

Extract from:

# Gates to a Global Empire



**OVER SEED, FOOD, HEALTH, KNOWLEDGE  
...AND THE EARTH**

A GLOBAL CITIZENS' REPORT

Coordinated by

 **Navdanya**  
international

## **SECTION 2**

### **BIOPIRACY: THE PLUNDER OF BIODIVERSITY AND KNOWLEDGE**

## DIGITAL BIOPIRACY TO UNDERMINE INTERNATIONAL TREATIES THAT PROTECT BIODIVERSITY AND PREVENT BIOPIRACY

In 1992, the International community created the UN Convention on Biodiversity (CBD)<sup>1</sup> which recognised the sovereignty of communities and countries to their biodiversity and knowledge. The Nagoya Protocol<sup>2</sup> under the Convention was meant to regulate the access to Biodiversity. Similarly, consequent to the FAO conference on Plant Genetic Resources in Leipzig in 1996<sup>3</sup>, the International Treaty on Plant Genetic Resources, or Seed Treaty<sup>4</sup> was negotiated in the FAO.

Gates, and his push to digitalise every aspect of life, undermines the CBD and the FAO Seed Treaty through Digital Sequence Information (DSI)<sup>5</sup> and patents based on digital genome mapping.



COP13 - Convention on Biological Diversity. Source: <https://mx.boell.org/es/2016/12/21/cuatro-pasos-adelante-y-uno-hacia-atras-en-la-regulacion-global-de-la-biologia-sintetica>

<sup>1</sup> Boisson de Chazournes, Laurence. "Convention on Biological Diversity Rio de Janeiro, 5 June 1992 / Cartagena Protocol on Biosafety to the Convention on Biological Diversity Montreal, 29 January 2000 ." *United Nations Audiovisual Library of International Law*, n.d. <https://legal.un.org/avl/ha/cpbcbd/cpbcbd.html>

<sup>2</sup> "About the Nagoya Protocol." *Convention on Biological Diversity*. Last modified June 9, 2015. <https://www.cbd.int/abs/about/>

<sup>3</sup> "A Brief History of The Process (ENB:09:47)." *IISD Reporting Services*, n.d. <https://enb.iisd.org/vol09/0947002e.html>

<sup>4</sup> "International Treaty on Plant Genetic Resources for Food and Agriculture ." *FAO*. <http://www.fao.org/plant-treaty/en/>

<sup>5</sup> "Digital Sequence Information | Commission on Genetic Resources for Food and Agriculture | Food and Agriculture Organization of the United Nations." <http://www.fao.org/cgrfa/topics/digital-sequence-information/en/>

## A TREATY TO PROTECT OUR AGRICULTURAL BIODIVERSITY <sup>1</sup>

Josè Esquinas-Alcazar

For centuries peasants have stored, selected, and exchanged seeds by keeping them in an evolutionary relationship with the surrounding environment. This is a heritage of humanity that has suddenly been threatened by the regime of the Green Revolution and by multinationals' entrance into the seed sector. If over the last thousands of years humanity had more than 10,000 natural species available for their nutrition, today we have just a little more than 150 commodities grown for commercial use. Amongst them, only 12 of those make up 80% of the global food supply and 4 of them alone, being rice, wheat, corn, and potato, cover more than half of our consumption.

The damage to biodiversity has been so significant that the same FAO, starting from the 1970s, began negotiations for the creation of a **UN International Treaty on Plant Genetic Resources for Food and Agriculture**, to contain biodiversity erosion. To this day, the Treaty, which came into force in 2004<sup>2</sup>, is the only international instrument protecting local farmers' rights to save and exchange their seeds within biodiverse systems. The Treaty provides for a global genetic resources reserve of 64 plant species that alone represent 80% of our fruits and vegetables consumption. This Treaty must be continuously strengthened and protected from economic interests, in the awareness of its inestimable value for the future of humanity. In November 2019, the biennial meeting for the Treaty took place in Rome which, according to many observers, was a failure precisely because of the huge economic corporate interests present.

In terms of the hoped-for and necessary advances for the protection of biodiversity, the focus on what was considered by many to be the most important, namely the updating of the benefit-sharing mechanism whereby those who receive plant genetic resources included in the multilateral system are required to pay a fair share of the benefits generated by the marketing of those products, we must acknowledge that no agreement has been reached. However, we should not consider it a failure; because the Treaty is constantly under definition there are still many positive aspects. Firstly, there has been no criticism of the Treaty as such. It has been consolidated and is regarded as a reference of fundamental importance by all - even by the seeds industry, that would not be able to work without access to genetic resources. Then there was the Rome meeting with the ratification of the USA and Japan, which took place only 2 years ago in 2018, almost 15 years after the European countries. Progress has also been made on farmers' rights and the important initiative on the monitoring and study of good practices, which will continue over the next two years, into 2022. The next phase is

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<sup>1</sup> Extract from: Masucci, Manlio. 'Un accordo per tutelare la biodiversità agricola'. *Terra Nuova*, 16 Feb. 2020, <http://www.terranuova.it/Il-Mensile/Un-accordo-per-tutelare-la-biodiversita-agricola>

<sup>2</sup> FAO Newsroom, Treaty on biodiversity to become law, 31 March 2004 - Rome, <http://www.fao.org/newsroom/en/news/2004/39887/index.html>



now being realized, that of interpretation of the Treaty, especially on those parts where the text has become obsolete as a result of the introduction of new technologies. It is preferred to not reach an agreement, rather than make a bad one. Therefore, as far as the benefit-sharing mechanism is concerned, it was decided to postpone the discussion, also because in the meantime, the huge issue of Digital Sequence Information (DSI)<sup>3</sup> has opened up and presents several issues.

DSI is about the digitalization of all genetic information related to seeds. In this way, it is possible to improve varieties without having access to the actual seed, but by simply using genetic sequences. This new technological milestone obviously has an immediate economic impact because some countries and seed companies, when using DSI, do not want to recognise the obligation of benefits distribution.

On the other hand, it is also true that it was the farmers who have developed the original varieties in the first place, and that - without those seeds - there would be no information available. This is like agreeing to buy a printed book but refusing to pay the digital version of the same book, even though the copyrights are the same. We are facing a revolution in the way we conceptualize seeds. We cannot allow for them to be defined as mere sequences of genetic information because they are real genetic resources. We must insist on establishing this principle. In 2 years' time in Rome, an agreement will need to be reached: we cannot afford to lose further biodiversity in times of climate change, when we will need resilient varieties to be available to everyone. The issue is so important, that we have no right to pessimism.

In the early stages of the process, small producers and multinationals agreed to sit at the same table the latter accepted the idea that an agreement had to be reached. As in the second half of the 1970s the loss of agroecological diversity became clear to everyone, including the FAO who had promoted the Green Revolution and even the multinationals. Every farmer had his/her own heterogeneous local varieties that had been replaced with a few commercial homogeneous varieties, which resulted more productive only by using fertilizers and pesticides. The increase in productivity was achieved at the price of biodiversity and local identity loss.

Everyone realised what the issue was, and the importance of biodiversity. Uniformity equals vulnerability, and it is therefore essential to preserve biological diversity in order to cope with both plant diseases and environmental changes. *Ex situ*<sup>4</sup> germplasm banks do not solve the problem because they store frozen germplasm. In this way, also the evolution of the plant freezes, and no longer

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<sup>3</sup> African Centre for Biodiversity, Third World Network, Prudence versus Pressure at the Seed Treaty, October 2019, [https://www.acbio.org.za/sites/default/files/documents/Prudence\\_versus\\_Pressure\\_at\\_the\\_Seed\\_Treaty.pdf#\\_blank](https://www.acbio.org.za/sites/default/files/documents/Prudence_versus_Pressure_at_the_Seed_Treaty.pdf#_blank)

<sup>4</sup> "Ex-Situ Conservation Definition | Biodiversity A-Z." <https://biodiversitya-z.org/content/ex-situ-conservation>

develops the ability to adapt to new conditions. Only "in situ"<sup>5</sup> conservation guarantees the preservation of a living seed that has the ability to adapt. The beginning of the negotiation was difficult, and we had to organize "secret meetings" to inform journalists and politicians about the facts. That was until we managed to convince the FAO to promote an international agreement.

The Treaty is also crucial because of inter-country interdependence. For example, what happened in Ireland in the 1940s, when potato crops, which was the national staple food, were attacked by a fungus, the *Phytophthora infestans*. The famine that followed is considered one of the greatest catastrophes in European history as it caused the death of some two million people. But what was the underlying problem? Why was it impossible to cope with the disease? The answer is simple and brings us back to the dangerous concept of uniformity: at the end of the 1500s, a handful of uniform varieties of potatoes were introduced into Ireland. And it is because of that uniformity that the *Phytophthora* fungus was able to spread easily. The conquistadors had only brought that one variety. At that point, how could this problem that threatened the rest of Europe be solved? European agronomists had to return to Latin America, and precisely to Peru, to find other diverse resistant varieties to eradicate the disease. But this is not an old story.



"A selection of Chiloé's roughly 400 native varieties of potatoes". Source: [https://en.wikipedia.org/wiki/Potatoes\\_of\\_Chilo%C3%A9](https://en.wikipedia.org/wiki/Potatoes_of_Chilo%C3%A9)

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<sup>5</sup> "In-Situ Conservation Definition | Biodiversity A-Z." <https://biodiversitya-z.org/content/in-situ-conservation>

For example, in 1971, a corn disease attacked all American hybrid varieties and wiped them all out. Confronted with evidence that commercial varieties could not adapt, agronomists searched and found resistant varieties in Africa. Diversity is what saved Europe and the United States. The only difference with the great Irish famine is that there were not millions of deaths, but billions of dollars lost. This explains the inter-country interdependence, where small farmers of Latin America solve the problems of Europe and small farmers of Africa solve the problems of the USA. In times of climate change, stability and uniformity are suicidal. These cases have recurred and continue to happen today.

Although inter-country interdependence is a fact, the dispute between developed and developing countries is always heated. At the last meeting in Rome, the chairmanship was entrusted to the USA and the working groups were unbalanced in favour of the developed countries behind which the interests of seed companies lie. This great paradox already existed in the 1970s. As the greatest diversity resides in developing countries while the most important germplasm banks are located in developed countries, whom do these genetic resources belong to?

According to the law, they belong to the country that preserves them. There was then a need to develop an agreement to make sure that these resources remained a patrimony of humanity. But even if they were declared a patrimony of humanity, who would use them? Still, the rich countries. That is why I speak of a paradox - the poorest countries, which were the actual suppliers of the raw material, had to pay royalties on the seeds afterwards.

We have now lost the beautiful concept of the Patrimony of Humanity in the Treaty, but we have come to a fairly good agreement that includes the multilateral system of benefit sharing, which includes economic benefits. Profits from new varieties will be channelled into an international financial mechanism aimed at financing projects for the benefit of farmers in developing countries. This was not an easy objective to achieve. In the beginning, the US opposed the principle that multinationals should be required to pay a percentage of their revenues. I remember that during the deadlock it was the multinationals themselves who declared that they would agree to pay a percentage. This episode tells us two things: the first is that it is vital for companies to have access to genetic material, and the second is that governments, in their efforts to defend multinationals, are often more royalist than the king.

But the multilateral system of benefit sharing has to be improved because so far, it's gathered very little revenue. It is a mechanism overloaded with bureaucracy. Moreover, there is the issue of having to trust the company that starts to calculate the percentages only after the commercialization of the new variety takes place, which often happens about 8 years after the acquisition of the genetic resources. As a matter of fact, payment for access to resources is supposed to be guaranteed. In short, it is a self-regulating mechanism that has not worked that well so far, to the point that it had to be supported by voluntary funds from countries.



Still, the Treaty is considered binding and it is important for farmers and consumers. It has been ratified by almost 150 countries. All legislation must adapt to it. Of course, concrete implementation depends on the priorities of each country. In Italy, for example, some regions have decided to apply it in advance without waiting for a national law.

As far as farmers are concerned, the Treaty is an instrument against the overwhelming power of multinationals. It recognises the rights of farmers, as guardians of agricultural biological diversity and traditional knowledge. Nothing must oppose the exchange of conservation and breeding of traditional varieties. As far as consumers are concerned, it is necessary to inform them that without biodiversity there is no diversity in their plates.

Nor do we have the right nourishment in industrial products whose production does not respect the environment, as territories are poisoned and biodiversity destroyed, while products travel thousands of kilometres and are full of chemicals. In Europe we are spending 700 million euros a year on diseases caused by junk food. The problem is that farmers are disappearing because they cannot compete with an industrial agriculture that does not pay for externalities. And with what results? Much more than we need is being produced but people are still dying of hunger or diseases caused by poor nutrition. A third of the food produced is also being thrown away. In Spain, each inhabitant throws away an average of 160 kilos of food per year. The employment factor is also affected. Today in Spain only 2.5% of the population works in agriculture and unemployment rates are sky-high. The employment factor is also an externality of the agribusiness system. In short, for every euro we pay in the agribusiness market, we pay two euros plus tax to reduce the negative effects. The real price of the food we buy is three times higher. We must reverse this situation, starting with the elimination of subsidies to industrial agriculture.



*Apple diversity, Italy*



## DIGITAL SEQUENCE INFORMATION (DSI) AND THE INTERNATIONAL TREATY ON GENETIC RESOURCES

Josè Esquinas-Alcazar

**W**hen the International Treaty was being negotiated there was a debate over what the treaty should be named. It was deliberately decided that the name should be referent to 'genetic resources' and not 'Seeds' (as was proposed by some countries), since what is really considered valuable is not the seed understood as a physical support, but the genetic resource or information contained in its genes.

In the same way that all the information contained in a book is coded in a 28-letter vocabulary (in the case of the Spanish language) which are repeated by changing the sequence of the letters, in the case of seeds the information is "written" in their genes in a vocabulary of only four "letters" (bases): Adenine, Guanine, Thymine and Cytosine. In both cases it is the sequence or order in which the respective "letters" appear that allows all the different messages in the book or all the characteristics of the plant to be expressed.

When we scientists can "read" the genetic code of a traditional seed or variety, it is possible to reproduce it with no other limits than those imposed by the available technology. Today, Digital Sequential Information (DSI) technology allows us to access these genetic resources, reproduce and use them without the need to have access to the physical or tangible seed.

For the reader of a book, it is its content, regardless of whether we have access to it physically or virtually, which is why the copyright is paid in both cases. Similarly, for the researcher or seed company, the value of a traditional variety or seed depends on its genes or genetic sequences regardless of whether we have access to them physically (seed) or virtually (DSI).

The crux of the matter is that the ISD is not only information but the Genetic Resource in virtual form and therefore its access, use and benefit sharing should be regulated as a Genetic Resource and not simply as information in the Multilateral System of Access and Benefit Sharing of the International Treaty.

If we were to allow access to the virtual genetic resource (DSI), without the obligation to share benefits, we would have emptied the treaty of its content and thrown overboard 30 years of difficult negotiations in search of a balance (ABS) between the interests of those who contribute their genetic resources and those who contribute the technology.

## **BEYOND GREEN GOLD: MEGADIVERSE COUNTRIES AS PROVIDERS OF GENETIC RESOURCES AND DIGITAL SEQUENCE INFORMATION**

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Adelita San Vicente Tello

**T**he Convention on Biological Diversity (CBD), which came into effect in 1993, has three main objectives: "The conservation of biological diversity; the sustainable use of its components; and the fair and equitable sharing of benefits arising from genetic resources". According to Article 1, these objectives may be achieved through, "appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding" (CBD).

As stated in Article 2 of the CBD, the definition of "technology" includes "biotechnology" which is defined as "any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use" (CBD). It is evident that this technology necessarily depends on genetic diversity, which is found in megadiverse countries such as Mexico.

In December of 2016, three important international meetings took place simultaneously in Cancun, Mexico: 1) the 13<sup>th</sup> meeting of the Conference of the Parties (COP) of the Convention of Biological Diversity (CBD); 2) the 8<sup>th</sup> COP of the Cartagena Protocol on the Biosecurity of Biotechnology, and; 3) the 2<sup>nd</sup> COP of the Nagoya Protocol (NP) on Access to Genetic Resources and Associated Traditional Knowledge. In all three of the meetings, emphasis was placed on "the very worrying shift towards a predominantly mercantile view of nature and the growing influence of the business sector at different levels of the organisation, in conferences, projects and activities of the Convention and its associated bodies. The participation of the business sector [in the CBD] through the Global Partnership for Business and Biodiversity is becoming increasingly important" (Betancourt, 2016).

In fact, it was during one of the meetings of the Conference of the Parties (COP) that the hosting delegation first began to promote the use of "integration of biodiversity" as a concept. This term quickly became mainstream in the COP and its official language, English, while in Spanish it began to be interpreted as the integration of biodiversity according to its exchange value, or in other words, its commercial potential.

Conversely, Mexico was the first of those countries that ratified the Nagoya Protocol to show to the world the way in which it might be implemented; it was applied to the maize species called *olotón*, a hugely important variety owing to its ability to "fix nitrogen" in the atmosphere. The Mexican Secretariat of Environment and Natural Resources (SEMARNAT) "welcomed the fact that in Mexico the

benefits established by the Nagoya Protocol were already being reflected, particularly with regards to the legal certainty needed for the use of genetic resources, by establishing measures to prevent their improper use" (SEMARNAT, 2018).

In these same meetings of the COP, it became evident that digital sequence information (DSI) was an increasingly important topic for attendees and sparking several debates on this particular approach to the storage of genetic information. So significant was it, that the 196 countries present at the meeting "agreed to investigate the ways in which digital sequence information might be used in new forms of biopiracy" (Böll, 2016).

DSI facilitates "digital biopiracy" because it allows for the downloading of genetic sequences of plants, microorganisms and seeds from the Internet, which can later be used to recreate physical DNA using methods taken from synthetic biology. This may be done without considering any potential benefit for the countries and communities from which the organisms originate, and in which this genetic information is based (Böll, 2016). DSI may include the following: sequences of nucleotides which form part of deoxyribonucleic acid (DNA), sequences of ribonucleic acid (RNA), amino acids which form proteins, chemical compounds derived from genetic information (metabolites) and even environmental information or information related to ecological interactions between sequences (epigenetics), as well as any other resulting information.

Today, there exist millions of DSI in public and private databases. These sequences can be used and modified for commercial purposes and patented, without following any of the basic principles established by the NP; in other words, their use does not necessarily imply any financial or non-financial benefits to the Parties, which provide those resources. They may not even require Prior Informed Consent (PIC) or Mutually Agreed Terms (MAT), much less the fair and equal sharing of the benefits that result from the use of genetic resources.

DSI are intrinsic to "physical" genetic resources and the two are therefore inseparable. Gaining access to DSI without following the main regulations of the NP encourages biopiracy and leads to unilateral economic benefits which miss the most important aim of the CBD; "the conservation and sustainable use of biological diversity". It is precisely for this reason, that it is important to recognize that DSI should be considered as valuable as any "physical" genetic resource.

Furthermore, the present low-cost of genetic sequencing and the free availability of DSI in databases are both factors that are contributing to a reduction in the need for "physical" access to genetic resources.

In Cancun, a very important agreement was reached: to request opinions with governments, civil society, indigenous and local communities so as to know their opinions on the theme of genetic resources as well as to establish ad hoc groups of technical experts to analyze these discussions (CBD, 2016). This agreement was envisaged as a starting point from which to begin analyzing the



implications of digital sequence information. It must be recognized that “the members of the CBD took an enormous step forward in addressing the controversial theme of digital biopiracy as a means of attending to the many legal gaps that exist in the Convention on Biological Diversity. Although its true to say that some Northern countries with powerful biotechnological industries (such as Canada) tried to have the theme of digital biopiracy removed from the discussion agenda, ultimately everyone agreed that the issue warranted deeper scrutiny and that this would be addressed as part of future meetings” (Böll, 2016).

It is crucial to recognise that open access to DSI has been fundamental to scientific research, which has resulted in studies that expand our knowledge of the many different aspects of genetic resources, both in evolutionary and taxonomic terms as well as in relation to diversity and conservation. Similarly, it has played a fundamental role in the development of medicines, and the diagnosis and molecular identification of organisms of biomedical interest, particularly in the field of public health, amongst others.

However, open access to this information has also been considered *res nullius*, a legal term translated as “nobody's thing”, which means that digital databases containing genetic information uploaded by researchers are freely available to companies and other parties who generate intellectual property rights over sequences with no regard for the existing ancestral work and knowledge that indigenous communities hold on that particular information.

The use of DSI implies great responsibility and its possible repercussions require ethical principles. Therefore, in order to fulfil the 3<sup>rd</sup> aim of the CBD, those researchers who upload sequences onto digital platforms must commit themselves to providing data that helps in the traceability of the aforementioned DSI. Finally, it must be said that open access does not mean unrestricted or unregulated access, because at least theoretically one could benefit from and make use of DSI obtained through unethical or bad practices.

As a megadiverse country, Mexico is an important provider of genetic resources and thus of many different kinds of DSI. It is acknowledged that biodiversity continues to be the inheritance of indigenous and local communities who, using the profound knowledge built up over centuries, and practices such as seed exchange and the sustainable management of nature, have managed to create and recreate biodiversity in line with their cosmologies which imply a positive and congruent relationship between communities and their environments. For this reason, it is clear that there is a need to promote of biocultural heritage (Toledo, 2008) as a strategic position, particularly for megadiverse countries, who are more likely to be providers of genetic resources and therefore, also, of DSI.

However, in past decades, successive neoliberal governments in Mexico (1982-2018) opened many of the nation's vital resources up to the transnational market, and amongst those were genetic resources. It is calculated that “since 1996, [the Mexican government] has authorized 4,238 permits for scientific collection” (Betancourt, 2016) and many of these authorizations have resulted in



*"Maize, the sacred grain used in the rituals of indigenous agriculture", by Jack Zalium, is licensed under CC BY 2.0 (<https://creativecommons.org/licenses/by/2.0/deed.en>).*

profiteering. Access was even provided to sensitive genetic resources such as those found in maize. Access to the genetic wealth of this particular cereal and the growing interest in its commercial potential was also demonstrated by a joint-visit made by Bill Gates and Mexico's richest man, Carlos Slim, to the International Centre for the Improvement of Maize and Wheat (CIMMYT) in Texcoco, State of Mexico. There they announced "the investment of 25 million dollars by the Bill & Melinda Gates Foundation and the Carlos Slim Foundation to CIMMYT, which, founded in 1943, had been an initiative of the Mexican government and the Rockefeller Foundation, in which the father of the Green Revolution, Normal Borlaug, had worked" (Nuel, 2013).

The current government, which was democratically elected in 2018, is determined to work for the poorest in society, to protect the sovereignty of the

resources that belong to the nation, and to ensure that indigenous communities are the true beneficiaries, thereby recognising their central role in the conservation of biodiversity. In this way, the government is working to include in local legislation and with great precision the guidelines set out by the NP, therefore reinforcing the vision that indigenous communities already have of their biocultural heritage. Regarding DSI, it is essential that criteria is specified to establish with clarity what the commitments and obligations of users of DSI databases should be so that they might be obliged to share the benefits and not avoid those measures indicated by the NP.

If regulation is often one step behind technology, then time is of the essence and the issue of access to DSI must be discussed and analysed in the 15th COP, through the lens of biculturalism. The challenge for all participating sectors is to face the issue head-on, and although it will not be easy, not to do so risks rendering the Nagoya Protocol meaningless.

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### BIOPIRACY OF CLIMATE RESILIENT SEEDS <sup>1</sup>

Navdanya

**B**iodiversity creates the resiliency needed in seeds to recover from climate disasters.

The Biotechnology industry and the Gates Foundation are intent on using the climate crisis as an opportunity to push GMOs to biopirate and patent climate resilient seeds and deepen their monopoly on the world's seed supply<sup>2</sup>.

Chemical agriculture and the globalized food system are responsible for 40-50% of all greenhouse gas emissions<sup>3</sup> that contribute to climate change<sup>4</sup>.

Both centralized systems and chemical-based monocultures are much more vulnerable to failure and collapse in unstable and climate extremes. It stands to reason therefore that GMOs and monopolies are not the answer to mitigating or adapting to climate change, or reversing biodiversity erosion for that matter, being embedded in chemical monocultures and centralised monopolistic control over the seed supply.

#### How the Gates Foundation Presents the Biopiracy of Flood Tolerant Rice as "Innovation"

**Problem:** In areas of Asia and Africa where rice-growing farmers depend on rain fed agriculture, rice productivity is low and unstable due to stresses such as flooding, drought, and poor soils<sup>5</sup>.

Flooding regularly afflicts over 6 million hectares in South Asia<sup>6</sup> and as much as one-third of the rain-fed lowland rice-growing areas in sub-Saharan Africa<sup>7</sup>.

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<sup>1</sup> Extracted from: Shiva, V. et al. (2017). *Seeds of hope, seeds of resilience – how biodiversity and agroecology offer solutions to climate change by growing living carbon*.

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<sup>2</sup> Capturing 'Climate Genes.'" *ETC Group*, October 21, 2010.

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<sup>3</sup> "Food and Climate Change: The Forgotten Link." *Grain*, September 28, 2011.

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<sup>5</sup> Vogel, E., Donat, M. G., Alexander, L. V., Meinshausen, M., Ray, D. K., Karoly, D., Meinshausen, N., & Frieler, K. (2019). The effects of climate extremes on global agricultural yields. *Environmental Research Letters*, 14(5), 054010. <https://doi.org/10.1088/1748-9326/ab154b>

<sup>6</sup> "2017 South Asian Floods." *Wikipedia*. [https://en.wikipedia.org/wiki/2017\\_South\\_Asian\\_floods](https://en.wikipedia.org/wiki/2017_South_Asian_floods)

<sup>7</sup> van Oort, P. A. J., & Zwart, S. J. (2018). Impacts of climate change on rice production in Africa and causes of simulated yield changes. *Global Change Biology*, 24(3), 1029–1045. <https://doi.org/10.1111/gcb.13967>

Neither newer rice varieties nor farmers' traditional varieties are able to survive prolonged submergence under water.

There is a need for new rice varieties that can withstand a range of environmental stresses.

**Innovation:** Harness the knowledge of leading global, regional, and national agricultural researchers and combine it with local know-how to develop and distribute submergence-tolerant rice to small farmers.

Through Stress Tolerant Rice for Africa and Asia (STRASA), the International Rice Research Institute (IRRI) partners with researchers at the Africa Rice Centre, an African research organisation, and national scientists in poor countries, creating submergence-tolerant rice varieties that can "hold its breath" underwater.

STRASA developed improved varieties through identifying and using traits that allow rice to make better use of oxygen even while submerged, therefore coping with this stress that can devastate crops<sup>8</sup>.

However, Climate resilience is a complex trait and cannot be "engineered" through the crude tools of transferring single gene traits from one organism to another. What corporations and the Gates foundation are doing is taking farmers' varieties with known climate resilient traits from public gene banks, mapping their genome, and taking patents on the basis of guesswork and speculation on which part of the genome contributes to the known trait.

Like Columbus -- who, setting out for India, getting lost and arriving in the Americas, "discovered" "America" -- Gates and Monsanto are "discovering" climate resilience.

Just as the narrative of Columbus' discovery erases the indigenous people who lived across the American continent, the patenting of climate resilience erases farmers breeding, and the biodiversity which they have given us. It erases the source of the seed, the culture of the seed, the commons of the seed. It is an enclosure through piracy - Biopiracy.

Patenting life through genetic engineering is rapidly giving way to patenting life through mapping the genome.

Navdanya's Community Seed Bank in Orissa has conserved more than 800 rice varieties and multiplied and distributed salt tolerant varieties and flood tolerant varieties. The "innovation" to evolve these climate resilient traits has occurred cumulatively and collectively over thousands of years. These traits and crops are a commons.

However, the biotech industry are now presenting the traits evolved by nature and farmers over centuries as the "invention" of "scientists", who rename the flood tolerant property in the farmer's variety, such as "Dhullaputia" from

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<sup>8</sup> "STRASA Legacy Site - Flood-Tolerant." *IRRI STRASA Legacy Site*.  
<https://sites.google.com/irri.org/strasalegacy/variatal-releases/submergence>

Orissa, as the Sub1A or the submergence tolerant gene. They proudly state "Using marker-assisted selection (/not transgenics) the researchers were able to isolate the submergence tolerant gene, Sub1A, and then transfer it to a rice variety that is grown on more than 5 million hectares in India and Bangladesh, known as Swarna. Most rice can tolerate flooding for only a few days, but researchers say the new variety, Swarna-Sub1, can withstand submergence for two weeks without affecting yields"<sup>9</sup>.

This is a scientifically flawed description based on genetic reductionism because flood tolerant traits, like other climate resilient traits such as salt tolerance and drought tolerance, are multi-genetic traits. They cannot be identified as a "Sub1A gene" because it is not simply just "a gene", which they have referred to as "Submergence tolerance 1 (Sub1) Quantitative trait locus (QTL)".

What marker assisted selection does, is identify the genetic sequence that is always linked to varieties which share a trait<sup>10</sup>. Such varieties are then selected for crossing conventionally with varieties like Swarna.

Farmers who have bred the traits did not need marker assisted selection to breed for climate resilience. The diversity and pluralism of knowledge systems, and diversity of languages to describe and name processes and organisms must be recognized.

Gates steals centuries of breeding by farmers and describes it as a new flood-tolerant rice which will offer relief for the world's poorest farmers<sup>11</sup>. This is how the Gates Foundation redefines the Biopiracy of flood-tolerant rice from India's farmers as 'innovation' having the consequence that farmers as breeders disappear, meaning the source of flood tolerant traits disappears. They become recipients of that which came from them in the first place. This is the regime of Bio Nullius, building on the concept of Terra Nullius<sup>12</sup> – that farmers' minds are 'empty', and their seeds 'empty' and 'innovation' only begins when Gates and Big Money takeover.)

Adapting to an unpredictable, changing climate requires diversity at every level. Biodiverse and decentralized systems have shown to be more resilient in times of climate change and have more flexibility to respond<sup>13 14</sup>.

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<sup>9</sup> Saikat Kumar Basu (2011) Earth grab: geopiracy, the new biomassters and capturing climate genes, by Diana Bronson, Hope Shand, Jim Thomas and Kathy Jo Wetter, *Biodiversity*, 12:4, 274-275, DOI: 10.1080/14888386.2011.643575

<sup>10</sup> "Smart Breeding." *Greenpeace International*, October 28, 2014.

<https://www.greenpeace.org/international/publication/7075/smart-breeding>

<sup>11</sup> Le, Vincent. "New Flood-Tolerant Rice Offers Relief for World's Poorest Farmers." *The Ronald Laboratory*, May 8, 2015. <https://cropgeneticsinnovation.ucdavis.edu/new-flood-tolerant-rice-offers-relief-worlds-poorest-farmers>

<sup>12</sup> "Terra Nullius." *Wikipedia*, [https://en.wikipedia.org/wiki/Terra\\_nullius](https://en.wikipedia.org/wiki/Terra_nullius)

<sup>13</sup> Shiva, V., & Leu, A. (2018). *Biodiversity, Agroecology, Regenerative Organic Agriculture: Sustainable Solutions for Hunger, Poverty and Climate Change*. Westville Publishing House. [https://books.google.com/books/about/Biodiversity\\_Agroecology\\_Regenerative\\_Or.html?id=Shyh wgEACAAJ&redir\\_esc=y](https://books.google.com/books/about/Biodiversity_Agroecology_Regenerative_Or.html?id=Shyh wgEACAAJ&redir_esc=y)

<sup>14</sup> Altieri, Miguel & Nicholls, Clara & Henao, Alejandro & Lana, Marcos. (2015). *Agroecology and the*



We also need biodiversity at the level of knowledge systems<sup>15</sup>.

Biodiversity of knowledge implies that we recognise the ever-evolving knowledge of women, farmers, tribals, citizens which comes from their life experience, their intimate connection with the Earth and local ecosystems as well as its biodiversity. We need to recognise the emerging sciences of agroecology and epigenetics.

At the ecosystems level, agroecology is also a systems paradigm. This is the real science of agriculture and food production, not biotechnology.

We also need biodiversity in our economic activities. We need local food systems, regional food systems, national food systems, while some trade can take place at the international level.

Finally, we need Biodiversity of political systems and decision making. Centralised and bureaucratic systems are like dinosaurs. They are not flexible and cannot adapt and evolve.

We need flexibility, which comes from diversity. Biodiversity in politics is what I call Earth Democracy.



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design of climate change-resilient farming systems. *Agronomy for Sustainable Development*. 35. 10.1007/s13593-015-0285-2.

[https://www.researchgate.net/publication/276291228\\_Agroecology\\_and\\_the\\_design\\_of\\_climate\\_change-resilient\\_farming\\_systems/link/555614ed08ae6943a8733699/download](https://www.researchgate.net/publication/276291228_Agroecology_and_the_design_of_climate_change-resilient_farming_systems/link/555614ed08ae6943a8733699/download)

<sup>15</sup> The International Commission on the Future of Food and Agriculture, *Manifesto on the Future of Knowledge Systems: Knowledge Sovereignty for a Healthy Planet*, Regione Toscana, Arsia, 2008, [https://navdanyainternational.org/wp-content/uploads/2016/04/conoscenze\\_ing.pdf](https://navdanyainternational.org/wp-content/uploads/2016/04/conoscenze_ing.pdf)

## BANANA BIOPIRACY THROUGH GMO BANANA

Vandana Shiva

There persists a 'creation myth' that is blind to nature's creativity and biodiversity, and to the creativity, intelligence, and knowledge of women. According to this 'creation myth' of capitalist patriarchy, rich and powerful men are the 'creators' and can pirate our knowledge and biodiversity. They can own seeds, plants, life through patents and intellectual property. They can tinker with nature's complex evolution over millennia and claim that their trivial, yet destructive acts of gene manipulation 'create' life, 'create' food, 'create' nutrition.

GMOS have been the means to own and control life through Patents. When Patents are taken on Biodiversity and Knowledge, evolved and conserved over millennia by indigenous cultures, it is called Biopiracy.

In the case of GM bananas it is one rich man, Bill Gates, financing one Australian scientist, Dr. James Dale at Queensland University of Technology, Australia, who knows one crop, the banana, to impose inefficient and hazardous GM bananas on millions of people in India and Uganda who have grown hundreds of banana varieties over thousands of years in addition to thousands of other crops. The Mantasa piece which follows is an excellent account of how "Dr Dale's globe-trotting GMO bananas are a globe-trotting case of biopiracy and biocolonialism".

Gates funded Dr. Dale to push iron enriched GMO bananas on India for reducing iron deficiency in anemic women in India and prevent death in childbirth.

Nature has given us a cornucopia of biodiversity, rich in nutrients. Malnutrition and nutrient deficiency results from destroying biodiversity, and with-it rich sources of nutrition. Pushing the Green Revolution in the name of increasing farm outputs for a burgeoning population of consumers has spread monocultures of chemical rice and wheat, driving out biodiversity from our farms and diets.

What survived the onslaught were uncultivated wild crops like the amaranth greens and chenopodium (bathua), which are rich in iron, despite being sprayed with poisons and herbicides, while optimizing growth of other crops. Instead of being seen as iron rich and vitamin rich resources, they were treated as 'weeds'.

As the 'monoculture of the mind' took over, biodiversity disappeared from our farms and our food. The destruction of biodiverse rich cultivation and diets has led to a malnutrition crisis, with 75% women now suffering from iron deficiency.

India's indigenous biodiversity offers rich sources of iron: Amaranth has 11.0 mg per 100 gm of food, buckwheat 15.5, neem 25.3, bajra 8.0, rice bran 35.0, rice flakes 20.0 bengal gram roasted 9.5, bengal gram leaves 23.8, cowpea 8.6, horse gram 6.77, amaranth greens have up to 38.5, karonda 39.1, lotus stem 60.6,

coconut meal 69.4, niger seeds 56.7, cloves 11.7, cumin seeds 11.7, mace 12.3, mango powder (amchur) 45.2, pippali 62.1, poppy seeds 15.9, tamarind pulp 17.0, turmeric 67.8, raisins 7.7<sup>1</sup>.

The knowledge of growing this diversity and transforming it to food is an integral part of women's knowledge, the reason for Navdanya creating a network for food sovereignty and putting it in women's hands – Mahila Anna Swaraj.

The solution to malnutrition lies in growing nutrition, and growing nutrition means growing biodiversity. It means recognizing the knowledge of biodiversity and nutrition among millions of Indian women who have received it over generations as "grandmothers' knowledge".

There is a curious urge among the biotechnology brigade to declare war against biodiversity in its centre of origin. An attempt was made to introduce Bt brinjal into India, which is the centre of diversity for brinjal. GM corn is being introduced in Mexico, the centre of diversity of corn. The GM banana is being introduced in two countries where banana is a significant crop and has large diversity. One is India, the other is Uganda, the only country where banana is a staple. The women of India succeeded in stopping the Gates GMO banana from being imposed on India, which falsely claimed it would save women's lives. It is still under field trials in Uganda after 10 years and millions of dollars to complete the research<sup>2</sup>.

Not only is the GM banana not the best choice for providing iron in our diet, it further threatens the biodiversity of bananas and iron rich crops, and, as recognized by Harvest Plus, the corporate alliance pushing Biofortification, there could be insurmountable problems with the biofortification of nutrients in foods as they '...may deliver toxic amounts of nutrients to an individual and also cause its associated side effects (and) the potential that the fortified products will still not be a solution to nutrient deficiencies amongst low income populations who may not be able to afford the new product and children who may not be able to consume adequate amounts'<sup>3</sup>.



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<sup>1</sup> Navdanya, "No to GMO Bananas - Protect Indigenous Biodiversity and Knowledge", [http://www.navdanya.org/attachments/banana\\_booklet\\_30-4-2013.pdf](http://www.navdanya.org/attachments/banana_booklet_30-4-2013.pdf)

<sup>2</sup> Queensland University of Technology. "Golden bananas high in pro-vitamin A developed: Research has produced a golden-orange fleshed banana, rich in pro-vitamin A." ScienceDaily. ScienceDaily, 7 July 2017. <https://www.sciencedaily.com/releases/2017/07/170707095806.htm>

<sup>3</sup> Quoted in *Food Biofortification: no answer to ill-health, starvation or malnutrition* By Bob Phelps <http://www.freshfruitportal.com/opinion-biofortification-is-an-obstacle-to-food-justice>



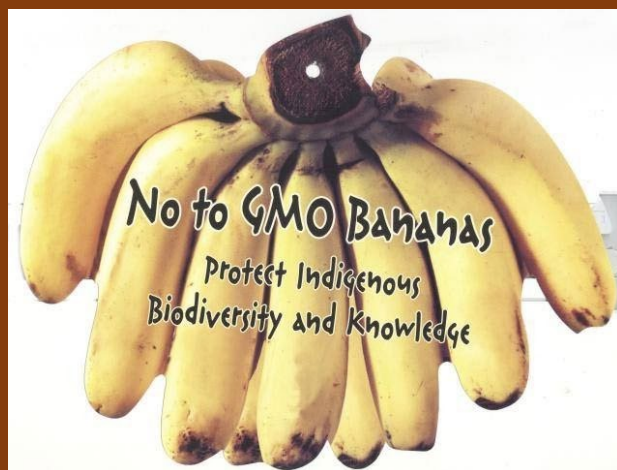
## CAMPAIGN - 'NO GMO BANANA'

Navdanya International - Seed Freedom Global Campaign

The No GMO Banana international campaign was launched by Navdanya and partners Mantasa, to stop the controversial project of Dr. James Dale of Queensland University of Technology, Australia, beneficiary of 15 million dollars in investment from the Bill and Melinda Gates Foundation. A petition was sent to the Prime Minister of India urging the cancelation of the project and agreement between the Department of Biotechnology and the University of Queensland in Australia, and to instead use the money to support a national movement of community and kitchen gardens in women's hands<sup>1</sup>.

After a meeting with farmers in Kediri, Indonesia<sup>2</sup> who highlighted their yellow and red bananas, Navdanya and the Indonesian activists decided to form a joint project to research Vit A rich indigenous bananas and explore from where the developers of GMO bananas got the vit A traits, leading to the GMO Banana Biopiracy research and campaign. They found that the beta-carotene rich traits had been pirated from an indigenous Micronesian banana. This led to the international Stop Banana Biopiracy campaign<sup>3</sup> and to an Open Letter to Dr James Dale at QUT, the Bill and Melinda Gates Foundation and the Convention on Biological Diversity<sup>4</sup>.

News also spread of banana feeding trials using students from Iowa State University (ISU) as guinea pigs, also funded by the Gates Foundation. In addition to the



ethical violations involved in Biopiracy of Banana, these unapproved human trials also were clearly another serious ethical violation, prompting graduate students at Iowa State to stage a silent protest in October 2014<sup>5</sup>, though the University refused to engage publicly or respond to issues raised by the students. The Alliance for Food Sovereignty in Africa (AFSA), Dr. Wendy White from Iowa State University and the Human

<sup>1</sup> Navdanya. "GMO Banana Petition – Letter to Prime Minister of India." *Seed Freedom*, October 5, 2014. <https://seedfreedom.info/gmo-banana-petition-letter-to-prime-minister-of-india/>

<sup>2</sup> Mantasa. "OUR SEEDS, OUR FUTURE: Strengthening Indonesia's Food Sovereignty." *Seed Freedom*, August 14, 2014. <https://seedfreedom.info/events/our-seeds-our-future-strengthening-indonesias-food-sovereignty/>

<sup>3</sup> "No Gmo Banana Campaign." *Seed Freedom*. Last modified October 2, 2014. <https://seedfreedom.info/campaign/no-gmo-banana-campaign/>

<sup>4</sup> Ibid.

<sup>5</sup> "Fralely Lecture Opposition – Iowa, USA." *Seed Freedom*, November 11, 2014. <https://seedfreedom.info/fraley-lecture-opposition-iowa-usa/>

Institutional Review Board of Iowa State University subsequently submitted an open letter and petition to the Bill and Melinda Gates Foundation expressing fierce opposition to the trials ISU<sup>6</sup> while ISU graduate students dispatched a petition with 57,309 signatures<sup>6</sup> to the College of Agriculture and Life Sciences with AGRA Watch members delivering the same petition to the headquarters of the Bill and Melinda Gates Foundation in Seattle, Washington. In April 2016, the petition was delivered to Dr Dale<sup>7</sup> at QUT in Australia, by Dr Vandana Shiva<sup>7</sup>, along with the above-mentioned Open Letter by the Alliance for Food Sovereignty in Africa. The Indian campaign

In addition to succeeding in stopping the Gates GMO banana from being imposed on India, these international campaigns against GMO Bananas<sup>8</sup> served to connect the issues of GMOs, Biopiracy, and the ethical violations of human trials by connecting movements in Asia, Africa, Australia and the US. It helped expose the colonialist mindset behind the project and the multiple human rights issues connected with it. The campaign also showed the absurdity of GMO bananas when there are so many more effective solutions to issues of nutritional and iron deficiencies



*No GMO Banana Campaign – Navdanya / Seed Freedom, 2014*

<sup>6</sup> Galvis, Ana. "Over 57,000 Express Concern with Human Feeding Trials of GMO Bananas." *Food First*. Last modified November 2, 2016. <https://foodfirst.org/over-57000-express-concern-with-human-feeding-trials-of-gmo-bananas/>

<sup>7</sup> Breasely, Adam, April 24, 2016, Facebook. <https://www.facebook.com/photo.php?fbid=10156904386995046&set=a.10150258487220046&type=1&theat>

<sup>8</sup> Tag: Gmobanana, Seed Freedom, <https://seedfreedom.info/tag/gmobanana/>

# BANANA BIOPIRACY: AN OPEN LETTER TO QUT'S DR JAMES DALE, THE BILL AND MELINDA GATES FOUNDATION AND THE CONVENTION ON BIOLOGICAL DIVERSITY <sup>1</sup>

Mantasa



Paul Gauguin, *Le Repas (The Meal)*, 1891

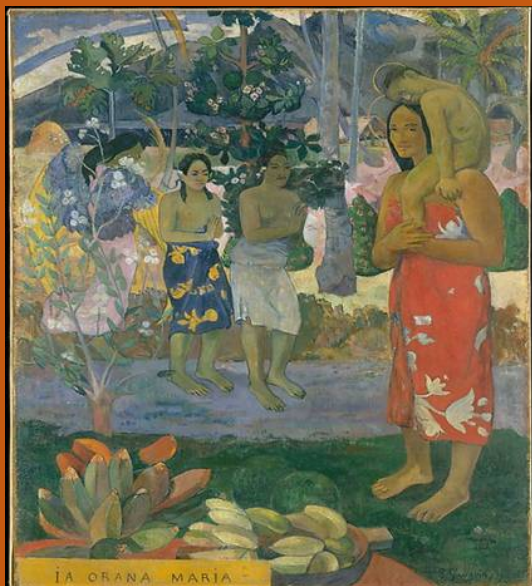
The Gates Foundation has invested 15 million dollars in Dr James Dale's GMO so-called 'super-bananas' developed at Queensland University of Technology (QUT) since approximately 2005. The project is being touted as philanthropy with a humanitarian purpose in combating micronutrient deficiency. The GMO bananas have gained considerable media attention for the project, but it is not at all clear that the GMO banana project is truly a charitable exercise. It is however a clear case of biopiracy.

Fe'i bananas (*Musa troglodytarum* L.) are a traditional food across the Asia-Pacific, found in an area ranging from Maluku in Indonesia to Tahiti and Hawaii in the Pacific. Until fairly recently local consumption of Fe'i bananas across the region had been largely displaced by imported, unhealthy, colonial food cultures.

<sup>1</sup> Extracted from: Mantasa. "No Gmo Banana Republic – Stop Banana Biopiracy!" *Seed Freedom*. Last modified October 12, 2014. <https://seedfreedom.info/no-gmo-banana-republic-stop-banana-biopiracy/>



In the early 2000's US researcher Lois Englberger, living in Micronesia, after searching for sources of vitamin A in the traditional diet of Micronesia, found that Micronesian 'Karat' bananas – so called because of their orange 'carrot-like' flesh and subsequent high beta-carotene content – had been traditionally used in Micronesia as an infant weaning food<sup>2</sup>.



Paul Gauguin, *La Orana Maria (The Virgin Mary)*, 1891

Based on Englberger's work, the Federated States of Micronesia have an ongoing program to bring back and encourage the cultivation and consumption of these local banana varieties<sup>3</sup>. Englberger's work with the Island Food Community of Pohnpei in FSM has seen the use of these varieties widely adopted in a campaign called 'Let's Go Local!'. The program has been so successful that the Karat banana has been adopted as the state emblem of Pohnpei<sup>4</sup>.

Englberger's work however, did include nutritional surveying of pacific banana cultivars in Australia held in collection by the Queensland Department of Primary Industries<sup>5</sup>:

*"What Dr Dale has done is to take the high beta-carotene banana gene for his GMO 'super-bananas' from an existing Fe'i banana variety from Papua New Guinea, following a study<sup>6</sup> that compared ten cultivars with yellow to orange fruit. The 'winner' was the Asupina cultivar<sup>7</sup>, which had the highest level of trans beta-carotene – the most important pro-vitamin A carotenoid. . . more than 25 times more than the level in the Cavendish cultivars that dominate the international banana trade. The trouble is, this makes Dr Dales' GMO 'super-banana' a clear case of biopiracy. The original Asupina, collected 25 years earlier from Papua New Guinea and held by the Queensland Department of Primary Industries (Q-DPI), is the rightful property of the nation and the communities that developed it" <sup>8</sup>.*

<sup>2</sup> Englberger, L., Darnton-Hill, I., Coyne, T., Fitzgerald, M.H. and Marks, G.C. 2003. Carotenoid-rich bananas: A potential food source for alleviating vitamin A deficiency. *Food and Nutrition Bulletin* 24(4):303-318. <http://www.musalit.org/seeMore.php?id=8855>

<sup>3</sup> Coghlan, Andy. "Orange Banana to Boost Kids' Eyes." *New Scientist*, July 10, 2014. <https://www.newscientist.com/article/dn6120-orange-banana-to-boost-kids-eyes/>

<sup>4</sup> Radford, Tim. "Carrot-like Banana Could Save Lives in the Tropics." *The Guardian*, July 8, 2004. <http://www.theguardian.com/uk/2004/jul/08/research.health>

<sup>5</sup> "Asupina." *The Banana Knowledge Platform of the ProMusa Network*. <http://www.promusa.org/Asupina>

<sup>6</sup> Mlalazi, Bulukani, Welsch, Ralf, Namanya, Priver, Khanna, Harjeet, Geijskes, Jason, Harrison, Mark, Harding, Rob, Dale, James, & Bateson, Marion (2012). Isolation and functional characterisation of banana phytoene synthase genes as potential cisgenes. *Planta*, 236(5), pp. 1585-1598. <https://eprints.qut.edu.au/52937/> & [http://eprints.qut.edu.au/52937/1/Mlalazi\\_2012\\_-\\_Accepted\\_PSY\\_draft\\_manuscript\\_-\\_ePrints\\_version.pdf](http://eprints.qut.edu.au/52937/1/Mlalazi_2012_-_Accepted_PSY_draft_manuscript_-_ePrints_version.pdf)

<sup>7</sup> Ibid.

<sup>8</sup> Breasley, Adam, and Oliver Tickell. "Why Is Bill Gates Backing GMO Red Banana 'Biopiracy'?" *The Guardian*, November 24, 2014. <https://theecologist.org/2014/nov/24/why-bill-gates-backing-gmo-red-banana-biopiracy>



The Asupina is not a wild variety as Dr Dale has claimed<sup>9</sup> – it is a domesticated cultivar from PNG. It is also not unpleasant to eat as Dr Dale has also claimed. As Englberger was at pains to point out, there are Fe'i banana varieties that are delicious when eaten raw, baked or boiled.



Paul Gauguin, (Tahitian Landscape), 1891

Dr Dale's globe-trotting GMO bananas are a globe-trotting case of biopiracy. The traditional knowledge they have used comes from Micronesia and Lois Englberger's work. The Q-DPI public collection from which Jeff Daniels sourced the Asupina variety should have been a collection held in public trust. Their GMO 'super banana' project, on which Dr Dale holds multiple patents for 'banana transformation', now proposes to

sell these purloined treasures back to the world as their own patented product from which they can derive royalties, determine access, and is ironically being offered up as an act of charity. Rather this is an act of biocolonialism.

Moreover, the GMO 'super-bananas' are an expensive distraction away from real solutions for vitamin A deficiency. We do not need to waste time and millions on GMOs when we have viable existing solutions that are based on biodiversity and available right now. Malnutrition is a complex problem that cannot be solved by monocultural solutions whether of the mind or of the field, not by 'Golden Rice' nor the cartoon solution of GMO 'super-bananas'.

Taking resources away from communities can only be done violently.

The GMO banana project began violently, with the unacknowledged theft of traditional knowledge and cultural heritage of local communities and farmers in PNG and Micronesia, which has now been enclosed in patents for 'banana transformation'.

It continued violently with the Market Trials conducted on unsuspecting human subjects in Iowa - female students, who were being paid 900 dollars to turn themselves into human guinea pigs, while no safety tests for human consumption of the GMO bananas have been done.

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<sup>9</sup> Huizen, Jennifer. "'Super Bananas' Enter U.S. Market Trials." *Scientific American*, July 1, 2014. <https://www.scientificamerican.com/article/super-bananas-enter-u-s-market-trials/>

## **Gates to a Global Empire**

### **...over Seed, Food, Health, Knowledge and The Earth**

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