/233859.shtml, 21.09.2012

8 PARENTS OF STUDENTS IN GM RICE TEST WIN PAYOUT, China Daily, China, URL: http://english.eastday.com/e/121208/u1a7046985.html, 08.12.2012
Hvistendahl & Enserink, Chinese researchers punished for role in GM rice study, http://news.sciencemag.org/people-events/2012/12/chinese-researchers-punished-role-gm-rice-study?ref=hp.%2012

9 http://www.irri.org/index.php?option=com_k2&view=item&id=12483&lang=en

1.3 Chronological overview

The Golden Rice project was initiated back in the 1980s. We can differentiate two stages. The first variety of the genetically engineered rice was presented to the public in 2000 (Ye et al., 2000). At the time, several observers criticised the very low carotenoid content, which was also confirmed by researchers at the University of Hohenheim. The rice they had intended to test on mice was found to contain only very minimal concentrations of the vitamin A precursor (see Then, 2009).

In 2005, the agribusiness corporation Syngenta published data on a genetically engineered rice variety that contained considerably higher amounts of carotenoids (Paine et al., 2005). The protagonists of the Golden Rice project took the view that such a high level of carotenoids meant that a bowl of rice per person each day would suffice to make a substantial contribution to reducing vitamin A deficiency (Paine et al., 2005).

Table 1 provides a brief outline of the 25-year history of the Golden Rice project. The hope of making simple technical solutions available with the help of genetically engineered plants to combat poverty issues such as vitamin A deficiency never materialised.

Table 1: Chronological timeline of the development of the Golden Rice project

Year	Project stage
1984	The idea for the Golden Rice project is developed during a conference in the Philippines.
1999	The first generation of Golden Rice is produced.
2000	It is announced around the world that this rice could save the lives of millions of children.
	A patent for the rice is filed (WO2000/053768).
2004	A second generation of Golden Rice is produced with substantially higher concentrations of carotenoids.
	A patent is also filed (by Syngenta)for this new variety (WO2004/085656).
2005	Managers of the project accuse critics and government authorities of being complicit in the death of children.
2009	The results of experimental tests with five volunteers are published. The aim of the tests was to find out whether carotenoids in the rice could be biologically absorbed.
	Reports surface about tests with Chinese school children.
	At a conference held by the Vatican, representatives of the Golden Rice team demand a significant loosening of safety standards for the market release of genetically engineered plants.
2010	Advocates maintain that the failure to grant Golden Rice cultivation approval had already caused millions of deaths ("Holocaust" accusation).
2011	A trial Golden Rice crop is harvested in the Philippines. The Gates foundation grants the International Rice Research Institution (IRRI) another USD 10 million for the Golden Rice project. Commercial cultivation is scheduled to begin in the Philippines in 2013 and 2017 in Bangladesh.
2012	Results from experiments with Chinese pupils are published. Public debates are triggered in China, responsible scientists are removed because parents and children were not informed properly.
2013	Commercial cultivation of Golden Rice is delayed by IRRI for several years.

2. Lack of technical data

This section discusses the rate of carotenoid degradation and its bioavailability (absorption and conversion rate). It is important to study the degradation rate to assess how much carotenoid content the rice loses during storage and cooking. Bioavailability studies tell us how effectively the body converts carotenoids into essential vitamin A.

2.1 Degradation rates

Golden Rice is only qualified for the fight against vitamin A deficiency if it does not lose drastic amounts of carotenoids during storage and cooking. Although it is relatively easy to determine carotenoid content, very little, if any, data has been made available on this issue to date. Although carotenoids seem to survive the cooking process (Tang et al., 2009), systematic trials with different cooking processes (boiling, steaming, frying) and their respective carotenoid content loss have not yet been published.

Data is also missing regarding the shelf life of the rice. How and to what extent temperature, light and air humidity affect the degradation rate of its carotenoid content is one of the most decisive factors in assessing the potential of Golden Rice. Rice is frequently stored for months after harvesting before it is finally consumed. It is almost certain that significant losses in carotenoid content occur during this time. WHO also points out that storage, among other things, can result in carotenoid content loss (WHO, 2006). Tang et al., (2009 and 2012), who conducted the first trial studies with volunteers in the United States, stored their rice at –20 degrees Celsius or even –80 degrees Celsius prior to cooking. Loss of carotenoid content is unlikely at temperatures this low. However, reliable data is still lacking on the shelf life of the rice under realistic conditions. Such information remains unavailable to date in spite of the fact that managers of the Golden Rice project have repeatedly announced its publication (see Then, 2009).

2.2 Bioavailability

Tang et al. (2009 and 2012) published the first data on the conversion rate (or biological availability) of carotenoids generated in Golden Rice. These findings were obtained in trial tests with five adult volunteers (three women and two men) in the United States. Further the rice was tested on 23 pupils in China (see above). Butter or meat was added to the rice during the test, as fats are needed for the absorption of carotenoids. Tang et al. (2009) do not discuss what the conversion rate of Golden Rice might be like under realistic conditions in developing countries. Also losses during storage and cooking were not discussed.

The authors conclude that Golden Rice is a suitable instrument against vitamin A deficiency. In his analysis of the Tang et al. (2009) study, Krawinkel (2009) warns against such general conclusions. He points out that the experiments are not suited to measure the real bioavailability. For instance it is not clear what other oils and fats would have to be consumed with the rice to enable the absorption of carotenoids in the intestine under realistic conditions.

2.3 Environmental factors

It is generally known that the concentration of components in plants can depend on interactions between the environment and the genotype. In transgenic plants, the added genes can bypass natural gene regulation. In many cases, little is known about their genetic stability under changing environmental conditions. For instance the concentration of Bt toxins in genetically engineered maize varies greatly, but the causes have not yet been completely explained (Then & Lorch, 2008).

The Golden Rice data available do not report exactly which environmental factors result in higher or lower carotenoid values and how great their variability is have yet to be discovered. These data would be necessary for assessing the nutritional quality as well as the risks of the genetically engineered rice.

3. Risks

Transgenic plants must undergo specific safety testing. Overall, it is striking how little data on Golden Rice has been published thus far. The data which are usually provided by the applicants to gain market authorisation such as data about exact insertion of the additional DNA, possible unintended change in the plants´ composition and a comparison of agronomic performance between the rice and conventional plants are not available so far. These data as well others are absolutely necessary to conduct any risk assessment.

In the case of Golden Rice, DNA technology is used to manipulate the genome of the plants by inserting an additional metabolic pathway. This causes carotenoids, new components not previously found in rice grains, to be generated. Unlike in mutagenesis or crossbreeding, the mechanisms of natural gene regulation are not used in genetic engineering; on the contrary, they are intentionally bypassed. Genetic intervention can result in a whole series of biological effects relevant to risk assessment. Possible reactions include a general weakening of plants (increased susceptibility to disease, lower yields), decreased tolerance to stressors (such as climatic conditions), but also improved fitness (for example, the increased production of pollen and seeds), or the production of unwanted (antinutritive, immunogenic or toxic) components.

There is the likelihood that certain environmental conditions trigger unintended reactions in transgenic plants, or that it might take several generations for these reactions to occur. Systematic studies of the interaction between genetically engineered plants and their environment are currently not required within the framework of the EU approval process. But the increasing number of publications addressing unintended traits in genetically engineered plants, e.g. in petunias (Meyer et al., 1992), cotton and maize (see Then & Lorch, 2008), potatoes (Matthews et al., 2005), wheat (Zeller et al., 2010) and soy (Gertz et al., 1999) show how badly studies are needed. These questions were not investigated in regard to the Golden Rice. Questions that Testbiotech forwarded to responsible experts at the IRRI did not result in substantive answers.

3.1 Health risks

It is astonishing that so far, there are no data available on the concentration of substances, metabolites and gene expression, and no studies were conducted such as testing for subchronic toxicity and immunogenic or antinutritive effects. No publications are available in which the substances and metabolic profiles of Golden Rice are compared to those of conventional parent plants.

Animal feeding trials to test any potential health risks posed by transgenic rice have not been carried out. Following their initial tests with volunteers in the United States, Tang et al. (2009) also assume that further testing would be necessary to assess the safety of Golden Rice:

> *A much longer exposure with a larger cumulative consumption of Golden Rice would be needed to make definitive assertions regarding the inherent safety of this food for human use.*

Specific announcements regarding further risk assessment studies of Golden Rice were first made in 2011. It was announced, the International Rice Research Institute (IRRI) would assess the safety of the plants in accordance with international standards. Then it would be up to Helen Keller

International (HKI), a worldwide non-governmental organisation also active in the Philippines, to evaluate whether the rice was in fact suitable for human consumption and whether it actually provided the required levels of vitamin A.[10] In 2013, IRRI stated that marketing of the plants had to be postponed since essential data were still missing. [11] For the first time, a feeding study to examine adverse health effects was announced. By doing so, the developers of Golden Rice for the first time admitted that crucial data to assess quality and safety of the plants were still missing.

3.2 Environmental risks

When transgenic rice is released in regions where weedy rice (a type of wild rice) grows, the transgenic rice can outcross to weedy rice through pollen flow. Wild rice varieties are very common in many agricultural regions (Ferrero, 2003; Chen et al., 2004). Genetic crossing between the rice cultivated in fields and the wild varieties that grow in neighbouring surroundings takes place quite extensively (Chen et al., 2004). Under these circumstances, the uncontrolled proliferation in the environment of a genotype whose natural gene regulation has been modified by a technical application can hardly be prevented. There is the possibility that alien genes can spread to and accumulate in rice plants' weedy relatives (Chen et al., 2004).

Other studies in China show that hybrids resulting from crossbreeding between cultivated transgenic rice and its wild relatives can exhibit unexpected biologic characteristics. For example, the concentration of Bt toxins poisonous to insects increased in some plants that were a cross between transgenic rice plants and wild varieties (Xia et al., 2009). Furthermore, hybrids featured improved fitness in comparison to non-transgenic parent plants (Lu & Yang 2009).

These effects can cause a widespread proliferation of plants. The improved fitness of the plants was unexpected and researchers cannot explain it by the specific changes introduced into the plants from genetic engineering. This means that the ability is limited for predicting the potential for proliferation and the biologic characteristics of transgenic rice and their crossbreeds. In any case, it seems very unlikely that alien genes, once they spread among wild populations, can be retrieved (see Bauer-Panskus et al., 2013). zurückholen lassen (siehe Bauer-Panskus et al., 2013). Recent research shows that climate change will cause transgenes move faster into weedy rice publications (Ziska et al., 2012).

10 http://irri.org/knowledge/publications/rice-today/features/golden-grains-for-better-nutrition
http://www.hki.org/reducing-malnutrition/biofortification/golden-rice/

11 http://www.irri.org/index.php?option=com_k2&view=item&id=12483&lang=en

This characteristic of rice, which can remain dormant for a long time, to spread its seeds beyond fields and into the surrounding environment, poses risks to ecosystems and can cause serious disruption to the cultivation of rice in general. Genetic exchange is not a one-way street; it works in both directions. Exchanges between fields and surrounding wild rice varieties can develop into a regular cycle. The pollen of wild rice varieties can also carry the alien genes back to the fields – even to fields where conventional rice is cultivated. Thus Golden Rice cultivation threatens to provoke an unpredictable and extremely problematic scenario:

1. The crossing of genetically engineered rice crop varieties and their wild relatives can exhibit surprising biological traits that can lead to speedy proliferation in the environment, with unpredictable ecological consequences.
2. Once alien genes have managed to mix with populations of wild rice, it is no longer possible to control or reverse their spreading.
3. Once alien genes have spread to populations of wild rice, the contamination of conventional rice crops is inevitable and must be expected.

The retrievability of genetically engineered plants should be a prerequisite for their use. The mid-term and long-term impact of their release on evolutionary processes, biodiversity and human health cannot be scientifically predicted with an adequate degree of certainty. Releases can only be accepted if their duration and location can be controlled (see Bauer-Panskus et al., 2013).

4. Golden lies

For a long time, Golden Rice has been associated with the highest humanitarian goals. A Time Magazine cover in 2000 proclaimed: “This rice could save a million kids a year” (Time Magazine, 2000). But what was completely at odds with the lofty project’s humanitarian goals was the fact that an adequate evaluation of the project in terms of its technical suitability was not possible at the time – a problem that has not been resolved to this day. At the time, scientists had merely been able to use genetic engineering to produce carotenoids in rice grains for the first time, albeit only in low concentrations. The actual concentration in the rice grains was perhaps even lower than originally stated (see Then, 2009).

Since then the proponents of the Golden Rice project have continued to raise high expectations and invoke moral arguments to speed up the approval process. At a biotechnology industry conference in 2005, Ingo Potrykus, the inventor of Golden Rice, not only emphasised the potential of Golden Rice, but also accused government agencies of imposing excessively stringent risk assessment standards on genetically engineered plants (see Then, 2012). He claimed that there were no significant differences between traditional breeding and genetic engineering – so why should genetic engineering be subject to risk assessment?

The main focus is on serious moral accusations: 'Over-regulation' is costing lives. Genetic engineering must be 'de-demonized', otherwise society would be committing 'a crime against humanity' (see Then, 2012). Potrykus continued to advance this line of argument in 2010 in an opinion piece in Nature magazine (Potrykus, 2010). He again maintained that there was no difference between traditional breeding and genetic engineering. Potrykus claimed that only the exaggerated requirements of regulating agencies were to blame that the product was not yet on the market:

> *Golden Rice will probably reach the market in 2012. It was ready in the lab by 1999. This lag is because of the regulatory differentiation of genetic engineering from other, traditional methods of crop improvement. The discrimination is scientifically unjustified. It is wasting resources and stopping many potentially transformative crops such as Golden Rice making the leap from lab to plate.*

In his publication, Potrykus completely ignored the fact that technical questions and issues having nothing to do with risk assessment significantly contributed to the delay in realising the project. For instance, the rice initially displayed a very low level of carotenoid concentration. Nothing was published regarding its bioavailability until 2009, and technical data regarding its shelf life is still not available (see above). Moreover, nearly all the information needed to even begin work on concrete risk assessment is still missing.

The choice of arguments and the way facts are presented make it evident that the interests served by the introduction of Golden Rice are not purely humanitarian. Advocates such as Potrykus (2010) are concerned with the general easing of risk assessment standards for genetically engineered plants. Transgenic plants should be considered equal to conventionally bred plants and exempted from having to undergo detailed risk assessment.

Other experts involved in the Golden Rice project advance arguments similar to those of Potrykus (e.g., see Dubock, 2009). Bruce Chassy, a strong proponent of the planned cultivation of Golden Rice in the Philippines, takes these arguments to an extreme (Chassy, 2010). He even goes so far as to compare the consequences of the delayed market approval of Golden Rice (which he abbreviates as GR) with the Holocaust. Chassy believes that Golden Rice should have been distributed to farmers without further testing as early as 2002 or 2003. In his paper entitled “The Silent Holocaust” he elaborates (Chassy, 2010):

> *“As noted previously, VAD kills approximately 2 million people a year – most of them rice-eating children. If GR had been bred by conventional means, two or three years might have been required to propagate and distribute the seeds, and – assuming a reasonable adoption rate – perhaps the lives of a half a million or a million people a year might have been saved until now. (…) GR has instead been confronted with critics who have delivered a long list of ill-founded claims about safety and efficacy. The consequence of these misperceptions about real risks is that GR has also confronted an intransigent regulatory system that requires millions of US dollars and many years to navigate for each new product. (…) Considering the minimal safety concerns associated with GR and the staggering annual toll of VAD, would it not have been a better choice to distribute the seeds just as would have been done if they were conventionally bred? The moral calculus is surprisingly simple: if GR had been distributed in 2002 or 2003, millions of lives might have been saved. Not to have disseminated the seeds of GR until now has allowed as many people to die silently as were killed in the holocaust.”*

Chassy’s Holocaust comparisons (2010) have to be seen as part of an international communications campaign. The argumentative patterns of the Golden Rice team and the industry are more or less congruent, and not only as far as Golden Rice is concerned. In fact, Golden Rice is being used as an opportunity to demand a general loosening of risk assessment standards for genetically engineered plants. The most important argumentative structures that these groups have in common are:

- They describe the risks posed by genetically engineered plants as being the same as those posed by conventionally bred plants.
- They hold regulatory agencies and critics responsible for delays in the development of Golden Rice.
- They do not discuss existing and effective methods for combating vitamin A deficiency, or give them only marginal attention.
- They show no moral qualms in invoking the obligation to help undernourished children in order to achieve a general expedited approval process for genetically engineered plants.

All in all, the communication strategies used by many proponents of the Golden Rice project are ethically questionable, propagandistic and alarmist. They clearly contradict the humanitarian goals of the project and impede factual debate. This nearly hysterical rhetoric was continuously exaggerated within the last years. Its most recent peak of absurdity was reached by a campaign „Golden Rice Now“[12].

But opinions on the Golden Rice Project do seem to be divided. Especially the scandal involving Chinese pupils is likely to have triggered a U-turn in the position of some of those responsible for the project. In 2013, for the first time IRRI, which is taking a lead in the project admitted that crucial investigations were still missing:[13]

> „The Philippine Rice Research Institute, in partnership with the International Rice Research Institute and other partners, have recently finished two seasons of field trials in the Philippines, but this doesn't mean that Golden Rice is now ready for planting by farmers. Data from these trials must next be submitted to Philippine government regulators for their evaluation as part of the biosafety approval process. (…) However, it has not yet been determined whether daily consumption of Golden Rice does improve the vitamin A status of people who are vitamin A deficient and could therefore reduce related conditions such as night blindness.“

Feeding studies were announced for the first time.[14] According to IRRI, market authorisation still cannot be expected in 2014:

> *As of September 2013, Golden Rice is still under development and evaluation by leading nutrition and agricultural research organizations. Golden Rice will not be broadly available to farmers and consumers unless and until it is (a) deemed safe for humans, animals, and the environment and approved by national regulators and (b) shown to reduce vitamin A deficiency in community conditions—a process that may take another two years in the Philippines.*

It has been made clear that the rice is still under development and it will take further years until all investigations are finalised:

> *The development of Golden Rice is on pace with this timeframe. In 2006, IRRI and others began working with a new version of the Golden Rice trait that produces significantly more beta carotene than the 1999 prototype, and it is this version of Golden Rice that is still*

12 http://www.allowgoldenricenow.org/crimes-against-humanity
13 http://www.irri.org/index.php?option=com_k2&view=item&id=12483&lang=en
14 http://irri.org/golden-rice/faqs/will-golden-rice-be-tested-on-animals

under development and evaluation. Golden Rice will only be made available broadly to farmers and consumers if it is approved as safe by national regulators and shown to reduce vitamin A deficiency in community conditions, a process that is likely to take another two to three years

These announcements regarding further evaluation were welcome news, but the impartiality of the institutions involved is doubtful. Gerard Barry is the project's coordinator at IRRI and a former Monsanto employee.[15] Monsanto, an American corporation, is the world leader in genetically modified plants. What is more, IRRI has secured for this project the services of Seed Stories, a communications consultancy[16] whose clients include industry associations such as CropLife International and corporations such as Monsanto.[17] Helen Keller International receives donations from food corporations and the pharmaceutical industry. Monsanto has also been supporting HKI for years.[18]

5. Conclusions

As regards essential transparency and due scientific diligence, the project has serious flaws that cannot be overlooked and that undermine its credibility. At the same time, proponents employ a strident and aggressive rhetoric, going as far as using Holocaust comparisons. Furthermore, well known proponents of the Golden Rice project are demanding a general easing of safety standards and testing requirements for the market approval of transgenic plants. To achieve this, they advance arguments that are obviously driven by partisan interests. This course of action is not consistent with the project's humanitarian approach, besides being scientifically and ethically unacceptable.

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15 http://www.lobbywatch.org/archive2.asp?arcid=4222

16 http://irri.org/news-events/hot-topics/golden-rice/golden-rice-blog/potential-benefits-of-golden-rice-highlightedin-recent-media-articles

17 http://www.seed-stories.com/clients.html

18 http://www.hki.org/about-us/financial-information/annual-reports

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