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#### The current WTO patent system is locking in global cannabis monopolies.

Kellner 21 “Mitigating the Effects of Intellectual Property Colonialism on Budding Cannabis Markets” Hughie Kellner [Hughie Kellner came from the small farm town of Uvalde, Texas and received a bachelor’s degree in Physics from the University of Texas at Austin. Upon graduation from the Indiana University Maurer School of Law, Hughie will deploy his physics degree while prosecuting patents in the Frankfurt am Main, Germany office of Leydig, Voit, & Mayer. After Hughie’s first year at Maurer, he worked for a law firm in Thailand as a Stewart Fellow.] Indiana Journal of Global Legal Studies Vol. 28 #1 (Winter 2021) <https://www.repository.law.indiana.edu/ijgls/vol28/iss1/9/> SM

B. How the Patent Has Become a Tool for Globalization

The trade-offs have been deemed beneficial by most of the international community, judging by the WTO’s TRIPS Agreement, whereby any signatory must institute a patent system to their national order.57 This requirement was seen to advance the benefits that intellectual property brings to markets and provide assurance for companies who depend upon intellectual property (for our purposes, patents) that they will be protected.58 Thus, investment and commercial activity can now more easily flow into countries where before the lack of protection rendered prospective costs of business prohibitive.59

The TRIPS Agreement imposed strong, uniform requirements upon signatory countries that went a long way towards its goal of globalization, and unlike most international treaties, required enforcement mechanisms with teeth.60 The most relevant requirement here is that the member patent office examining the patent may not discriminate “as to the place of invention, the field of technology and whether products are imported or locally produced.”61 This requirement allows great freedom to engage in business within member countries, and prevents a patent office from giving any advantage to its own citizens that it would not give to a foreigner, unless allowed under other treaties.62 Further, if a patent is secured in the relevant country, a business does not need to set up a subsidiary within that country to obtain protection.63

To assist actors whose businesses cross international borders, the PCT was enacted by the World Intellectual Property Organization (WIPO) to reduce barriers when seeking protection for inventions.64 The PCT, while a treaty in name, acts more like an organization; as the WIPO describes the PCT:

The Patent Cooperation Treaty (PCT) assists applicants in seeking patent protection internationally for their inventions, helps patent Offices with their patent granting decisions, and facilitates public access to a wealth of technical information relating to those inventions. By filing one international patent application under the PCT, applicants can simultaneously seek protection for an invention in a very large number of countries.65

Importantly, filing an application to the PCT does not grant a patent international reach; the inventor must file a patent application and await approval in each jurisdiction they wish to pursue, and patents are still enforceable only in the countries where they are obtained.66 Rather, filing your invention to the PCT, and denoting the countries where you seek patent protection, means that the PCT will provide information on the timeframe and likelihood of a patent being granted in that jurisdiction, along with certain assistance that varies based on the jurisdiction sought.67

C. How Companies Can Utilize Patents Internationally

Both the TRIPS Agreement and the PCT reduce barriers to transferring business across national boundaries by easing the transference of the intellectual property needed. The PCT acts merely as a helping hand and information collection tool, while the TRIPS Agreement acts to ensure that intellectual property will operate largely the same from jurisdiction to jurisdiction and, importantly, will be protected with uniform minimum standards. Without commenting on the desirability of this uniform treatment throughout varying economies, it has never been easier for businesses to use their intellectual property to enter international markets.68 In fact, under the TRIPS Agreement and PCT, companies can file a patent in a country where they have no connections,69 acquire a patent, and simply license the technology to (or bring infringement suits against) companies in the member country without needing to ever establish a presence.70

Notably, the PCT and many countries’ patent systems require you to file your patent application within a restricted timeframe after it is first disclosed.71 Thus, this transportation of patent rights must be loosely simultaneous throughout jurisdictions. However, the fact still remains that sophisticated actors who utilize the protections of the TRIPS Agreement can now acquire a monopoly to practice an invention in any country that is a signatory to the TRIPS Agreement or PCT. This usually reaches far short of global domination since companies generally file only in jurisdictions where they expect the benefit of using the patent to outweigh the cost of applying for one.72 However, if the inventor files a patent in every country that has a viable market for that invention, especially if only a few markets exist, the inventor could create an economic climate close to a global monopoly.

#### Thailand proves – the world is trending towards legalization but big pharma patents lock in cannabis monopolies and crowd out local growth.

Kellner 21 “Mitigating the Effects of Intellectual Property Colonialism on Budding Cannabis Markets” Hughie Kellner [Hughie Kellner came from the small farm town of Uvalde, Texas and received a bachelor’s degree in Physics from the University of Texas at Austin. Upon graduation from the Indiana University Maurer School of Law, Hughie will deploy his physics degree while prosecuting patents in the Frankfurt am Main, Germany office of Leydig, Voit, & Mayer. After Hughie’s first year at Maurer, he worked for a law firm in Thailand as a Stewart Fellow.] Indiana Journal of Global Legal Studies Vol. 28 #1 (Winter 2021) <https://www.repository.law.indiana.edu/ijgls/vol28/iss1/9/> SM

The reason the Thai public was so concerned over the cannabis patents filed by Otsuka and GW is that they represented the floor falling out from beneath them. The patents claimed both cannabinoid oil itself and a process for extracting the cannabinoid oil from the cannabis plant, which, based on the way they sought protection, was very likely not patentable anyway.88 However, if either Otsuka or GW received a patent, that patent would be an incredibly powerful tool in clearing competition in the upcoming market. Members of the Thai public saw their newly granted cannabis industry about to be swallowed up and taken from them by a foreign pharmaceutical company before they even had a chance to venture into it themselves.

This more than questionable “emergency order,” which temporarily blocked the possible grant of patents to Otsuka or GW, paid lip service to the allowances under the TRIPS Agreement,89 but in reality discriminated based on the applicant’s nationality. The goal of the order was to avoid a scenario of foreign monopolization that could pop up in any market that is a signatory to the TRIPS Agreement and institutes some form of commercialization of cannabis. GW and Otsuka Pharmaceuticals did not do anything illegal; they had the right to apply for protection of their intellectual property and did so. The Thai government acted on legally questionable grounds,90 but had a just reason to do so: attempting to avoid the exportation of an upstart cannabis market that would provide a lucrative cash crop to a highly agrarian Thai population.91

The scenario of recreational cannabis markets being promptly secured by foreign interests grows more and more likely as cannabis companies grow larger and more countries look to liberalize cannabis laws.92 As of right now, Canada’s recreational cannabis market, the only recreational cannabis market open to privatization,93 supports the largest cannabis companies in the world with vast amounts of capital, competition, and the best incentives to research and develop products better than and before their competitors.94

The logic of the feared scenario is as follows: if there exists a jurisdiction that establishes a market that produces entities who innovate more than any other jurisdiction, then that jurisdiction will be state of the art by definition. When another jurisdiction opens up a market, until that market supports entities who are innovating on their own and at a level that surpasses or escapes the prior jurisdiction, all entities will either operate below state of the art or at the same level as the prior, more advanced jurisdiction. With that innovation comes the possibility for patent protection. As discussed in Part II, a patent is only enforceable in the jurisdiction (usually country) it is acquired in. However, with the binding rules of the WTO TRIPS Agreement and the helping hand of the PCT, a patent in one country can easily become a patent in another country. If a patent is acquired by the most innovative entities and exported to the less innovative jurisdiction, entities in the less innovative jurisdiction must pay to use that patent if they wish to operate at the state of the art or, alternatively, stop their business. Therefore, the monopoly of one jurisdiction can be imposed upon another jurisdiction, suppressing actors in the less advanced jurisdiction simply because the first jurisdiction got a head start.95 This fear was present at the time the TRIPS Agreement was signed and is still present today:

[S]ome analysts interpret the growing concern of industrialized nations with intellectual property rights as an attempt to control the diffusion of new technologies . . . to freeze the existing international division of labor by way of the control of technology transfers . . . . [I]t is important to recognize that for a [lesser developed] country a reform designed to increase intellectual property rights protection will tend to generate a welfare loss at its initial stages. Because [lesser developed countries] are typically net importers of technology, a usual consequence of a more strict regime of intellectual property laws would be an increase in royalty payments to foreigners.96

As this plays out in today’s evolving cannabis industry, if someone is going to make advancements in the cannabis industry, most of those advancements will be from the Canadian actors before Thai actors, due to the head start and the stronger expected return on innovation in the Canadian recreational market. The Canadian actors’ innovations would be merely the product of the regulatory policies of their respective jurisdiction being amenable to innovation, and then importing those innovations into a jurisdiction that had not previously been amenable to innovation. Accordingly, the Canadian Patent Office has seen the effects of the innovative incentives: the Canadian market has produced and processed many patent applications.97

Further, even if Thailand prohibited any foreign actor from producing, importing, exporting, selling, or engaging with the Thai cannabis industry in any meaningful way, a foreign company could still force itself into the industry with the patent rights and structures available to it under the TRIPS Agreement.98 Without ever having a physical presence, business can be generated by filing a patent and forcing others to license the use of the patent or face an infringement lawsuit.99 Even if an action is not infringing, a patent could be used to threaten a lawsuit upon a new business 100 (every business in the Thai market will be new) that likely would not possess the resources to defend a patent lawsuit (one of the most expensive types of lawsuits)101 and would be forced to submit to a licensing arrangement or close its doors.102

This is so only because Canada decided to violate the terms of the UN Single Convention.103 Thus, Canada was able to safely internalize every first-mover benefit available because the other 184 countries party to the Single Convention, and all other G7 countries, would still be prevented from establishing a recreational cannabis market. Canada may not have had any malicious motives; after all, it did ensure that its regulatory scheme governed international trade as mandated by the Single Convention,104 and thus attempted to keep any acts that violate that treaty from causing other nations to violate it. This seems like the intention of a good neighbor who knows they have broken the rules, but the best intentions in the world do not alone alter the operation or availability of other global legal structures.

A solution needs to be found whereby local actors, who did not have a chance to innovate, are given an opportunity to establish themselves so they can innovate while foreign business and investment is also allowed to participate in the market, bringing their advantage of experience rather than legal monopoly. In the following section, I argue that a solution, unique to the cannabis market, can be found by imposing a small and circumscribed amendment to the TRIPS Agreement, as a resolution to the Canadian recusal from the UN Single Convention.

#### Big pharma leverages cannabis patents to block out competition and secure monopoly – decks medical marijuana access

Barnett 20 Hailey A. Barnett [J.D. candidate 2020, Tulane University Law School; B.A. 2017, Communication, cum laude, Texas A&M University.], "High Risk, High Reward: Patent Law's Effects on the Medical Marijuana Industry," Tulane Journal of Technology and Intellectual Property 22 (2020): 125-164 <https://heinonline.org/HOL/LandingPage?handle=hein.journals/tuljtip22&div=8&id=&page=> SM

B. Cannabis Patents and Pharmaceutical Companies

Patent protection is a key component of the United States legal system. On principle, we should compensate and reward those who have rightfully invented something, as well as incentivize and stimulate further innovation. The marijuana industry has been historically composed of people who believe in the cause, the plant, and the health benefits it brings. Yet, many of the field's "new players" are getting involved with a specific 89 business purpose in mind. Cannabis patents are one way to normalize and bring the industry to the mainstream, but the winners in the patent system are often those who are first and have the most money.'90

It's no secret why everyone wants a piece of the marijuana industry pie: according to an April 2018 report by Grand View Research, Inc., the global legal marijuana market is projected to be worth $146.4 billion by 025.'9' The report additionally found that in 2016, medical marijuana emerged as the largest segment of the industry and is estimated to be valued at $100.03 billion by 2025.192

One way to obtain a monetary stake in the medical marijuana market is to use the patent process to acquire ownership over a particular strain and its seeds.' 93 This limited monopoly ensures that the patent holder "is the only one who can make or sell the product, or license other people to do so."'94 However, there are so many unanswered questions that surround IP protection of a federally illegal substance, it is unclear if the patents will be upheld.'9 5 If cannabis patents are upheld in federal courts, it is possible that a handful of companies could be in a position to demand licensing fees from the rest of the industry.1 96

This incentive is particularly appealing to major multinational pharmaceutical companies (Big Pharma) and is already being capitalized on today. For example, pharmaceutical firms are already seven of the top ten cannabis patent holders in Canada.' 97 These patents, filed prior to the country's full legalization of marijuana, would have been difficult to enforce prior to legalization.' 9 8 However, after Canada legalized marijuana on October 17, 2018, the patents became fully enforceable and gave the companies a key strategic advantage over non-patent holders in the ever- increasingly competitive market.' 99 The biggest concern is that Big Pharma companies will harness their powerful lobbies and seemingly bottomless payrolls to engage in patent blitzes. In other words, they will try to enlarge their patent portfolios and subsequent ownership of marijuana strains and their ancillary byproducts, such as oils, to marginalize competitors.

In the United States, the FDA plays a crucial role in approving and 201 regulating medications for public use. Big Pharma requires the FDA's approval to bring their products to the public market, and it's no secret that Big Pharma's influence on the agency has accrued over many decades and billions of dollars spent.2 0 2 The current FDA Commissioner Scott Gottlieb recently slammed Big Pharma and accused drugmakers of using "gaming tactics" to stall the introduction of generic versions of biologic drugs, "a move that cost the U.S. healthcare system billions of dollars last year. "203 One of these tactics is to engage in patent blitzes, or evergreening, right before a drug's patent protection (and subsequent market exclusivity 20 4 period) expires. "In the pharmaceutical trade, when brand-name companies patent 'new inventions' that are really just slight modifications of old drugs, it's called 'evergreening. "'205 Evergreening occurs because once a drugmaker's patent on a particular drug expires, the door is open for other producers to bring generic versions of the drug to market.206 Patents in patent blitzes are often granted for even the most trivial improvements and innovations related to existing drugs.207 The purpose of evergreening is two-fold: first, to extend the commercial dominance of brand-name drugs, and second, to tie up producers of the generic drugs in 2 08 costly, time-consuming litigation. Evergreening prevents a generic drug's market entry and further extends Big Pharma's monopolies.2 09

A prime example of recent evergreening is when Mylan hiked the price of its life-saving epinephrine injectable drug, EpiPen, by more than 400%.210 After Teva Pharmaceuticals gained approval from the FDA for the first generic version of EpiPen, Mylan sued them for patent infringement, although epinephrine alone was already a generic drug.2 1 Mylan settled and kept "Teva off the EpiPen market until 2015."212 Much like AbbVie's battle with AmGen over a generic version of the former's costly biologic drug Humira, Big Pharma's inclination to place company profits over the needs and desires of patients could continue with cannabis strain patents. 2 13 This will ultimately affect cost and access to medical marijuana products.

Thanks to shifting public opinion and state legalization, a growing number of cannabis patent applications have been filed with the USPTO and it is very likely they will be granted. Although marijuana remains illegal at the federal level, the premature filings signal hope that sometime in the near future, the federal government will reconsider its stance on cannabis, and make medical and recreational marijuana use legal from sea to shining sea.215

Companies with a large numb1er of cannabis strain patents, such as BioTech, could become an even bigger national player in the field of cannabis strain patents as they acquire more market share. Overall, if Big Pharma obtains exclusive rights to use, produce, and sell particular cannabis strains, together with their large influence over the FDA and other government regulatory bodies, they can control public access and maintain already robust profit margins.217

Not surprisingly, Big Pharma is not the only industry chasing profits from marijuana IP rights. Smaller breeders, including scientists who alter the plant for medicinal purposes, worry that large bioagricultural companies like Monsanto and Syngenta will hoard cannabis-based patents and deploy their massive economic power to position themselves as another dominant force in the market.218 in short, an open and accessible marketplace for cannabis products, especially for medicinal use, depends on tracking the patent activity of wealthy, powerful entities to ensure smaller entities are not marginalized.219

#### Monopolies kill cannabis biodiversity which throttles medical marijuana advances and industry innovation.

Barnett 20 Hailey A. Barnett [J.D. candidate 2020, Tulane University Law School; B.A. 2017, Communication, cum laude, Texas A&M University.], "High Risk, High Reward: Patent Law's Effects on the Medical Marijuana Industry," Tulane Journal of Technology and Intellectual Property 22 (2020): 125-164 <https://heinonline.org/HOL/LandingPage?handle=hein.journals/tuljtip22&div=8&id=&page=> SM

A. Biodiversity Implications for Cannabis Strain Patents

Biodiversity, or biological diversity, is an ongoing controversy in the marijuana patent industry. Like comprehensive research on the benefits and drawbacks of medical marijuana, "empirical analysis on biodiversity in the patent system is limited."2 2 2 Biodiversity is a broad term but is generally defined as "biological diversity in an environment as indicated by numbers of different species of plants and animals." 23 Increasingly, however, countries and companies are asserting IP rights in native flora, 224 impacting global biodiversity.

"Historical documents from around the world, some dating as far back as 2900 B.C., tell us that cannabis has lived alongside humans for thousands of years, cultivated for food, fiber, and fodder, as well as for religious and medicinal purposes." 2 5 The fear is that without a wide variety of cannabis strains available for breeding and growing, production and processing of the plant will inevitably consolidate into the hands of large conglomerates.22 6

The United States and Thailand are signatories to the Convention on Biological Diversity (Biodiversity Convention), a multilateral treaty committed to sustainable development. The Biodiversity Convention's goals include "conserving biological diversity, promoting the sustainable use of its components, and the fair use and equitable sharing of benefits from biological resources."228 The Biodiversity Convention requires signatories to enforce regulations on plant patent applications and mandates that new patent applications include the plant's genetic resources and evidence of local use if they seek to patent the plant in a certain country. This is the chief reason behind the Biodiversity Sustainable Agriculture Food Sovereignty Action Thailand's (Biothai) call for careful scrutiny of recently filed foreign cannabis patents in the country, as discussed in greater detail in the next Section.

Since medical marijuana is now legal for use and manufacture in Thailand, the mere implication that fabled Thai marijuana strains, such as "Northern Lights," could be available on the global market has generated 23 much buzz. 1 Like Cuban cigars or French champagne, Thai marijuana is known for its potency and quality.232 Thailand's marijuana is apure sativa landrace strain, meaning it is a local strain of cannabis that has adapted to Thailand's native environment and conditions over time. Environment plays a key role in the THC, CBD, and terpene quality and quantity and is part of what makes landrace strains so unique. For example, the marijuana plants and seeds that are indigenous to the tropical jungles of Thailand are bred to preserve their naturally occurring high THC levels.235

As more cannabis strain patents are granted worldwide, it is possible that growers will be increasingly dependent on seed makers that hold patents on certain types of seeds and methods used to produce them. As a result, growers will be subject to agreements and royalties and will be charged licensing fees for use of the seeds. A healthy number and variety 236 of available cultivars are vital for advancing cannabis legalization and the industry’s continued growth. From an agricultural perspective, the patent system encourages a consolidation and reduction of variety in order to enhance and maximize profits. This can be seen in today's staple crops, such as com, soy, and wheat, where fewer cultivars exist than they did decades ago.23 9 Other crops globally consumed today, such as fruits 240 and vegetables, are likely grown from patented varieties or cultivars. As a result, agricultural biodiversity has diminished due to the introduction and consolidation of genetically modified, patented varieties, and it is highly likely the cannabis industry could see a similar fate.24 1

Cannabis biodiversity will be threatened if there are fewer available cultivars and, thus, fewer strain options.2 42 Fewer available strains could also lead to limited consumer experiences and patient treatment options. This notion, coupled with already limited clinical and scientific research, could significantly throttle advances in medical marijuana availability and use.2 43 The corporatization of the industry, thanks to patent law, could see smaller growers and businesses merging into giant conglomerates, with 2 the profits being held in the hands of a very few. 4 In short, the "winners" of the cannabis patent wars will dominate the industry post-prohibition.2 45

Some argue that expanding strain patents could have the opposite effect and allow researchers and physicians to "correctly identifty], dos[e], and perhaps even personalize prescriptions for particular strains in the future" to treat specific ailments.24 6 Patents are a hallmark of innovation, and with wide access to more and better cannabis strains, there could be innovation advances in the industry as a whole.2 47 However, the reality is that cannabis patents are likely to be held by large corporations, given what we have seen before with the United States government and the FDA's involvement.24 8

Both medical marijuana patients and recreational marijuana users are strain-driven. While the current cannabis landscape is rich with hundreds of different varieties, strain patents could lead to a "locked genetic landscape where innovation becomes rare and costly."2 4 9 Further, a monopoly on the local strains of one country could have disastrous effects on that country's biodiversity and its rights to that biodiversity.2 50

#### Monopolies kill market growth and disincentivize innovation.

Gunelius 20 “How Big Business, Monopolies and Stacked Licenses Impact the Marijuana Industry,” February 7, 2020, Originally published 3/4/17, Susan Gunelius is President & CEO of KeySplash Creative, Inc. <https://www.cannabiz.media/blog/how-big-business-monopolies-and-stacked-licenses-impact-the-marijuana-industry> SM

However, the continued growth and development of big businesses with deep pockets in the cannabis industry has many people worried that the result of continued mergers and acquisitions will be monopolies, lower quality products, and a shift of revenues away from mom and pop businesses in local communities to out-of-state (or out of country) corporations.

The Start of Monopolies and Oligopolies in the Cannabis Industry

Monopolies and oligopolies are already developing in the cannabis industry — not just in terms of big businesses usurping smaller businesses but also in terms of state regulations that allow vertical integration, which leads to markets dominated by one or a few players that control the cultivation, processing, and sale of cannabis products.

To clarify, all but two states (Louisiana and Washington) with active medical or recreational cannabis programs allow or require vertical integration of the cannabis supply chain. Cannabiz Media defines the related cannabis license structures as follows:

Fully stacked licenses: A single licensed business can or is required to handle all operations from seed to sale in a fully vertically integrated structure.

Partially stacked licenses: A single licensed business can or is required to handle more than one operation but not all operations from seed to sale.

Unstacked licenses: Different businesses handle different operations across the supply chain from seed to sale.

For example, in Minnesota, the state’s medical marijuana program requires full vertical integration with only one type of license – the Medical Cannabis Manufacturer license. Currently, only two of these licenses are allowed in the state to grow, process, and sell (at four dispensaries each) cannabis.

Other states, like Colorado and Oregon, have ceased to award additional licenses to some cannabis businesses in the past thereby creating oligopolies. In California, oligopolies are forming in a different way. Regulations passed leading up to opening the state’s adult-use market in 2018 allowed large businesses to exploit a loophole and obtain as many cultivator licenses as they could afford.

Across the country, smaller cannabis businesses are struggling to compete with other bigger cannabis companies. In Maryland, large out-of-state companies (including several well-known cannabis companies that are publicly traded on the Canadian Securities Exchange) have been quietly taking control of multiple marijuana dispensaries through management agreements or acquisition plans that circumvent the state’s regulations limiting ownership to one dispensary.

The concern about monopolies and oligopolies in the cannabis industry was in the Florida news extensively throughout 2019 when a Florida court ruled that the state’s required vertical integration was unconstitutional.

The Future of Marijuana and Big Business

Bottom line, whenever every business that wants to be in an industry cannot enter the market, competition will not flourish. The result is the same whether businesses are shut out due to state regulations or because big businesses have deeper pockets and force smaller players to leave. Either way, the result is the same. Fewer players equals less competition which usually leads to higher prices and limited market growth.

As Sean Williams of The Motley Fool warned back in 2017, “The culprit for the substantial drop in marijuana prices appears to be big businesses infiltrating the industry and flooding the market with product. As with any industry, if big business can push the little guy out, they’ll have considerably more liberties down the road to raise their prices back up and capture a juicier margin, along with greater market share.”

Only free competition ensures fair prices and market growth over the long-term as well as ongoing innovation and product accessibility.

#### Cannabis innovation solves rising food insecurity – key to new techniques and future sustainability

SS 19 [Soft Secrets is a global cannabis news and information platform. Supported by its own network of reporters and editors at home and abroad. Soft Secrets is the leading source for cannabis cultivation, legalization, culture and entertainment.] “The Urban Farm Revolution,” Soft Secrets, March 4, 2019, https://softsecrets.com/en-US/article/urban-farm-revolution TG

As the world's population races in ever greater numbers to our sprawling and polluted metropolises, the problem of how best to feed the swelling ranks of city-dwellers becomes ever more pressing. Providing a suitable habitat for the fruits and vegetables we depend on can be extremely difficult in an urban setting. Beyond the high cost of land, local climatic conditions can be greatly altered by the growth of a city, and can have adverse effects upon agriculture. But it is a pressing issue - food prices are currently at record global highs, and significant numbers of the urban poor are facing rising food insecurity, a problem shared by an increasing number of nations as the global recession deepens. A beautiful juxtaposition of the organic and the artificial (Tim Gonzalez) To assist in counteracting this rising insecurity, various city farm schemes have been proposed throughout the world, and many have been implemented already. Most major US cities now have some form of scheme in place; a few of the very largest conurbations, such as New York City, Philadelphia, Los Angeles and the Bay Area, have seen great successes. By redeveloping derelict spaces and thinking creatively (rooftop vegetable gardens are a great example), it is possible to get a lot back from a relatively small input - but despite the many success stories, we are very far from achieving self-sufficient cities.

Over the years, the transfer of knowledge between legal agriculturalists and (largely) illegal cultivators of Cannabis has been great. The first indoor Cannabis gardeners were greatly supported by the wealth of pre-existing knowledge of indoor growing in general, and due to massive selection pressures on establishing efficient, covert and low-impact systems, they and their descendants have become leaders in the field. Now their knowledge is proving valuable to the urban farming industry, and liaisons between Cannabis growers and various urban farm initiatives are becoming more common in some parts - although for obvious reasons remain largely unpublicized. The art of producing a high yield from a limited space, without sacrificing quality, is without doubt the specialty of the pot farmer. 'Sea of Green' is a classic example of a Cannabis cultivation technique that has been successfully applied to various other fruiting plants, such as tomatoes, beans and peas. This technique is suitable for plants that can be planted very close together, and will flower and fruit after very little vegetative time. Examples of such knowledge transfer in this direction are few, but Cannabis growers are important for other reasons also.

The Cannabis market is worth almost $120 billion in the US alone, according to some estimates, and growers are often among the earliest adopters of new and experimental techniques, which helps to encourage further research and development and ultimately leads to improved products. Lighting systems are a good example: the need to reduce heat, power consumption, and visibility to law enforcement meant that LED lighting technologies were eagerly taken up by the Cannabis world, even in their earliest stages of development, helping to reach our current highly competitive standards. Now LEDs are the sole lighting source for many productive commercial enterprises, including PlantLab, a vertical farm scheme in Den Bosch, the Netherlands, whose managers report up to three times the yield from conventional systems using their specially-tweaked high-efficiency LED rigs. Similarly, hydroponics as a technique for high-yield, intensive cultivation was adopted by the earliest indoor growers, so avidly that the method soon became inextricably linked to Cannabis. This is still the case: pioneers of new hydroponic urban farming schemes have occasionally found their suggestions summarily rejected by investors on the basis of an uncomfortably strong perceived association. However, ignoring these schemes may well prove hugely short-sighted, as they show several signs of being truly viable options for a sustainable future.

#### Now is key – COVID spiked global food insecurity and political instability

Eiran et al 21 [Ehud Eiran, senior lecturer at University of Haifa, visiting scholar in political science at Stanford University, former assistant foreign policy advisor to Israeli prime minister. Michaela Elias, MA in earth systems from Stanford University. Aron M Troen, associate professor of nutrition science and policy at the Hebrew University of Jerusalem.] “No bread, No Peace.” Foreign Policy, January 23, 2021, <https://foreignpolicy.com/2021/01/23/food-hunger-national-security-issue-instability/> TG

We know that rising food insecurity can exacerbate social and political instability.

Another important reminder that food is essential to national security was the United Nations Security Council unanimous adoption in 2018 of[Resolution 2417](https://www.un.org/press/en/2018/sc13354.doc.htm), which, for the first time in the council’s history, condemned starvation as a form of warfare. Among other things, the resolution stated that armed conflict has both direct and indirect effects on access to food. The resolution further reaffirmed protections for civilians under international humanitarian law and the importance of securing access to food during conflict.

A third development is the rise in the number of hungry people in the world. A recent Intergovernmental Panel on Climate Change (IPCC) report[showed](https://www.ipcc.ch/site/assets/uploads/sites/4/2020/02/SRCCL-Chapter-5.pdf) that from 1961 to 2013, food supply per capita increased by more than 30 percent. However, in the last few years, more people have been going hungry. The FAO’s annual report from July 2020[showed](http://www.fao.org/3/ca9692en/CA9692EN.pdf) that about 690 million people are hungry—a rise of 10 million in one year and nearly 60 million in five years. Additionally, according to the FAO report, in 2019, about 2 billion people did not have regular access to safe, nutritious, and sufficient food, and about 750 million faced severe food insecurity.

Finally, the coronavirus pandemic has shown, at least initially, that food supply chains are more vulnerable than many expected. The pandemic led to price fluctuations that the United States, for instance, had not seen since the 1970s. The Bureau of Labor Statistics[showed](https://www.bls.gov/opub/mlr/2020/article/the-impact-of-the-covid-19-pandemic-on-food-price-indexes-and-data-collection.htm) that egg prices as measured by the producer price index increased by more than 50 percent between February and April 2020, and then dropped by 40 percent in May. And the prices of imported animal products, including meat and poultry, rose by 20 percent between March and June 2020. In December 2020, British supermarkets warned of potential shortage of fruit and vegetables, as France halted traffic across the Channel in response to reports about the COVID-19 mutation spreading in Britain. Meanwhile, less developed countries have experienced even sharper rises in food prices. In South Sudan, for example, prices of staples like wheat and cassava[have surged](https://www.usglc.org/coronavirus/global-hunger/) since February 2020 by 62 percent and 41 percent, respectively, and in Kenya, the price of maize has risen by 60 percent since 2019. These increases in staple prices create conditions for social instability.

Food-policy experts and international agencies such as the FAO are worried, but their concern is largely framed in terms of the pandemic’s impact on human nutrition and well-being. Yet we know that rising food insecurity can exacerbate social and political instability. Take, for instance, the sharp hikes in global food prices in 2007 and 2008 that led to street demonstrations and food riots in more than 40 countries. Or the food price index of the FAO[reaching a historic peak](https://ucanr.edu/blogs/food2025/blogfiles/14415.pdf) in 2011, which might have contributed to the Arab Spring, where starvation was[used by warring parties](https://academic.oup.com/jicj/article/17/4/699/5721410) (mostly the Assad regime) to occupy territory and for social control. Overall, food insecurity can lead to the collapse of social trust, the devastation of local economies, displacement, and worsening conditions for refugees.

Already, COVID-19-related food shortages and economic distress have generated social unrest. In Kenya, increasing desperation contributed to[stampedes in Nairobi](https://www.ctvnews.ca/health/coronavirus/stampede-in-kenya-as-slum-residents-surge-for-food-aid-1.4891503) during a food giveaway in April 2020, leaving two dead and many injured. In Bangladesh, thousands of unpaid garment workers[blocked roads in Dhaka](https://www.thenation.com/article/society/coronavirus-global-food-crisis/) and demanded wages in April 2020, saying they would rather risk infection than go without sufficient food. Rising hunger amid the pandemic also sets the stage for the politicization of critical humanitarian assistance. Nongovernmental organizations in Zimbabwe, for instance, have[reported](https://allafrica.com/stories/202004160783.html) that the ruling party is using the government food distribution amid COVID-19 lockdowns to shore up support by supplying only to its affiliates, while also[preventing the opposition](https://allafrica.com/stories/202004230541.html) from distributing food.

#### Food insecurity leads to nuclear war – extinction

Cribb 19 [Julian Cribb, distinguished science writer with more than thirty awards for journalism, October 3, 2019. “Food or War.” Cambridge University Press. https://www.cambridge.org/core/books/food-or-war/2D6F728A71C0BFEA0CEC85897066DCAF]

Although actual numbers of warheads have continued to fall from its peak of 70,000 weapons in the mid 1980s, scientists argue the danger of nuclear conflict in fact increased in the first two decades of the twenty first century. This was due to the modernisation of existing stockpiles, the adoption of dangerous new technologies such as robot delivery systems, hypersonic missiles, artificial intelligence and electronic warfare, and the continuing leakage of nuclear materials and knowhow to nonnuclear nations and potential terrorist organisations. In early 2018 the hands of the ‘ Doomsday Clock ’ , maintained by the Bulletin of the Atomic Scientists, were re-set at two minutes to midnight, the highest risk to humanity that it has ever shown since the clock was introduced in 1953. This was due not only to the state of the world ’s nuclear arsenal, but also to irresponsible language by world leaders, the growing use of social media to destabilise rival regimes, and to the rising threat of uncontrolled climate change (see below). 12 In an historic moment on 17 July 2017, 122 nations voted in the UN for the first time ever in favour of a treaty banning all nuclear weapons. This called for comprehensive prohibition of “ a full range of nuclear-weapon-related activities, such as undertaking to develop, test, produce, manufacture, acquire, possess or stockpile nuclear weapons or other nuclear explosive devices, as well as the use or threat of use of these weapons. ” 13 However, 71 other countries– including all the nuclear states– either opposed the ban, abstained or declined to vote. The Treaty vote was nonetheless interpreted by some as a promising first step towards abolishing the nuclear nightmare that hangs over the entire human species. In contrast, 192 countries had signed up to the Chemical Weapons Convention to ban the use of chemical weapons, and 180 to the Biological Weapons Convention. As of 2018, 96 per cent of previous world stocks of chemical weapons had been destroyed– but their continued use in the Syrian conflict and in alleged assassination attempts by Russia indicated the world remains at risk. 14 As things stand, the only entities that can afford to own nuclear weapons are nations– and if humanity is to be wiped out, it will most likely be as a result of an atomic conflict between nations. It follows from this that, if the world is to be made safe from such a fate it will need to get rid of nations as a structure of human self-organisation and replace them with wiser, less aggressive forms of self-governance. After all, the nation state really only began in the early nineteenth century and is by no means a permanent feature of self-governance, any more than monarchies, feudal systems or priest states. Although many people still tend to assume it is. Between them, nations have butchered more than 200 million people in the past 150 years and it is increasingly clear the world would be a far safer, more peaceable place without either nations or nationalism. The question is what to replace them with. Although there may at first glance appear to be no close linkage between weapons of mass destruction and food, in the twenty first century with world resources of food, land and water under growing stress, nothing can be ruled out. Indeed, chemical weapons have frequently been deployed in the Syrian civil war, which had drought, agricultural failure and hunger among its early drivers. And nuclear conflict remains a distinct possibility in South Asia and the Middle East, especially, as these regions are already stressed in terms of food, land and water, and their nuclear firepower or access to nuclear materials is multiplying. It remains an open question whether panicking regimes in Russia, the USA or even France would be ruthless enough to deploy atomic weapons in an attempt to quell invasion by tens of millions of desperate refugees, fleeing famine and climate chaos in their own homelands– but the possibility ought not to be ignored. That nuclear war is at least a possible outcome of food and climate crises was first flagged in the report The Age of Consequences by Kurt Campbell and the US-based Centre for Strategic and International Studies, which stated ‘ it is clear that even nuclear war cannot be excluded as a political consequence of global warming ’ . 15 Food insecurity is therefore a driver in the preconditions for the use of nuclear weapons, whether limited or unlimited.

#### Nuke war causes extinction – Ice Age, famines, and war won’t stay limited

Edwards 17 [Paul N. Edwards, CISAC’s William J. Perry Fellow in International Security at Stanford’s Freeman Spogli Institute for International Studies. Being interviewed by EarthSky. How nuclear war would affect Earth’s climate. September 8, 2017. earthsky.org/human-world/how-nuclear-war-would-affect-earths-climate] Note, we are only reading parts of the interview that are directly from Paul Edwards -- MMG

In the nuclear conversation, what are we not talking about that we should be?

We are not talking enough about the climatic effects of nuclear war. The “nuclear winter” theory of the mid-1980s played a significant role in the arms reductions of that period. But with the collapse of the Soviet Union and the reduction of U.S. and Russian nuclear arsenals, this aspect of nuclear war has faded from view. That’s not good. In the mid-2000s, climate scientists such as Alan Robock (Rutgers) took another look at nuclear winter theory. This time around, they used much-improved and much more detailed climate models than those available 20 years earlier. They also tested the potential effects of smaller nuclear exchanges. The result: an exchange involving just 50 nuclear weapons — the kind of thing we might see in an India-Pakistan war, for example — could loft 5 billion kilograms of smoke, soot and dust high into the stratosphere. That’s enough to cool the entire planet by about 2 degrees Fahrenheit (1.25 degrees Celsius) — about where we were during the Little Ice Age of the 17th century. Growing seasons could be shortened enough to create really significant food shortages. So the climatic effects of even a relatively small nuclear war would be planet-wide. What about a larger-scale conflict? A U.S.-Russia war currently seems unlikely, but if it were to occur, hundreds or even thousands of nuclear weapons might be launched. The climatic consequences would be catastrophic: global average temperatures would drop as much as 12 degrees Fahrenheit (7 degrees Celsius) for up to several years — temperatures last seen during the great ice ages. Meanwhile, smoke and dust circulating in the stratosphere would darken the atmosphere enough to inhibit photosynthesis, causing disastrous crop failures, widespread famine and massive ecological disruption. The effect would be similar to that of the giant meteor believed to be responsible for the extinction of the dinosaurs. This time, we would be the dinosaurs. Many people are concerned about North Korea’s advancing missile capabilities. Is nuclear war likely in your opinion? At this writing, I think we are closer to a nuclear war than we have been since the early 1960s. In the North Korea case, both Kim Jong-un and President Trump are bullies inclined to escalate confrontations. President Trump lacks impulse control, and there are precious few checks on his ability to initiate a nuclear strike. We have to hope that our generals, both inside and outside the White House, can rein him in. North Korea would most certainly “lose” a nuclear war with the United States. But many millions would die, including hundreds of thousands of Americans currently living in South Korea and Japan (probable North Korean targets). Such vast damage would be wrought in Korea, Japan and Pacific island territories (such as Guam) that any “victory” wouldn’t deserve the name. Not only would that region be left with horrible suffering amongst the survivors; it would also immediately face famine and rampant disease. Radioactive fallout from such a war would spread around the world, including to the U.S. It has been more than 70 years since the last time a nuclear bomb was used in warfare. What would be the effects on the environment and on human health today? To my knowledge, most of the changes in nuclear weapons technology since the 1950s have focused on making them smaller and lighter, and making delivery systems more accurate, rather than on changing their effects on the environment or on human health. So-called “battlefield” weapons with lower explosive yields are part of some arsenals now — but it’s quite unlikely that any exchange between two nuclear powers would stay limited to these smaller, less destructive bombs.

#### Cannabis innovation is key to sustainable water use and efficiency

Lauria 17 [Jim, BS Chemical Engineering from Manhattan College, VP of sales and marketing for Mazzei Injector Company] “Why California’s Cannabis Industry Will Lead Water Innovation,” The New Humanitarian, February 6, 2017, <https://deeply.thenewhumanitarian.org/water/community/2017/02/06/why-californias-cannabis-industry-will-lead-water-innovation> TG

* SS ev warrants help too

FOR YEARS, I’VE been standing on my deck in San Francisco, [looking south](https://wateronline.epubxp.com/i/694011-july-2016/38) to Silicon Valley for innovation in water efficiency. But I’m starting to realize that I might have been gazing in the wrong direction. Maybe I need to turn around and look north, over the spires of the Golden Gate Bridge, toward the Emerald Triangle in Humboldt, Mendocino and Trinity counties, the hotbed of California’s newly legalized commercial cannabis production.

Of course, though California voters legalized recreational marijuana – and its production – last year, many growers in the Emerald Triangle and other parts of the state are not rank beginners. Eager to build their reputations for quality and just as anxious to maximize yields of a crop that’s sold by the gram, cannabis cultivators have been among the most driven and exacting farmers in agriculture.

So now we have highly motivated growers, under regulatory scrutiny, in a state that’s been gripped in an epic drought for the past six years. If you ask me, those are the people who will be leading agriculture toward sustainable water management.

Major Motivator

Now that it’s emerging from the shadows, California cannabis is likely to be recognized as the state’s top-valued crop, which is no surprise, especially as experts believe 60 to 70 percent of the pot sold in America comes from the Golden State. The Christian Science Monitor cites a value of $11–17 billion per year for the California cannabis crop. Compare that to the state’s next-ranked commodity, milk and cheese, at $6.7 billion.

Cannabis grown indoors yields an average value of $112 per square foot (0.1 square meter), according to a [report on indoor farming](https://stateofindoorfarming.agrilyst.com/?mc_cid=435afb16ab) by Agrilyst, well ahead of greens ($64 per square foot) and strawberries ($22). In fact, Agrilyst calculated indoor cannabis production to be 9,000 times more productive on a dollar basis than commercial corn production. And even outdoors, pot is a smokin’ deal. The [Denver University Law Review](https://duwaterlawreview.com/dont-forget-to-water-the-weeds/) calculated a return of 22 cents to $6.67 per gallon (3.8 liters) of water from cannabis grown in Colorado, compared to 2 to 3 cents per gallon ROI from potatoes, another of the state’s major crops.

Reducing Demand

The first step toward sustainable water management in cannabis, or any crop, is in limiting the demand side of the equation. Some cannabis growers in the Emerald Triangle have generated controversy by withdrawing water from streams and rivers to supply illegal grows on government land, and sending polluted water and sediment from poorly built roads back into the creeks. But those farmers now fall under state law, whether it’s a requirement to prove a legal water right or to comply with groundwater pumping rules such as the Sustainable Groundwater Management Act (whose high-risk groundwater management areas are outside the Emerald Triangle, at least for now) and other use restrictions like those detailed in California SB 837.

In fact, [Water Deeply](https://ww2.kqed.org/science/2016/07/11/growing-marijuana-state-will-now-regulate-water-use-for-pot-cultivation/) reported that half of the state’s estimated 50,000 cannabis growers will likely have to prove their water rights and build storage that will allow them to gather water during the winter to draw on in summer, instead of tapping limited surface-water flows.

Limited Access

Stored water is going to be especially vital farther south. Cannabis may be included in California’s agriculture reports from here on out, but pot growers won’t have access to federal water supplies, like the Central Valley Project water that sustains billions of dollars’ worth of other crops in the state’s salad bowl. Because marijuana is still outlawed by the federal government, which owns 48 percent of California’s land mass and controls the large majority of its irrigation supplies, federal agencies are keeping pot growers at arm’s length.

Notably, the Bureau of Reclamation, which built and operates the Central Valley Project, won’t supply cannabis growers, even though they’re permitted by the state.

Don’t expect anything different from the U.S. Army Corps of Engineers or the U.S. Department of Agriculture. When it comes to water – or technical support for water conservation efforts – cannabis growers may be left high and dry.

That creates a great vacuum that can be filled by water industry experts and farming consultants, by the way. Forward-thinking suppliers of water technology could be to today’s “Green Rush” what mining equipment suppliers like Levi Strauss were to the Gold Rush in the mid-1800s.

One of those experts is Richard Restuccia, vice president of landscape solutions for Jain Irrigation. Here’s what Richard said about cannabis cultivation:

“This is a group that’s more interested in quality and sustainability than we’ve seen before. The indoor growers that I speak with have a ton of knowledge of what they’re doing,” said Restuccia of the cannabis growers – mostly indoor cultivators – who are contacting him daily for the latest in drip-irrigation technology. “More important, they have a lot of knowledge and interest in doing irrigation the right way. They are managing this scientifically. They’re trying to perform at a very high level – they’re shooting for a crop a month, where they usually get a crop in three or four months. They have a thirst for knowledge and information that I have never seen.”

Thirst for Data

As growers scramble for data, debates rage over how much water cannabis production actually consumes. Scott Bauer of the California Department of Fish and Wildlife published a [widely cited estimate](https://cdfgnews.wordpress.com/2015/03/25/cdfw-scientists-publish-groundbreaking-work-on-marijuanas-effect-on-the-environment/) of 6 gallons per plant per day, about twice as much as a wine-grape vine. NORML, a marijuana advocacy group, prefers figures closer to 2.6 gallons per plant per day. Cannabis grower groups and the Small Farmers Association are pushing growers toward goals of 0.5 to 1 gallon per plant per day. Now that’s efficiency.

Careful management will be a key tool in achieving those efficiency water targets, as well as targets for managing crop nutrients. We’ll see fertilizers managed in minute detail in an effort to optimize yields, reduce costs and reduce pollution in discharged water.

Spoon-feeding nutrients through irrigation water has long been proven to improve yield and quality in fruit and vegetable production. Precise delivery of fertilizer through irrigation water is also a powerful tool in limiting runoff of nutrients into surface water, leaching of nitrates into groundwater, or volatilization of nitrogen into the atmosphere. Cannabis cultivators, using those sophisticated tools, rival even the best vegetable growers when it comes to knowing exactly how much nutrient their crops are utilizing.

Nutrient delivery tools will also be vital as cannabis growers are scrutinized by regulatory officials. Regional water-quality control boards and other environmental agencies will demand [best management practices](https://www.waterboards.ca.gov/water_issues/programs/enforcement/docs/cannabis_enfrcmnt/bmp_cc_flyer.pdf) and detailed production records from cannabis growers, just as they do from dairy producers or other farmers. And marijuana producers have the resources to invest in systems that don’t only meter nutrients – whether they’re delivered as commercial fertilizer solutions or compost tea – but also record the amounts applied to the crop.

#### Water scarcity causes Russia-China nuclear war

[Klare](https://www.thenation.com/authors/michael-t-klare/) 20 [Michael T. Klare, The Nation’s defense correspondent, is professor emeritus of peace and world-security studies at Hampshire College and senior visiting fellow at the Arms Control Association in Washington, DC. Most recently, he is the author of [All Hell Breaking Loose: The Pentagon’s Perspective on Climate Change](https://www.panmacmillan.com.au/9781627792486/all-hell-breaking-loose/).] “How Rising Temperatures Increase the Likelihood of Nuclear War.” The Nation. January 13, 2020. <https://www.thenation.com/article/archive/nuclear-defense-climate-change/>

Severe water scarcity in northern China could prompt yet another move with nuclear implications: an attempted annexation by China of largely uninhabited but water-rich areas of Russian Siberia. Thousands of Chinese farmers and merchants have already taken up residence in eastern Siberia, and some commentators have spoken of a time when climate change prompts a formal Chinese takeover of those areas—which would almost certainly prompt fierce Russian resistance and the possible use of nuclear weapons.

#### IndoPak nuke war too – rising temps and dams spike the risk

[Klare](https://www.thenation.com/authors/michael-t-klare/) 20 [Michael T. Klare, The Nation’s defense correspondent, is professor emeritus of peace and world-security studies at Hampshire College and senior visiting fellow at the Arms Control Association in Washington, DC. Most recently, he is the author of [All Hell Breaking Loose: The Pentagon’s Perspective on Climate Change](https://www.panmacmillan.com.au/9781627792486/all-hell-breaking-loose/).] “How Rising Temperatures Increase the Likelihood of Nuclear War.” The Nation. January 13, 2020. <https://www.thenation.com/article/archive/nuclear-defense-climate-change/> TG

The risk to Pakistan from climate change is thought to be particularly acute. A large part of the population is still engaged in agriculture, and much of the best land—along with access to water—is controlled by wealthy landowners (who also dominate national politics). Water scarcity and mismanagement is a perennial challenge, and climate change is bound to make the problem worse. Climate and Social Stress: Implications for Security Analysis, a 2013 report by the National Research Council for the US intelligence community, highlights the danger of chaos and conflict in that country as global warming advances. Pakistan, the report notes, is expected to suffer from inadequate water supplies during the dry season and severe flooding during the monsoon—outcomes that will devastate its agriculture and amplify the poverty and unrest already afflicting much of the country. “The Pakistan case,” the report reads, “illustrates how a highly stressed environmental system on which a tense society depends can be a source of political instability and how that source can intensify when climate events put increased stress on the system.” Thus, as global temperatures rise and agriculture declines, Pakistan could shatter along ethnic, class, and religious lines, precisely the scenario that might trigger the sort of intervention anticipated by the US Joint Special Operations Command.

Assuming that Pakistan remains intact, another great danger arising from increasing world temperatures is a conflict between it and India or between China and India over access to shared river systems. Whatever their differences, Pakistan and western India are forced by geography to share a single river system, the Indus, for much of their water requirements. Likewise, western China and eastern India also share a river, the Brahmaputra, for their vital water needs. The Indus and the Brahmaputra obtain much of their flow from periods of heavy precipitation; they also depend on meltwater from Himalayan glaciers, and these are at risk of melting because of rising temperatures. According to the IPCC, the Himalayan glaciers could lose as much as 29 percent of their total mass by 2035 and 78 percent by 2100. This would produce periodic flooding as the ice melts but would eventually result in long periods of negligible flow, with calamitous consequences for downstream agriculture. The widespread starvation and chaos that could result would prove daunting to all the governments involved and make any water-related disputes between them a potential flash point for escalation.

As in Pakistan, water supply has always played a pivotal role in the social and economic life of China and India, with both countries highly dependent on a few major river systems for civic and agricultural purposes. Excessive rainfall can lead to catastrophic flooding, and prolonged drought has often led to widespread famine and mass starvation. In such a setting, water management has always been a prime responsibility of government—and a failure to fulfill this function effectively has often resulted in civil unrest. Climate change is bound to increase this danger by causing prolonged water shortages interspersed with severe flooding. This has prompted leaders of both countries to build ever more dams on all key rivers.

India, as the upstream power on several tributaries of the Indus, and China, as the upstream power on the Brahmaputra, have considered damming these rivers and diverting their waters for exclusive national use, thereby diminishing the flow to downstream users. Three of the Indus’s principal tributaries, the Jhelum, Chenab, and Ravi rivers, flow through Indian-controlled Kashmir (now in total lockdown, with government forces suppressing all public functions). It’s possible that India seeks full control of Kashmir in order to dam the tributaries there and divert their waters from Pakistan—a move that could easily trigger a war if it occurs at a time of severe food and water stress and one that would very likely invite the use of nuclear weapons, given Pakistan’s attitude toward them.

#### Lack of cannabis biodiversity is vulnerable to wipeout which decks innovation, and wrecks ag nutrition and biodiversity writ large

Hunt 20 [Dale, PhD Biology from UC San Diego, JD in Intellectual Property Law from UC Berkeley, Founder and Senior Attorney at Planet & Planet Law Firm, Founder and CEO at Breeder’s Best] “Biodiversity in Commercial Cannabis: Why It Matters,” Cannabis Business Times, August 7, 2020, <https://www.cannabisbusinesstimes.com/article/biodiversity-in-commercial-cannabis-why-it-matters/> [brackets in original] TG

The limitation of a monoculture is that it’s a total commitment to one strategy. If a new virus or other pathogen reaches a monoculture crop that is susceptible to it, the entire crop is uniformly susceptible and can be wiped out. We are all living through the emergence of a new virus, so we know the outbreak of a new pathogen is something that really can happen. If our human population were a genetic monoculture highly susceptible to the new coronavirus, everyone would need to be in an intensive care unit. Fortunately, for every person who needs advanced treatment, there are many more who show no symptoms when infected; and others are somewhere between these extremes. This dynamic can also exist with crops—a genetic monoculture that is susceptible will be affected uniformly by a new pathogen, while a genetically diverse farm will have a more robust and varied response.

Historic examples of this problem include the Irish Potato Famine in the 19th Century, the “Panama disease” wipeout of the Gros Michel banana variety in the 1950s, and the southern corn leaf blight of 1970. In these cases, monocultured crops had no resistance to new pathogens, which spread widely and caused massive crop failures.

Another downfall of repeated monoculturing is its effect on the land and nearby habitat. Each crop has its own interaction with the soil and the organisms around it. In a sense, each crop takes something from the soil and some crops put something back into it. If, year after year, all the “taking” is of the same kind, then whatever is continuously taken can be depleted. This is a common problem of nitrogen-depleting crops that traditionally were rotated, in a given space, with nitrogen-replacing crops the following season. Nitrogen is essential for things like photosynthesis, protein production, and other vital aspects of plant health and productivity. In the absence of effective crop rotation, the soil can become critically low in nitrogen and unsuitable for farming.

In addition, the monoculture can affect nearby populations of insects, wildlife, soil microbes, etc. Some will thrive from positive interactions with the monoculture—to the point of a population explosion or other form of overgrowth—while others will dwindle because they do not interact well with that particular crop. The net effect is that a prolonged monoculture almost inevitably distorts the environment around it. For example, an analysis of more than 450 data sets and more than 50 insect species demonstrated that “variance in plant nutritive traits substantially reduces [insect] performance” and “increased [diversity] within agricultural crops could contribute to the sustainable control of insect pests in agroecosystems,” according to William C. Wetzel, lead author of the paper “Variability in plant nutrients reduces insect herbivore performance” published in the journal Nature in 2016.

#### Biodiversity loss causes extinction – also multiplies threats of escalation

Torres 16 [Phil Biologist, conservationist, science advocate & educator. 2 years based in Amazon rainforest, now exploring science around the world. “[Biodiversity Loss: An Existential Risk Comparable to Climate Change](http://futureoflife.org/2016/05/20/biodiversity-loss/)” <http://futureoflife.org/2016/05/20/biodiversity-loss/>]

According to the Bulletin of Atomic Scientists, the two greatest existential threats to human civilization stem from climate change and nuclear weapons. Both pose clear and present dangers to the perpetuation of our species, and the increasingly dire climate situation and nuclear arsenal modernizations in the United States and Russia were the most significant reasons why the Bulletin [decided](http://thebulletin.org/press-release/doomsday-clock-hands-remain-unchanged-despite-iran-deal-and-paris-talks9122) to keep the Doomsday Clock set at three minutes before midnight earlier this year.

But there is another existential threat that the Bulletin overlooked in its Doomsday Clock announcement: biodiversity loss. This phenomenon is often identified as one of the many consequences of climate change, and this is of course correct. But biodiversity loss is also a contributing factor behind climate change. For example, deforestation in the Amazon rainforest and elsewhere reduces the amount of carbon dioxide removed from the atmosphere by plants, a natural process that mitigates the effects of climate change. So the causal relation between climate change and biodiversity loss is bidirectional.

Furthermore, there are myriad phenomena that are driving biodiversity loss in addition to climate change. Other causes include ecosystem fragmentation, invasive species, pollution, oxygen depletion caused by fertilizers running off into ponds and streams, overfishing, human overpopulation, and overconsumption. All of these phenomena have a direct impact on the health of the biosphere, and all would conceivably persist even if the problem of climate change were somehow immediately solved.

Such considerations warrant decoupling biodiversity loss from climate change, because the former has been consistently subsumed by the latter as a mere effect. Biodiversity loss is a distinct environmental crisis with its own unique syndrome of causes, consequences, and solutions—such as restoring habitats, creating protected areas (“biodiversity parks”), and practicing sustainable agriculture.

Deforestation of the Amazon rainforest decreases natural mitigation of CO2 and destroys the habitats of many endangered species.

The sixth extinction.

The repercussions of biodiversity loss are potentially as severe as those anticipated from climate change, or even a nuclear conflict. For example, according to a 2015 [study](http://www.ncbi.nlm.nih.gov/pubmed/26601195) published in Science Advances, the best available evidence reveals “an exceptionally rapid loss of biodiversity over the last few centuries, indicating that a sixth mass extinction is already under way.” This conclusion holds, even on the most optimistic assumptions about the background rate of species losses and the current rate of vertebrate extinctions. The group classified as “vertebrates” includes mammals, birds, reptiles, fish, and all other creatures with a backbone.

The article argues that, using its conservative figures, the average loss of vertebrate species was 100 times higher in the past century relative to the background rate of extinction. (Other scientists have suggested that the current extinction rate could be as much as 10,000 times higher than normal.) As the authors write, “The evidence is incontrovertible that recent extinction rates are unprecedented in human history and highly unusual in Earth’s history.” Perhaps the term “Big Six” should enter the popular lexicon—to add the current extinction to the previous “Big Five,” the last of which wiped out the dinosaurs 66 million years ago.

But the concept of biodiversity encompasses more than just the total number of species on the planet. It also refers to the size of different populations of species. With respect to this phenomenon, multiple studies have confirmed that wild populations around the world are dwindling and disappearing at an alarming rate. For example, the 2010 [Global Biodiversity Outlook](https://www.cbd.int/gbo3) report found that the population of wild vertebrates living in the tropics dropped by 59 percent between 1970 and 2006.

The report also found that the population of farmland birds in Europe has dropped by 50 percent since 1980; bird populations in the grasslands of North America declined by almost 40 percent between 1968 and 2003; and the population of birds in North American arid lands has fallen by almost 30 percent since the 1960s. Similarly, 42 percent of all amphibian species (a type of vertebrate that is sometimes called an “ecological indicator”) are undergoing population declines, and 23 percent of all plant species “are estimated to be threatened with extinction.” [Other studies](http://commondreams.org/views/2016/02/10/biodiversity-loss-and-doomsday-clock-invisible-disaster-almost-no-one-talking-about) have found that some 20 percent of all reptile species, 48 percent of the world’s primates, and 50 percent of freshwater turtles are threatened. Underwater, about 10 percent of all coral reefs are now dead, and another 60 percent are in danger of dying.

Consistent with these data, the 2014 [Living Planet Report](http://bit.ly/1ssxx5m) shows that the global population of wild vertebrates dropped by 52 percent in only four decades—from 1970 to 2010. While biologists often avoid projecting historical trends into the future because of the complexity of ecological systems, it’s tempting to extrapolate this figure to, say, the year 2050, which is four decades from 2010. As it happens, a 2006[study](http://science.sciencemag.org/content/314/5800/787) published in Science does precisely this: It projects past trends of marine biodiversity loss into the 21st century, concluding that, unless significant changes are made to patterns of human activity, there will be virtually no more wild-caught seafood by 2048.

48% of the world’s primates are threatened with extinction.

Catastrophic consequences for civilization.

The consequences of this rapid pruning of the evolutionary tree of life extend beyond the obvious. There could be surprising effects of biodiversity loss that scientists are unable to fully anticipate in advance. For example, prior research has shown that localized ecosystems can undergo abrupt and irreversible shifts when they reach a tipping point. According to a 2012 [paper](http://www.nature.com/nature/journal/v486/n7401/full/nature11018.html) published in Nature, there are reasons for thinking that we may be approaching a tipping point of this sort in the global ecosystem, beyond which the consequences could be catastrophic for civilization.

As the authors write, a planetary-scale transition could precipitate “substantial losses of ecosystem services required to sustain the human population.” An ecosystem service is any ecological process that benefits humanity, such as food production and crop pollination. If the global ecosystem were to cross a tipping point and substantial ecosystem services were lost, the results could be “widespread social unrest, economic instability, and loss of human life.” According to Missouri Botanical Garden ecologist Adam Smith, one of the paper’s co-authors, this could occur in a matter of decades—far more quickly than most of the expected consequences of climate change, yet equally destructive.

Biodiversity loss is a “threat multiplier” that, by pushing societies to the brink of collapse, will exacerbate existing conflicts and introduce entirely new struggles between state and non-state actors. Indeed, it could even fuel the rise of terrorism. (After all, climate change has been [linked](http://thebulletin.org/climate-change-and-syrian-uprising) to the emergence of ISIS in Syria, and multiple high-ranking US officials, such as former US Defense Secretary [Chuck Hagel](http://www.defense.gov/News-Article-View/Article/603441)and CIA director [John Brennan](http://www.cnsnews.com/news/article/cnsnewscom-staff/cia-director-cites-impact-climate-change-deeper-cause-global), have affirmed that climate change and terrorism are connected.)

The reality is that we are entering the sixth mass extinction in the 3.8-billion-year history of life on Earth, and the impact of this event could be felt by civilization “in as little as three human lifetimes,” as the aforementioned 2012 Nature paper notes. Furthermore, the widespread decline of biological populations could plausibly initiate a dramatic transformation of the global ecosystem on an even faster timescale: perhaps a single human lifetime.

The unavoidable conclusion is that biodiversity loss constitutes an existential threat in its own right. As such, it ought to be considered alongside climate change and nuclear weapons as one of the most significant contemporary risks to human prosperity and survival.

#### Thus the plan – the member nations of the World Trade Organization ought to delay patent enforcement for cannabis.

Kellner 21 “Mitigating the Effects of Intellectual Property Colonialism on Budding Cannabis Markets” Hughie Kellner [Hughie Kellner came from the small farm town of Uvalde, Texas and received a bachelor’s degree in Physics from the University of Texas at Austin. Upon graduation from the Indiana University Maurer School of Law, Hughie will deploy his physics degree while prosecuting patents in the Frankfurt am Main, Germany office of Leydig, Voit, & Mayer. After Hughie’s first year at Maurer, he worked for a law firm in Thailand as a Stewart Fellow.] Indiana Journal of Global Legal Studies Vol. 28 #1 (Winter 2021) <https://www.repository.law.indiana.edu/ijgls/vol28/iss1/9/> SM

* Includes enforcement and duration

A simple solution to the problem is this: if a nation, or jurisdiction, provides for some new use of cannabis, be it medicinal, recreational, or scientific, the legislation or decision doing so should be accompanied by a law stating that patents may not be enforced as they relate to the subject matter legalized (cannabis strains, methods for ingesting/using, etc.) for some determinate amount of time, after which, patents may be acquired.105 This, at first glance, may seem to some patent attorneys to be a drastic solution as opposed to, for example, compulsory licensing106 or some other means that does not abscond with the rights demanded by international agreements. In support of my proposal, I will first explain why banning enforcement for a certain period yet keeping patent acquisition is desired, rather than banning patent acquisition altogether, as a means of highlighting the benefits that will accrue from the proposed change. Second, I will argue that imposing patent enforcement during the beginning stages of a jurisdiction’s cannabis market development is difficult to justify, as the incentives that patent enforcement are supposed to bring about already exist in great strength, leaving little for the patent sacrifice to provide.

\*\*Footnote 105: There are many aspects of this solution that this note will not address. One of those aspects is the exact duration. All that is addressed is that duration should be less than the full term of a patent for reasons advanced herein. Further, it is assumed that the exact suitable duration is better adjusted to the economic capabilities of the relevant jurisdiction than uniformly imposed. Another aspect is how the solution should be implemented. This effect, of a patent being filed but not yet enforceable for a significant portion of its term of protection, is not uncommon in the pharmaceutical world where a drug may take ten to fifteen, even eighteen years to get approved, and is only enforceable for the remainder of the twenty years since it was filed, leaving possibly two years to do. Therefore, the solution proposed may occur on its own in some medicinal cannabis markets that have long drug patent examination periods, such as Thailand, specifically. That is why the solution proposed does not come with a specified form of implementation; the same goal may be achieved through controlling varying means and portions of the patent application process.

#### The plan solves by reigning in monopolies without killing innovation.

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Patents may still be sought and possibly even acquired if the government so chooses. In this way, examiners will not introduce a new subject matter eligibility analysis changing the fundamental scheme of patentability. Rather, examiners will process the patent as normal, under conditions that actors within the patent system understand, reducing frustration with changing subject matter eligibility rules that are already ambiguous.107 Further, if the promulgating body determines that the window invalidating patent enforcement should be shorter than the patent term would last, there is a benefit for all actors involved. The reasoning supporting a patent enforcement ban rather than a patent acquisition ban rests on five principles.

First, the entity filing the patent will still receive monopoly protection for its invention, albeit with a shorter window than usual. Thus, the incentive to file a patent and disclose the invention to the public still exists, and in a lucrative market such as that for cannabis, a smaller window of monopoly can be compensated by the higher value of that window, which could bring the perceived benefit from a patent back to usual levels.108

Second, if the invention is conceived during the enforcement ban, patent acquisition would allow inventions to be processed just as patents. By allowing patent processing before and after the ban, the legal regime will reduce administrative costs and increase legal certainty.109 By comparison, a system where patent acquisition is prohibited until after the ban would only result in a complex scheme whereby prior use, prior art, and other novelty requirements are handled.

Third, if actors are utilizing technology under such currently unenforceable but soon-to-be enforceable patents, they will have clear notice when they must cease such infringing action, and either close their doors or develop a compliant way of doing business. Thus, actors in the market can establish themselves and then innovate their own means of carrying out business or license it from those who do. This is the exact action patents are meant to incentivize, innovating new solutions to problems, even if the problem here is merely a legal one.110

Fourth, after the cannabis market sustains established actors, the cannabis market may find that the benefits of promoting more actors in the market111—the purpose of barring patent enforcement—are once again outweighed by the value of the incentives that the patent system provides.112 Setting a time period for when patent enforcement will return ensures that the market is not devoid of the incentives once the initial “green rush”113 wears off.

Fifth, this solution bans foreign monopolies, not foreign participation. This solution does not inhibit foreign companies from moving their business to local markets if the legal regime allows.114 With the ability to move their intellectual property portfolio, foreign companies can still acquire a trademark and operate their business plan, benefitting from the experience acquired in the prior years of operation. Foreign participants, just like domestic participants, cannot monopolize their innovations, and are thus placed on an equal footing.

### FW

#### Synthetic a posteriori moral naturalism is the basis of ethics since the normative supervenes on the natural

**Lutz and Lenman 18.** Lutz, Matthew and Lenman, James, "Moral Naturalism", The Stanford Encyclopedia of Philosophy (Fall 2018 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/fall2018/entries/naturalism-moral/>. //Massa

The first argument against normative non-naturalism concerns normative supervenience. **The normative supervenes on the natural; in all** metaphysically **possible worlds in which the natural facts are the same as** they are in **the actual world, the moral facts are the same** as well. **This** claim **has been called the “least controversial thesis in metaethics”** (Rosen forthcoming); **it is very widely accepted.** But it is also a striking fact that stands in need of some explanation. **For naturalists**, such an explanation is easy to provide: **the moral facts just are natural facts, so when we consider worlds that are naturally the same** as the actual world, **we will ipso facto be considering worlds that are morally the same** as the actual world. But for the non-naturalist, no such explanation seems available. In fact, **it seems** to be in principle **impossible for a non-naturalist to explain how the moral supervenes on the natural.** And if the non-naturalist can offer no explanation of this phenomenon that demands explanation, this is a heavy mark against non-naturalism (McPherson 2012).

#### Phenomenal introspection can bridge the gap from experiential natural facts to moral truths and necessitates hedonism. When I observe a lemon’s yellowness in my field of vision, I can introspect to conclude brightness is a feature of that lemon. When I feel pleasure, introspection on hedonic tones reveals that moral goodness is a property of pleasure.

#### This connection is irrefutable – everything else regresses – robust neuroscience proves.

Blum et al. 18 Kenneth Blum, 1Department of Psychiatry, Boonshoft School of Medicine, Dayton VA Medical Center, Wright State University, Dayton, OH, USA 2Department of Psychiatry, McKnight Brain Institute, University of Florida College of Medicine, Gainesville, FL, USA 3Department of Psychiatry and Behavioral Sciences, Keck Medicine University of Southern California, Los Angeles, CA, USA 4Division of Applied Clinical Research & Education, Dominion Diagnostics, LLC, North Kingstown, RI, USA 5Department of Precision Medicine, Geneus Health LLC, San Antonio, TX, USA 6Department of Addiction Research & Therapy, Nupathways Inc., Innsbrook, MO, USA 7Department of Clinical Neurology, Path Foundation, New York, NY, USA 8Division of Neuroscience-Based Addiction Therapy, The Shores Treatment & Recovery Center, Port Saint Lucie, FL, USA 9Institute of Psychology, Eötvös Loránd University, Budapest, Hungary 10Division of Addiction Research, Dominion Diagnostics, LLC. North Kingston, RI, USA 11Victory Nutrition International, Lederach, PA., USA 12National Human Genome Center at Howard University, Washington, DC., USA, Marjorie Gondré-Lewis, 12National Human Genome Center at Howard University, Washington, DC., USA 13Departments of Anatomy and Psychiatry, Howard University College of Medicine, Washington, DC US, Bruce Steinberg, 4Division of Applied Clinical Research & Education, Dominion Diagnostics, LLC, North Kingstown, RI, USA, Igor Elman, 15Department Psychiatry, Cooper University School of Medicine, Camden, NJ, USA, David Baron, 3Department of Psychiatry and Behavioral Sciences, Keck Medicine University of Southern California, Los Angeles, CA, USA, Edward J Modestino, 14Department of Psychology, Curry College, Milton, MA, USA, Rajendra D Badgaiyan, 15Department Psychiatry, Cooper University School of Medicine, Camden, NJ, USA, Mark S Gold 16Department of Psychiatry, Washington University, St. Louis, MO, USA, “Our evolved unique pleasure circuit makes humans different from apes: Reconsideration of data derived from animal studies”, U.S. Department of Veterans Affairs, 28 February 2018, accessed: 19 August 2020, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6446569/>, R.S.

**Pleasure** is not only one of the three primary reward functions but it also **defines reward.** As homeostasis explains the functions of only a limited number of rewards, the principal reason why particular stimuli, objects, events, situations, and activities are rewarding may be due to pleasure. This applies first of all to sex and to the primary homeostatic rewards of food and liquid and extends to money, taste, beauty, social encounters and nonmaterial, internally set, and intrinsic rewards. Pleasure, as the primary effect of rewards, drives the prime reward functions of learning, approach behavior, and decision making and provides the **basis for hedonic theories** of reward function. We are attracted by most rewards and exert intense efforts to obtain them, just because they are enjoyable [10].

Pleasure is a passive reaction that derives from the experience or prediction of reward and may lead to a long-lasting state of happiness. The word happiness is difficult to define. In fact, just obtaining physical pleasure may not be enough. One key to happiness involves a network of good friends. However, it is not obvious how the higher forms of satisfaction and pleasure are related to an ice cream cone, or to your team winning a sporting event. Recent multidisciplinary research, using both humans and detailed invasive brain analysis of animals has discovered some critical ways that the brain processes pleasure [14].

Pleasure as a hallmark of reward is sufficient for defining a reward, but it may not be necessary. A reward may generate positive learning and approach behavior simply because it contains substances that are essential for body function. When we are hungry, we may eat bad and unpleasant meals. A monkey who receives hundreds of small drops of water every morning in the laboratory is unlikely to feel a rush of pleasure every time it gets the 0.1 ml. Nevertheless, with these precautions in mind, we may define any stimulus, object, event, activity, or situation that has the potential to produce pleasure as a reward. In the context of reward deficiency or for disorders of addiction, homeostasis pursues pharmacological treatments: drugs to treat drug addiction, obesity, and other compulsive behaviors. The theory of allostasis suggests broader approaches - such as re-expanding the range of possible pleasures and providing opportunities to expend effort in their pursuit. [15]. It is noteworthy, the first animal studies eliciting approach behavior by electrical brain stimulation interpreted their findings as a discovery of the brain’s pleasure centers [16] which were later partly associated with midbrain dopamine neurons [17–19] despite the notorious difficulties of identifying emotions in animals.

Evolutionary theories of pleasure: The love connection BO:D

Charles Darwin and other biological scientists that have examined the biological evolution and its basic principles found various mechanisms that steer behavior and biological development. Besides their theory on natural selection, it was particularly the sexual selection process that gained significance in the latter context over the last century, especially when it comes to the question of what makes us “what we are,” i.e., human. However, the capacity to sexually select and evolve is not at all a human accomplishment alone or a sign of our uniqueness; yet, we humans, as it seems, are ingenious in fooling ourselves and others–when we are in love or desperately search for it.

It is well established that modern biological theory conjectures that **organisms are** the **result of evolutionary competition.** In fact, Richard Dawkins stresses gene survival and propagation as the basic mechanism of life [20]. Only genes that lead to the fittest phenotype will make it. It is noteworthy that the phenotype is selected based on behavior that maximizes gene propagation. To do so, the phenotype must survive and generate offspring, and be better at it than its competitors. Thus, the ultimate, distal function of rewards is to increase evolutionary fitness by ensuring the survival of the organism and reproduction. It is agreed that learning, approach, economic decisions, and positive emotions are the proximal functions through which phenotypes obtain other necessary nutrients for survival, mating, and care for offspring.

Behavioral reward functions have evolved to help individuals to survive and propagate their genes. Apparently, people need to live well and long enough to reproduce. Most would agree that homo-sapiens do so by ingesting the substances that make their bodies function properly. For this reason, foods and drinks are rewards. Additional rewards, including those used for economic exchanges, ensure sufficient palatable food and drink supply. Mating and gene propagation is supported by powerful sexual attraction. Additional properties, like body form, augment the chance to mate and nourish and defend offspring and are therefore also rewards. Care for offspring until they can reproduce themselves helps gene propagation and is rewarding; otherwise, many believe mating is useless. According to David E Comings, as any small edge will ultimately result in evolutionary advantage [21], additional reward mechanisms like novelty seeking and exploration widen the spectrum of available rewards and thus enhance the chance for survival, reproduction, and ultimate gene propagation. These functions may help us to obtain the benefits of distant rewards that are determined by our own interests and not immediately available in the environment. Thus the distal reward function in gene propagation and evolutionary fitness defines the proximal reward functions that we see in everyday behavior. That is why foods, drinks, mates, and offspring are rewarding.

There have been theories linking pleasure as a required component of health benefits salutogenesis, (salugenesis). In essence, under these terms, pleasure is described as a state or feeling of happiness and satisfaction resulting from an experience that one enjoys. Regarding pleasure, it is a double-edged sword, on the one hand, it promotes positive feelings (like mindfulness) and even better cognition, possibly through the release of dopamine [22]. But on the other hand, pleasure simultaneously encourages addiction and other negative behaviors, i.e., motivational toxicity. It is a complex neurobiological phenomenon, relying on reward circuitry or limbic activity. It is important to realize that through the “Brain Reward Cascade” (BRC) endorphin and endogenous morphinergic mechanisms may play a role [23]. While natural rewards are essential for survival and appetitive motivation leading to beneficial biological behaviors like eating, sex, and reproduction, crucial social interactions seem to further facilitate the positive effects exerted by pleasurable experiences. Indeed, experimentation with addictive drugs is capable of directly acting on reward pathways and causing deterioration of these systems promoting hypodopaminergia [24]. Most would agree that pleasurable activities can stimulate personal growth and may help to induce healthy behavioral changes, including stress management [25]. The work of Esch and Stefano [26] concerning the link between compassion and love implicate the brain reward system, and pleasure induction suggests that social contact in general, i.e., love, attachment, and compassion, can be highly effective in stress reduction, survival, and overall health.

Understanding the role of neurotransmission and pleasurable states both positive and negative have been adequately studied over many decades [26–37], but comparative anatomical and neurobiological function between animals and homo sapiens appear to be required and seem to be in an infancy stage.

Finding happiness is different between apes and humans

As stated earlier in this expert opinion one key to happiness involves a network of good friends [38]. However, it is not entirely clear exactly how the higher forms of satisfaction and pleasure are related to a sugar rush, winning a sports event or even sky diving, all of which augment dopamine release at the reward brain site. Recent multidisciplinary research, using both humans and detailed invasive brain analysis of animals has discovered some critical ways that the brain processes pleasure.

Remarkably, there are pathways for ordinary liking and pleasure, which are limited in scope as described above in this commentary. However, there are **many brain regions**, often termed hot and cold spots, that significantly **modulate** (increase or decrease) our **pleasure or** even produce **the opposite** of pleasure— that is disgust and fear [39]. One specific region of the nucleus accumbens is organized like a computer keyboard, with particular stimulus triggers in rows— producing an increase and decrease of pleasure and disgust. Moreover, the cortex has unique roles in the cognitive evaluation of our feelings of pleasure [40]. Importantly, the interplay of these multiple triggers and the higher brain centers in the prefrontal cortex are very intricate and are just being uncovered.

Desire and reward centers

It is surprising that many different sources of pleasure activate the same circuits between the mesocorticolimbic regions (Figure 1). Reward and desire are two aspects pleasure induction and have a very widespread, large circuit. Some part of this circuit distinguishes between desire and dread. The so-called pleasure circuitry called “REWARD” involves a well-known dopamine pathway in the mesolimbic system that can influence both pleasure and motivation.

In simplest terms, the well-established mesolimbic system is a dopamine circuit for reward. It starts in the ventral tegmental area (VTA) of the midbrain and travels to the nucleus accumbens (Figure 2). It is the cornerstone target to all addictions. The VTA is encompassed with neurons using glutamate, GABA, and dopamine. The nucleus accumbens (NAc) is located within the ventral striatum and is divided into two sub-regions—the motor and limbic regions associated with its core and shell, respectively. The NAc has spiny neurons that receive dopamine from the VTA and glutamate (a dopamine driver) from the hippocampus, amygdala and medial prefrontal cortex. Subsequently, the NAc projects GABA signals to an area termed the ventral pallidum (VP). The region is a relay station in the limbic loop of the basal ganglia, critical for motivation, behavior, emotions and the “Feel Good” response. This defined system of the brain is involved in all addictions –substance, and non –substance related. In 1995, our laboratory coined the term “Reward Deficiency Syndrome” (RDS) to describe genetic and epigenetic induced hypodopaminergia in the “Brain Reward Cascade” that contribute to addiction and compulsive behaviors [3,6,41].

Furthermore, ordinary “liking” of something, or pure pleasure, is represented by small regions mainly in the limbic system (old reptilian part of the brain). These may be part of larger neural circuits. In Latin, hedus is the term for “sweet”; and in Greek, hodone is the term for “pleasure.” Thus, the word Hedonic is now referring to various subcomponents of pleasure: some associated with purely sensory and others with more complex emotions involving morals, aesthetics, and social interactions. The capacity to have pleasure is part of being healthy and may even extend life, especially if linked to optimism as a dopaminergic response [42].

Psychiatric illness often includes symptoms of an abnormal inability to experience pleasure, referred to as anhedonia. A negative feeling state is called dysphoria, which can consist of many emotions such as pain, depression, anxiety, fear, and disgust. Previously many scientists used animal research to uncover the complex mechanisms of pleasure, liking, motivation and even emotions like panic and fear, as discussed above [43]. However, as a significant amount of related research about the specific brain regions of pleasure/reward circuitry has been derived from invasive studies of animals, these cannot be directly compared with subjective states experienced by humans.

In an attempt to resolve the controversy regarding the causal contributions of mesolimbic dopamine systems to reward, we have previously evaluated the three-main competing explanatory categories: “liking,” “learning,” and “wanting” [3]. That is, dopamine may mediate (a) liking: the hedonic impact of reward, (b) learning: learned predictions about rewarding effects, or (c) wanting: the pursuit of rewards by attributing incentive salience to reward-related stimuli [44]. We have evaluated these hypotheses, especially as they relate to the RDS, and we find that the incentive salience or “wanting” hypothesis of dopaminergic functioning is supported by a majority of the scientific evidence. Various neuroimaging studies have shown that anticipated behaviors such as sex and gaming, delicious foods and drugs of abuse all affect brain regions associated with reward networks, and may not be unidirectional. Drugs of abuse enhance dopamine signaling which sensitizes mesolimbic brain mechanisms that apparently evolved explicitly to attribute incentive salience to various rewards [45].

Addictive substances are voluntarily self-administered, and they enhance (directly or indirectly) dopaminergic synaptic function in the NAc. This activation of the brain reward networks (producing the ecstatic “high” that users seek). Although these circuits were initially thought to encode a set point of hedonic tone, it is now being considered to be far more complicated in function, also encoding attention, reward expectancy, disconfirmation of reward expectancy, and incentive motivation [46]. The argument about addiction as a disease may be confused with a predisposition to substance and nonsubstance rewards relative to the extreme effect of drugs of abuse on brain neurochemistry. The former sets up an individual to be at high risk through both genetic polymorphisms in reward genes as well as harmful epigenetic insult. Some Psychologists, even with all the data, still infer that addiction is not a disease [47]. Elevated stress levels, together with polymorphisms (genetic variations) of various dopaminergic genes and the genes related to other neurotransmitters (and their genetic variants), and may have an additive effect on vulnerability to various addictions [48]. In this regard, Vanyukov, et al. [48] suggested based on review that whereas the gateway hypothesis does not specify mechanistic connections between “stages,” and does not extend to the risks for addictions the concept of common liability to addictions may be more parsimonious. The latter theory is grounded in genetic theory and supported by data identifying common sources of variation in the risk for specific addictions (e.g., RDS). This commonality has identifiable neurobiological substrate and plausible evolutionary explanations.

Over many years the controversy of dopamine involvement in especially “pleasure” has led to confusion concerning separating motivation from actual pleasure (wanting versus liking) [49]. We take the position that animal studies cannot provide real clinical information as described by self-reports in humans. As mentioned earlier and in the abstract, on November 23rd, 2017, evidence for our concerns was discovered [50]

In essence, although nonhuman primate brains are similar to our own, the disparity between other primates and those of human cognitive abilities tells us that surface similarity is not the whole story. Sousa et al. [50] small case found various differentially expressed genes, to associate with pleasure related systems. Furthermore, the dopaminergic interneurons located in the human neocortex were absent from the neocortex of nonhuman African apes. Such differences in neuronal transcriptional programs may underlie a variety of neurodevelopmental disorders.

In simpler terms, the system controls the production of dopamine, a chemical messenger that plays a significant role in pleasure and rewards. The senior author, Dr. Nenad Sestan from Yale, stated: “Humans have evolved a dopamine system that is different than the one in chimpanzees.” This may explain why the behavior of humans is so unique from that of non-human primates, even though our brains are so surprisingly similar, Sestan said: “It might also shed light on why people are vulnerable to mental disorders such as autism (possibly even addiction).” Remarkably, this research finding emerged from an extensive, multicenter collaboration to compare the brains across several species. These researchers examined 247 specimens of neural tissue from six humans, five chimpanzees, and five macaque monkeys. Moreover, these investigators analyzed which genes were turned on or off in 16 regions of the brain. While the differences among species were subtle, **there was** a **remarkable contrast in** the **neocortices**, specifically in an area of the brain that is much more developed in humans tha

n in chimpanzees. In fact, these researchers found that a gene called tyrosine hydroxylase (TH) for the enzyme, responsible for the production of dopamine, was expressed in the neocortex of humans, but not chimpanzees. As discussed earlier, dopamine is best known for its essential role within the brain’s reward system; the very system that responds to everything from sex, to gambling, to food, and to addictive drugs. However, dopamine also assists in regulating emotional responses, memory, and movement. Notably, abnormal dopamine levels have been linked to disorders including Parkinson’s, schizophrenia and spectrum disorders such as autism and addiction or RDS.

Nora Volkow, the director of NIDA, pointed out that one alluring possibility is that the neurotransmitter dopamine plays a substantial role in humans’ ability to pursue various rewards that are perhaps months or even years away in the future. This same idea has been suggested by Dr. Robert Sapolsky, a professor of biology and neurology at Stanford University. Dr. Sapolsky cited evidence that dopamine levels rise dramatically in humans when we anticipate potential rewards that are uncertain and even far off in our futures, such as retirement or even the possible alterlife. This may explain what often motivates people to work for things that have no apparent short-term benefit [51]. In similar work, Volkow and Bale [52] proposed a model in which dopamine can favor NOW processes through phasic signaling in reward circuits or LATER processes through tonic signaling in control circuits. Specifically, they suggest that through its modulation of the orbitofrontal cortex, which processes salience attribution, dopamine also enables shilting from NOW to LATER, while its modulation of the insula, which processes interoceptive information, influences the probability of selecting NOW versus LATER actions based on an individual’s physiological state. This hypothesis further supports the concept that disruptions along these circuits contribute to diverse pathologies, including obesity and addiction or RDS.

#### Evolution proves the reliability of phenomenal introspection – when we introspect on data from our eyes or ears, such as whether one sees or smells food or a predator, we use the same part of the brain that introspects on hedonic tones and identifies their moral relevance.

#### Thus, the standard is consistency with hedonic act utilitarianism.