THE CACAO DEBATE: ARE WE SAYING BYE TO CHOCOLATE?

Words by Natalia Barszcz

It is no secret that climate change is affecting our planet rapidly, with more acute outcomes than expected. Yet as dreamy as T-shirt weather in February sounds, global warming has severely negative impacts on the nature around us. Can it be severe enough to wipe out (or more likely dry out) chocolate?

Wait – what are you on about?

It all started in 2016. The National Oceanographic and Atmospheric Administration (NOAA) published a report stating that climate change will have a significant effect on our planet in the next several decades, putting the agricultural land and global crop production at risk. Higher temperatures and dryer air were predicted to consequently shrink the regions of agricultural plantations, making the future of the food industry questionable. The report focused on a few popular products predicted to be affected the most, such as almonds, avocados, coffee, and cacao beans all requiring specific microclimates and conscious care.

Although NOAA explained that the issue of predicted produce inaccessibility is not a matter of extinction but could mostly result in its outpricing, the media grasped the story quickly, naturally boosting its intent. The biggest aggravator of the issue, Business Insider, focused on the cacao beans specifically, as it is indeed their harvesting areas that are already being affected the most by global warming – southern areas of Asia, Africa, and South America. In its article Chocolate is on track to go extinct in 40 years, it warned about cacao plants are being "slated to disappear as early as 2050 thanks to warmer temperatures and dryer weather conditions." A full chocolate detox in our sixties? No, thank you.

But why chocolate?

Ever heard the term El Niño? You probably have, as this is the main reason for vastly warmer and dryer climate around the southern areas of the Pacific and Atlantic oceans - exactly where most cacao is harvested.

El Niño Southern Oscillation (ENSO), as the full term goes, are variations in winds and sea temperatures that occur irregularly in the tropical areas of the Pacific Ocean. They happen in two phases – the warming one called El Niño and the cooling one, La Niña – depending on the state of the weather in that particular time. It has been noted that the impacts of El Niño and La Niña events have become more severe over the past 20 years due to a warmer climate, yet considering those rising temperatures, increased carbon emissions, and dryer climate, the number of the cooling phase events has severely decreased in the last few decades. In fact, World Meteorological Organization (WMO) has recently reported a 50% - 60% chance for El Niño atmospheric patterns to affect the oceans in the next two months, juxtaposing it with a highly unlikely development of La Niña, calling 2019 "the warmest year in history so far".

With warmer seas and higher temperatures, the air around the concerned areas becomes more and more dry – exactly what Theobroma cacao, or simply a cacao tree, doesn't like. Its preferred environment is mostly described as quite warm (temperature not lower than 18°C and not higher than 32°C), with fresh, slightly humid air – usually described as conditions in which the later produced chocolate could start melting in your hands after holding it for a few minutes. Such conditions make a perfect, balanced mix for cacao beans to flourish quickly and efficiently. The most popular destinations for cacao plantations are lands around Ghana, Indonesia, Côte d'Ivoire, and Brazil – the areas emphasised by the NOAA report to be affected by global warming the most. It is predicted that they will experience 2.1°C increase in temperature by 2050, resulting in intensified droughts, higher CO_2 levels, and the process of evapotranspiration – the loss of moisture in plants' cores due to warmer surroundings.

The combination of heat, dryness, and overly humid microclimate, unfortunately makes the ideal environment for crop diseases and infections . How? 'An increase in CO_2 levels may encourage the production of

plant biomass. An increase in biomass can modify the microclimate and affect the risk of infection. In general, increased plant density will tend to increase leaf surface wetness duration and regulate temperature, and thus make infection by foliar pathogens more likely', explain Hitender Gautam, Manish Bhardwaj, Rohitashw Kumar scientists from Dr. Yashwant Singh Parmar University of Horticulture and Forestry in Himachal Pradesh and Sher-e-Kashmir University of Agricultural Sciences and Technology, specialists in plant pathology and agricultural engineering. It has been found that 89.5% of plantations are becoming less suitable for cacao growth and production, with droughts causing decreased yield in 89% of cacao trees and mortality in 15%.

Is there no way out?

Yet the situation is not as gloomy as it seems, because science has got our backs. "Climate change can limit the land area suitable for farming crops like cacao, and its effects can worsen the spread of diseases that infect cacao but we're hoping to 'supercharge' the cacao plant's immune system and make cacao that won't be infected by viruses or fungi," says Megan Hochstrasser, Science Communications Manager from Innovative Genomics Institute (IGI) at UC Berkeley and UC San Francisco. Together with MARS Inc., a global food producer and supplier, the scientists are essentially working to engineer cacao trees resistance to diseases and infections, one of the most important factors in impacting global agricultural productivity. "We're applying a new technology called CRISPR to edit cacao's DNA for the better. CRISPR lets us make precise, targeted changes, sometimes simply turning a gene off rather than adding in anything new.", she says.

Could it change the taste, the structure, the look of chocolate known to us, you might ask? "Such genome editing to confer disease resistance is far less likely to affect the chocolate than other approaches would. Before CRISPR, making disease-resistant cacao would involve making essentially random changes to its DNA through breeding or radiation/chemical mutagenesis something that is far more likely to have genetic side effects that could alter the quality, taste, or other properties of chocolate made from this cacao." Megan explains. At the moment, IGI is in the process of testing any possible effects of their work on chocolate, results soon to be reported further.

On the other side of the American coast, plant biologists Mark Guiltinan and Siela Maximova from Pennsylvania State University in University Park are tackling the issue of significantly lowering numbers of Theobroma cacao on plantations and its consequence of production shortage. Their solution? Cloning. Yes, you read it right. They take tiny pieces of cacao trees' flowers, put them in germ-free solution, and add hormones that make these flower pieces grow into individual flourishing young plants clones of the original cacao tree that the flower piece was taken from. As the cloned plants are not genetically modified during the process, the scientists strive to choose healthy cacao trees with fully operating genes not infected and strong enough to fight possible bugs. Diversity here is key as different variations of Theobroma Cacao have different levels of resistance to particular diseases if one planted their land with identical cacao trees, the whole plantations could potentially be effaced by just a single infection their initial gene was not immune to.

Not just a matter of the future, but being used in the present, this innovative method has managed to boost the concerning cacao beans' shortage notably. The scientists report that around 100 million cacao trees, representing nearly 100 different varieties, have been created and planted across Indonesia so far all of them with the same genes as their parent plants.

So… We don't have to worry about chocolate?

Asked about final thoughts and the most accurate predictions for the case of cacao and chocolate, Megan Hochstrasser excludes the dark scenario of its extinction, and focuses on other, often neglected but important factors. 'Absolute extinction is unlikely. Changes in the climate of cacao's key growth areas and possible spread of infectious diseases are severe threats to chocolate. But even if all cacao isn't wiped out, a major production shortage is sure to have negative consequences on its availability, price, and quality. It's important to keep in mind that even if this just means your Snickers bar gets a little more expensive, threats to cacao are also threats to the cacao farmers that you never see. There are between 40 to 50 million people worldwide who work in jobs related to cacao, cocoa and chocolate. So understanding and protecting the cacao trees is globally important,' she explains.

Adam Gardner, coordinator of the British Fairtrade Foundation an organization that puts time and care into ethical produce sourcing, organic food production, and conscious work ethic within the agricultural business is one of those who understand the issue. As the organization's representative responsible for navigating and monitoring the production processes, he regularly visits their plantations in West Africa and has noted significant changes.'The production in Ivory Coast declined by an estimated 30% because of the climate change, because of the changing weather patterns. Farmers right now are using their income to try and save the situation. It's really about mitigating against this.', he says. Due to such vast decline in production and simultaneously increasing demand for purer, richer, less-processed chocolate, it was noted that the chocolate market in the United States alone world's biggest chocolate market in fact is predicted to circulate over $30 billion by 2021. Who will pay for these additional costs if not us, the customers?

Although the future of cacao is not as fearful as Business Insider once painted, this issue is definitely a double-edged sword. To answer the initial question we are not saying bye to chocolate but we might have to change our expectations in terms of its availability and prices of all cacao-derived products chocolate bars, candy, Nutella, chocolate chip cookies, warm cocoa, mocha at some point. The hope for preserving the chocolate we know and can afford, lays in science.