

Restore the Power of the Food System: The ‘Right’ Foods Should Be C.A.T.

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The way a 21st-century person eats, is very different than ever before. After World War II food patterns have increasingly become dominated by the food industry. Consequently, modern day people are confronted with consuming more and more processed foods and synthetic ingredients. Generally speaking, this food is safe to eat — at the least in the short term — and the food and agro industries are indispensable for feeding the ever-increasing population of the world. Despite these positive aspects, the ‘Western diet’ — mainly processed foods, high in animal products, fried foods, and salty snacks — comes with evident problems. Books like ‘Salt Sugar Fat’ (Michael Moss) and ‘In Defense of Food’ (Michael Pollan) give an eloquent and disturbing insight into the food industry and the implications of eating processed foods. Obesity is only the most visible consequence of what people eat. In fact, seven out of ten deaths are food related. The consumption of ultra-processed foods has been reported to increase the risk of cancer (Fiolet et al, 2018). This is considered to be a global problem. The World Health Organization (WHO) (www.who.int/mediacentre/news/releases/2018/world-leaders-ncds/en/) announced in February 2018 the forming of a ‘high-level commission with several heads of state and ministers, leaders in health, and entrepreneurs. The group will propose bold and innovative solutions to accelerate prevention and control of the leading killers on the planet: the non-communicable or chronic diseases.’ Commission member Michael R. Bloomberg of the WHO explains: ‘For the first time in history, more people are dying of non-communicable diseases, such as heart disease and diabetes, than infectious diseases. This loss of human life spares no one — rich or poor, young or old — and it imposes heavy economic costs on nations.’ Chronic diseases are lifestyle related. Consequently, they are preventable if only people were protected from tobacco, harmful use of alcohol, and unhealthy foods and sugary drinks.

However, the consequences of the Western diet are not limited to what we eat. It also has an impact on all kinds of agriculture, breeds and varieties, biodiversity, agricultural practices, distribution of wealth, cultures and landscapes. Agriculture occupies more than one-third of all potentially cultivable land, uses about 70% of freshwater and is responsible for up to 30% of greenhouse gas emissions (Aleksandrowicz, et al. 2016). Particularly the consumption of bovine meat contributes to environmental changes like global warming. Grain-fed animals have a poor conversion rate of feed to food, which greatly diminishes the overall food supply. Of the calories in the feed that cattle consume, humans receive just three percent through beef (Cassidy, et al, 2013).

To feed the increasing world population, farming methods have changed accordingly. Quantity and food security are increasingly important. In the second half of the 20th century farmers have for instance moved from traditional sources of nitrogen, like crop rotation to synthetic sources. Yields have risen by using synthetic fertilizers and all kinds of crop protection. The extensive use of industrial chemicals has been linked to numerous environmental hazards including global warming, groundwater contamination, and the loss of biodiversity. Furthermore, the production of fertilizers is especially highly energy intensive, which implies that agriculture has become increasingly dependent on the use of fossil fuels and varieties that fit within this particular food production system (Crews & Peoples, 2004).

The world faces serious challenges and many of those involve current food behaviour. People have been seduced into liking food and drinks that are neither healthy nor good for the environment. Clearly, the WHO is right: the world needs bold and innovative solutions. We need a robust food system that is able to feed the world in a healthy and sustainable way. But how? This paper stresses the importance of a systems approach. There are no easy answers in restoring the power of food, but we will present a formula: the ‘right’ food needs to be C.A.T.: Convenient, Affordable, and Tasty.

Systems approach

The need for change is evident. Governments and gurus point out what people should do. Dietary guidelines and health books make headlines. There are TV shows that challenge people to lose weight. Most efforts that are aimed at curbing the Western world into something better are focussed on people, the consumer. But if you look more closely you see that the problem is much more complex. The consumer is merely at the end of the food system. A singular focus on people is not likely to yield results if other aspects of the system determine their capacity to change, even if they are motivated to change. Agriculture, nutrition, and health are closely connected, but they are often seen and studied separately. The result is that practices in the one sector may have undesired effects in another. Just to mention one of many examples, the extensive use of antibiotics in livestock farming threatens human health due to antibiotic-resistant bacteria (Dwivedi, et al. 2017).

Health councils all over the world basically agree upon that the regular diet should be more plant-based and less meat-centric; people should eat more fresh, real foods and

less (ultra-) processed foods. This should also reduce the consumption of salt and sugar. Coincidentally this same diet would also be good for the planet. This is good news. Shifting the Western diet to a variety of more sustainable dietary patterns could potentially lead to reductions as high as 70–80% of greenhouse gas emissions and land use, and 50% of water use (Aleksandrowicz, et al. 2016). Dietary change can improve health and reduce the environmental impact of food production. The way to achieve that is by adopting a less meat-centric diet, and by reducing food waste (Crews & Peoples, 2004).

How can we curb the 21st-century diet? How do we motivate and empower people to make better choices? Can the people buy or afford the products that are good for them? Do they know how to prepare these foods and eat healthily? Do we even know what is healthy? People are different, shouldn't the dietary advice on what is good for them also be different? A systems approach is needed for a better future for food and health. This paper suggests looking at the food system from different angles. A grid was developed to identify four segments and to discuss the challenges in each area. As a start it distinguishes products and people and subsequently looks at them from an individual and a general level point of view. This grid-approach will give a better insight into how the food system is organized and what factors contribute to the present system and food behaviour. It will show that only a systemic approach with bold and overarching efforts can change the current dietary pattern. The grid below (Figure 1) shows the aspects that will be addressed. This paper does not have the ambition to give a complete overview of all aspects. Some of the major changes are addressed and the interrelation is shown.

	PRODUCT (supply)	PEOPLE (demand)
INDIVIDUAL	<p>DELICIOUSNESS product development & innovation</p> <p>i.e., plant characteristics, nutritional value, new varieties, and culinary success factors</p>	<p>LIKING & WANTING food choices</p> <p>i.e., brain & sensory research; neuro-aesthetics, pleasure, extrinsic factors</p>
GENERAL	<p>SYSTEMS THINKING knowledge development</p> <p>i.e., plant breeding, regulation (taxation and subsidies), education</p>	<p>FACILITATING healthy food</p> <p>i.e., accessibility & the role of retail. The C.A.T. Formula: The 'right' foods should be Convenient, Affordable, and Tasty</p>

Figure 1: Food-systems-grid.

Products

What we eat and drink comes from the land or out of the water. It has been harvested in some way or form. Mankind

has come a long way from being hunter-gatherers. Modern food systems are profoundly influenced by industry and industrial requirements. Factors such as consistency, predictability, low cost, and high yield have grown to be more important than taste and nutritional value. Consequently, varieties have been selected that maximize yield and minimize crop failure. Uniformity promotes efficiency. Today 95% of the world's calories come from just thirty species. Almost half of the global calorie demand is supplied by only three crops: maize, rice, and wheat, which of course have been carefully selected or engineered and partly modified to perform. This loss of diversity alone has had significant negative health consequences. Local production and more biodiversity on farms need to find a place in this modern, globalized food system (Dwivedi, et al. 2017).

Modern food systems are quantity oriented. Robust varieties reliably produce numbers at a low price. Nutrients and taste have not been among the criteria that shaped modern agriculture. The persistent pursuit of farming and marketing practices that emphasize cheapness, security and abundance over quality has led to a loss of micronutrients from our foods and evidence that micronutrient deficiencies significantly undermine our health. This is confirmed by research from all over the world. Thomas (2007) states 'A knowledge of the chemical composition of foods is the first essential in the dietary treatment of disease or in any quantitative study of human nutrition'.

There is debate whether organic farming would be a solution and if organic farming could feed the earth. Results of meta-analyses based on 343 peer-reviewed publications indicate significant differences in composition between organic and non-organic crops/crop-based foods. Notably, the concentrations of a range of antioxidants were found to be substantially higher in the organic ones. This is particularly important, as antioxidants have previously been linked to a reduced risk of chronic diseases. Significant differences were also detected for minerals and vitamins for example. Furthermore, in conventional crops pesticide residues were found to be four times higher, and they also contained significantly higher concentrations of Cadmium, a toxic metal. The differences in antioxidants and Cadmium are related to use of synthetic fertilizers (Baranski, et al, 2014).

Most basic foods have grown to be commodities with as little variation as possible. That is exactly what the food industry requires. Taste and varietal character are sought after by people that love food, including food producers that are quality oriented, but a nuisance for the food industry that operates on a large scale. Taste doesn't need to come from products: it can also be provided by additives, sugar and salt, which are all easy to use and very cheap. The food industry prefers them to natural ingredients for reasons of chemical stability, availability and price. If vitamins, minerals or other health promoting elements are missing, they are added and consequently industry food has become a kind of Lego-box which is adjusted to the consumers

need or demand and supposed health effects. It has led to a radical and abrupt change of what is commonly eaten.

Food safety and hygiene are also found to be more important than taste and nutritional value. Currently many processed foods are free from unwanted bacteria; ingredients that are used, have been refined, bleached, sterilized, and so on. In the process, not only bacteria, but also much of fibre is removed. These fibres are important for the microbiota in our gut. We have looked at the nutrients of our food and overlooked the need to feed the gut. The microflora in the gut have deteriorated, which may explain 'metabolic syndrome', a chronic inflammation, the common denominator of most chronic diseases. Gut bacteria play an immense role in our immune defence and one may speculate about the relation between diet and incidence of allergies and other immune responses in Western society.

Food fibres should be an important reason for eating unprocessed foods and especially a variety of vegetables, fruits, pulses and nuts. A mission is to make them just as delicious as the foods that most people have grown used to eating. Supposedly, nobody will object to eating something delicious. Therefore, knowing more about taste and deliciousness would help all kinds of educators and professionals in the world of food and beverage, from farmers to professionals in the food industry including chefs in the culinary domain; marketers, food designers, and packaging experts would all benefit. Just as health councils and dieticians that need to find a way to motivate people to make different food choices would benefit from this knowledge.

People

This huge change in what people eat, requires the assessment of food behaviour. In affluent societies food is no longer scarce. There is an abundance of cheap, palatable food that people like, sometimes to excess. The ubiquity of food constitutes what is called the 'obesogenic' environment which requires self-control of a person to fight all these tempting foods. To be able to curb food behaviour one needs to understand how food choices are made. People do the liking. Products can be delicious; liking is the positive response. When you take a bite into your favourite food, the look, taste, texture, and smell can give pleasure. This goes beyond the sensory properties. We all know how 'hunger is the best spice'; contrarily food items may also be disliked after one has turned seriously ill from eating it.

In human evolution, food choice was dominated by the urge to fulfil physiological needs; food is fuel; one eats what is needed to keep the biological system going. This phenomenon is thought to explain the liking for fat and sugar as rich sources of energy. However in a modern society that is dominated more by plenty than scarcity, the motivation to eat and drink is no longer physiological but driven by the search for pleasure. The world of pleasure is ruled by another brain area. Usually people want the things

that they like and like the things that they want. In the world of pleasure liking and wanting can become dissociated. This is what happens when the brain gets addicted. The search for reward, 'wanting', takes over from liking, even to a level where it doesn't give pleasure anymore. Many of the modern industry foods have been designed to be hyper-palatable and contain sugar, generally without fibres which would normally help its digestion and prevent spikes in blood sugar. These foods lead to overeating, which is one of the primary causes of obesity (Robinson, 2015).

Tasting is learning, so is liking. The brain is involved: we learn to like and to dislike. Some preferences come easily and others are 'acquired tastes'. The liking for beer, Brussels sprouts, coffee, and dark chocolate takes time to develop. Wine tasting can also serve as an example. People can learn to recognize flavours and build up experience. In the process it is likely that preferences and liking are going to shift. Unfortunately, this is exactly what has happened in the modern brain that has been fed with the Western diet: the unhealthy food choices are liked; 'healthy' is negatively correlated with 'tasty'. This means the word healthy can better be avoided in the description of foods. In general, the description of healthy foods is often less attractive than unhealthy choices. Using more appealing, indulgent descriptions of healthy and nutritious foods should be considered (Turnwald et al., 2017). Words are an important and overlooked ingredient.

Food addiction could be a serious problem that is hard to cure. Abstinence is an effective strategy to cure people from their addiction, but that is hard to do in the case of food. But even without being a food addict people may develop habits that perpetuate unhealthy behaviour. A study of Cornell shows that such habits can be changed by traditional motivational marketing practices like giving reward points for healthy food choices. They are reported to be more effective in the long run than discounts. Furthermore such a healthy-loyalty program could be a win-win situation for food service providers. It would help to create a better image and stimulate return visits from people that are interested in health options (Chan, 2017).

The validation of Klossé's flavour styles cube and the formulation of the Culinary Success factors are steps in gaining these insights which could lead to a better understanding of taste and flavour and the components that drive liking. In this approach flavour and tasting are distinguished. Taste and flavour are considered to be a product characteristic. Tasting is what people do; flavour perception is therefore personal, but taste can be studied from a molecular standpoint. Mouthfeel is the basis of the model that enables us to classify taste. Quality perception, liking or disliking, is an interaction between a person and what he or she is eating or drinking. Consequently, the commercial success of a product is a mix of the actual flavour (ingredients, preparation and so forth) and how it is perceived. A host of external influences such as its packaging, advertising, price, hospitality, atmosphere, etc.

can influence tasting. Likewise, aspects that affect people, such as culture, education, age, knowledge and experience, religion, sense of taste, etc. will have an influence. If we truly want to understand why people enjoy some products more than others, it is necessary to take all of these aspects into account (Klosse, 2013, Klosse, 2004).

Systems thinking

Now we shift our focus from the individual level to the general level. What are the aspects to consider? We may conclude that the current food system produces cheap, nutritionally inferior food that contributes to both diet related health risks and agro-environmental degradation. This system is driven by commercial and economic motives. And we could add that there is fragmented oversight of national food systems (Dixon, 2015).

'Let food be thy medicine, and medicine thy food'. It seems as if this advice that is credited to 'the father of medicine', Hippocrates (c 460-c 370 BC), is as true today as it was when he wrote it. He was likely the first to look at environmental factors, diet, and living habits as causes for disease. These days the worlds of food, environment and health have grown apart. Holistic thinking has been replaced by the reductionist approach and linear cause-effect relations between one food compound and one physiologic effect. This approach is bottom-up and has been predominant in research. It gave us the understanding of the fundamental mechanisms in nutrition. But nutrition-health-environment interactions are complex and must be based on multi-causal, nonlinear relations. A holistic approach starts with a general view and uses reductionist research. Reductionism has its virtues but we need to be 'intelligently holistic'. 'Hyperspecialized technoscience' is not the only answer for the future. Foods are more than the sum of isolated nutrients and phytochemicals. Compounds within foods interact, their physical structure matters just like other physicochemical food properties. Comparable foods may have a different metabolic effect (Fardet, 2016, Fardet and Rock, 2014).

Viewing the importance of vegetables and fruits, plant breeding should be part of the systems approach. Modern foods have lost many micronutrients and this clearly has negative health effects. This is confirmed by research from all over the world (Thomas, 2007). Adding supplements may not be the answer. Vitamin D for instance, needs magnesium to metabolize. About half of the population in the US is assumed to be magnesium deficient, which implies that taking Vitamin D supplements is useless for these people. They may be better off to be outside, enjoy the sun when possible and eat magnesium rich foods like nuts, bananas, beans, broccoli, brown rice, egg yolk, fish oil, milk, mushrooms, and whole grains. (Uwitonze & Razzaque, 2018). But then we need to be sure that these foods do indeed contain the supposed bioactive ingredients and deliver the supposed health effects. This requires

innovative plant breeding programs and methods to produce food (Dwivedy, 2017).

Governments are not passive. Some countries have introduced taxation on unhealthy foods or policies like limiting the size of soft drinks in the retail industry or restricting the advertising of unhealthy foods, especially targeting young children. Although such initiatives are in line with what needs to be done, they are reported to have minimal effects (Chan, 2017). Furthermore, they are singularly targeting the consumer and not looking at the system. The same governments that tax the consumer give subsidies to agriculture. And what is subsidized? The production of a select number of crops that are grown globally on a large scale, limiting biodiversity and with negative health effects (Franck et al. 2013). Subsidies go to farming starchy grains like corn, wheat, soybean, rice, and sorghum. Corn is mainly used to produce High Fructose Corn Syrup, other food additives and biofuels, soybeans are used to produce cheap oil to deep-fry snacks and sorghum is mainly farmed for animal feed, just as the others grains are. Dairy and meat are also on the receiving end of subsidies. About 56 percent of all calories consumed in the US come from subsidized foods, according to researchers. In Europe the situation is not much different: seventy percent of the budget of the European Union is spent on agriculture. Clearly not all is spent on subsidizing dubious elements in the food system. Nevertheless the role of the government in this respect should be taken seriously. Siegel et al (2016) report that chronic diseases are related to the higher consumption of calories from subsidized food commodities and suggest that agricultural and nutritional policies should be better aligned. Economic development based on cheap calories overlooks the economic needs of the global rural population (3 billion people), fifty per cent of whom work in agriculture (Altieri et al. 2011). Agricultural households need to earn a decent income, otherwise it is hard to imagine that they will stay in agriculture or that their children will take over (Dixon, 2015).

In systems thinking, governments could take a guiding role in shaping the ideal food system. This is the system that (a) offers adequate nutrition and health, (b) creates biodiversity and avoids negative ecological and environmental impact, and (c) ensures a livelihood for farmers, diverse landscapes, equitable access to land, water, seeds and other inputs (Dwivedy, 2017). Government could promote healthy eating by educating the population and informing them about the essence of a healthy lifestyle. They could also promote healthy food choices by giving incentives to consumers, positive rewards such as coupons, for healthy food choices. On the other side they could introduce a serious tax on the use of fertilizer and other elements that have a negative impact on the environment. After all, 'the polluter pays' is a righteous principle. If the societal costs of the current system were to be incorporated in food prices it would quickly lead to innovative solutions, regenerative farming methods, and the production *and* consumption of healthy foods.

To conclude this section just imagine there a system that promotes good practices by giving subsidies in a star system:

- One star: for farms that do not use harmful chemicals, which includes synthetic fertilizer
- Two stars: for farms that actively promote biodiversity and short supply chains
- Three stars: for regenerative farming, crop rotation, use of own seeds
- Four stars: for extra efforts to revitalize the soil and surrounding nature
- Five stars: for inspiring farmers that do all of the above and dedicate time for the community, like teaching, educating other farmers, developing new methods and sharing their ideas in the media, etc.

Facilitation

To conclude this grid approach, we focus on facilitation: people need to have access to healthy foods and be able to buy and use them in a way that combines tasty and healthy. Foods are predominantly bought in supermarkets, which implies that we must focus on the role of the retail companies in the food system. Their role has not been explicitly mentioned yet, but we should, and not only because it is where the regular consumer buys his food. Retail companies are huge conglomerates with an enormous buying power. It is suggested that they have an unprecedented and disproportionate power in the food system. Nevertheless, Pulker, et al. (2018) state that there is 'very little public health research' about the impact of their power. Nevertheless, it is obvious that supermarkets shape food choices and food preferences by determining what is in the stores and by allocating how much space is made available for every product group. Furthermore, they determine food prices, not only for the consumer but also in the system. With their buying power they have an impact on the price farmers get for their products. But their influence goes further. For instance, offering low priced meat not only stimulates sales but also enforces meat producers to choose for low cost production methods, which means cheap feed and compromises on animal welfare. In general, low prices in the shops stimulate the relentless search for cheapness in the system, with all the undesired results. Retail organizations have the potential to improve public health, but just a few positive initiatives seem to be reported (Pulker et al. 2018).

Retail organizations could use their supposed power in a positive way. Clearly supermarkets don't just sell the infamous ultra-processed foods; real foods are on sale as well. There is no apparent reason why a conscious consumer that aspires to make healthy choices shouldn't be able to make their choice in a supermarket. After all, supermarkets are commercial institutions and supposedly they can make money on selling both healthy and unhealthy products. This is an important start; promoting healthy choices in the retail space shouldn't necessarily impede their

commercial capacity. Considering their role in the food system, retail organizations have power and influence over other actors, like food producers and manufacturers, and government. Consequently, they are in a perfect position to help encourage the food behaviour in the desired direction. They could be a partner, instead of a being a threat.

From a consumer point of view, we have made clear that the food choices that people make need to change. How are we going to achieve that in the supermarket? To begin with, presume that the products people buy, are found to be Convenient, Affordable and Tasty. They are C.A.T. Convenient implies that people know how to use them and have the capacity to do so. Affordable means that people are able to buy them and Tasty has everything to do with liking what they have bought. Looking at the future we can say better choices also need to be C.A.T. If the better, healthy and sustainable food choice is either inconvenient, hard to prepare or not available in the desired quantity, or much more expensive, or not as delicious, it will probably not be a great success. So better food choices need to be C.A.T. Retail organizations have influence in every aspect, so they could play a major role in seducing consumers to make better food choices.

There are other places where better food choices could be facilitated: for example schools, healthcare institutions and within companies. In general, these are places where people need to be for a prolonged period of time and are dependent on others for providing a meal. Policies could be implemented to provide healthy foods. It seems quite logical that young children at school and elderly people in nursing homes should be served the 'right foods'. Especially in places where the government is in charge. Companies may have a vested interest as well: happy and healthy employees are likely to be productive. Google is an example of a company that takes responsibility in this instance, and acts. On sustainability the company's website states 'climate change is real' and mentions all kinds of measures that are taken to protect the planet. The Google Food Program has been installed to actively promote eating a plant-centric diet, all over the world. Ugly vegetables are used that would otherwise go to waste. Food is free and 'flavour rules' at Google.

Conclusion

Slowly but surely the food system has changed to accommodate the needs of the 21st century consumer. This development has advantages and seems to deliver what it should, but has negative aspects as well. These detrimental effects need to be confronted and stopped. A systems approach is needed to achieve that. Food production is strongly associated with the major challenges of fighting chronic diseases and reducing environmental damage. We urgently need new models that focus on the vitality of people and planet, not only on growth, profit and GDP. In general, we need to organize a system that encourages both

people and the environment to remain healthy and prevent problems and diseases. According to Wessels (2006) it is a myth that progress depends on a growing economy. He challenges the belief that new technology is essential and inevitable and shows how systems can be regenerative and allow true progress. If we are on the wrong track, we need to change tracks.

There is reason to be optimistic about the future. There is at least global awareness of both the problem and the solution. That does not mean that food behaviour will change easily. Singular solutions and ones that are solely focussed on the consumer are not likely to have an effect substantive change. A systems approach will be more effective. The grid that is proposed in this paper suggests that we consider products and people and look at them on an individual and on a general level. People need to be able to make food choices that are C.A.T., convenient, affordable and tasty. Farmers, food producers, governments, retail organizations can all work together to come up with bold and innovative solutions for a better food system that is healthy and sustainable.

About the author

Peter Klosse has over thirty years of experience in gastronomy. He owns the five-star Hotel and Restaurant De Echoput, near Apeldoorn in The Netherlands. The kitchen is renowned for the preparation of the products from the forest: game, berries and mushrooms and has a long Michelin-star history. Since the late eighties, he has studied wine and food pairing. He developed a new flavour theory, which evolved into a PhD on flavour classification.

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