Trends in Food Science & Technology

The vegan trend and the microfoundations of institutional change: A commentary on food producers' sustainable innovation journeys in Europe

Ulla A. Saari[1,2]*, Cornelius Herstatt[3], Rajnish Tiwari[3], Ozgur Dedehayir[4], Saku J. Mäkinen[1]

[1] Industrial Engineering and Management, Faculty of Management & Business,

Tampere University, Tampere, Finland

[2]Jönköping International Business School, Jönköping University, Sweden

[3]Hamburg University of Technology, Hamburg, Germany

[4]Queensland University of Technology, Brisbane, Australia

* Corresponding author. E-mail: ulla.saari@ju.se

Permanent address: Jönköping University,

Gjuterigatan 5, Box 1026, 551 11 Jönköping, Sweden

The vegan trend and the microfoundations of institutional change: A commentary on food producers' sustainable innovation journeys in Europe

Abstract

Background

Today's meat and dairy industry has a vast environmental footprint. To reach the UN sustainable development goals (SDGs) of ending hunger globally (SDG #2) and achieving sustainable consumption and production (SDG #12), this food production system needs to change. Recent years have seen the rise in popularity of the vegan or plant-based diet among consumers, which can go some way to reducing the environmental burden. This trend has motivated pioneering food producers to develop innovative vegan food products for niche markets, thus driving the sustainability transition of the food sector.

Scope and Approach

This commentary tracks how three pioneering food companies have responded to the vegan trend in Europe. From the analysis of the sustainable innovation journeys of these innovative food producers, we propose a framework that presents a multi-level perspective on the socio-technical transition of the food production and consumption system.

Key Findings and Conclusions

The findings show how food producers, incumbents, and new entrants progress through an early phase of planning a direction and establishing a goal, followed by pivoting and experimenting in response to changes in the business environment. This innovation journey concludes as the company moves from experimentation and learning activities onto innovation implementation. The paper postulates a model that describes how regime level changes arise from the

microfoundations of the food production and consumption system, as the innovation journeys of companies drive institutional change towards sustainability. The paper identifies future research avenues to explore the sustainable development of vegan food production in more depth.

Key words:

sustainable innovation journey; sustainability transition; veganism; vegan food producer; plant-based food industry

The vegan trend and the microfoundations of institutional change: A commentary on food producers' sustainable innovation journeys in Europe

1. Introduction

Livestock industries such as meat and dairy have been regarded as unsustainable due to environmental externalities, including greenhouse gas emissions (from digestion of livestock such as ruminants), land degradation due to overgrazing, soil erosion, deforestation, biodiversity loss, the contamination of surface and groundwater due to poor waste management and the salinization of soils (Cole, 2008; Richards, 2012; Goldstein et al., 2016). Some studies suggest that 18% of global greenhouse gas emissions can be attributed to animal agriculture, which is a larger percentage than that of the transport sector in its entirety (Deckers, 2009; Judge and Wilson, 2015). The excess production and consumption of meat and dairy not only has a significant impact on the environment, but also on human health and the economy (Godfray et al., 2018; Springmann et al., 2016; World Economic Forum, 2019). According to the World Health Organization and the World Cancer Research Fund, health conditions such as cardiovascular disease, obesity, dyslipidaemia, hypertension, breast, colon and prostate cancer, and type 2 diabetes are more likely to be observed in meat eaters than non-meat eaters (Cole, 2008; Deckers, 2009; Bouvard et al., 2015; Radnitz, et al., 2015). A meat- and dairy-based diet is inherently higher in fat and cholesterol, and lower in essential ingredients such as phytochemicals, antioxidants, fiber, and protective nutrients like vitamin C, vitamin E, folate, provitamin A, copper, potassium, and magnesium (Dyett et al., 2013, p.119).

In this commentary, we turn our attention to veganism and the vegan (or plant-based) diet, which avoids the consumption of foods that have been derived from animals in any stage of their production. We argue that veganism not only protects animal rights (Singer, 1990), but also offers a solution to some of the systemic problems of the global food system underlined by the United Nations (UN) Sustainable Development Goals (SDG), especially SDG #12 that promotes sustainable consumption and production, and SDG #2 that aims to end global hunger. If more people worldwide would follow a plant-based diet, the detrimental environmental impact of the resource intense production of animal- and ruminant-derived foods, especially meat and dairy products, would be reduced significantly (Fresán & Sabaté, 2019). The reduction of meat consumption and a change in food consumption behavior of meat eaters are seen necessary to enable a more sustainable and eco-friendly food production and supply system (Hartmann & Siegrist, 2017).

Although individuals following a vegan lifestyle form a minority in the economically developed world, recent trends indicate notable growth in their numbers. In addition to animal welfare and environmental sustainability, plant-based eaters are motivated by a concern for human health. A 2017 survey conducted in Europe among 13000 respondents subsequently underscored negative health effects (40%) as the prime motivator for planning to reduce meat consumption within the following five years, ahead of animal welfare (17%), expenses (14%), negative environmental effects (12%), and social pressure (6%) (Statista, 2018a). This motivation is supported by recent clinical and observational research which shows that a plant-based diet helps to prevent many health problems, such as obesity (Turner-McGrievy, Mandes, & Crimarco, 2017), cancers, including breast and prostate cancers (Mroz et al., 2011; Hwang & Choi, 2015; Madigan & Karhu, 2018), while also lowering the risk of cardiovascular and chronic diseases

(Anand et al., 2015; Baden et al., 2019; Kim et al., 2019). A plant-based diet can even have positive mood benefits (Beezhold et al., 2015; Null & Pennesi, 2017). The recent recommendation of the 'EAT-Lancet Commission on Food, Planet, and Health' of a universal healthy reference diet (Willett et al., 2019) is therefore a plant-based one consisting mainly of whole grains, legumes, vegetables, fruits, nuts, and unsaturated oils, accompanied with moderate levels of seafood and poultry, and no or only a low quantity of red or processed meat.

Despite the levels of meat consumption decreasing slightly in some EU countries, this is not the case across the board (Gordon & Schoon, 2015). This is because shifting today's cultural, technological, industrial, and political dimensions of a food system paradigm, from one centering on animal agriculture to a new, predominantly plant-based food regime is challenging. Such a socio-technical transition (Geels, 2002) requires not only a change in consumer behavior, but also the provision of new products that can satisfy the needs of consumers. In this commentary we are concerned with the latter in particular, and focus on European food businesses, including traditional meat producers, which have started introducing disruptive plant-based food innovations for local niche markets in response to the growing vegan trend in Europe. These developments could help change the institutional regime and facilitate a sustainability transition in the food sector and thus contribute to the UN SDGs #2 and #12 (Loorbach & Wijsman, 2013; Luederitz et al., 2017; Markard, Raven, & Truffer, 2012).

In this commentary, we aim to outline how food businesses undertake sustainable innovation journeys around plant-based food, and how these journeys can ultimately bring about a socio-technical regime of sustainable food production and consumption. We first describe how veganism has developed and how this is reflected in three European countries: Germany, the Netherlands and Finland. We then present illustrative cases of food producers which innovate

plant-based food products in their respective sustainable innovation journeys (Geels, Hekkert, & Jacobsson, 2008) in reaching the market. The three cases have been analyzed based on publicly available information from company websites and the media. In addition, we have used statistical data collected by Statista as well as secondary data sources (public press and academic articles) to examine demand-side factors such as perspectives on diets and the vegan trend. From these analyses, we postulate a model of institutional change towards sustainable food production as a multilevel framework contextualizing the innovation journeys of vegan food producers within the changing landscape.

2. Development of the vegan trend in Europe

Veganism is a contemporary and expanding societal phenomenon, that has been lately growing in Western developed countries, which is demonstrated by the steadily growing number of vegans and people following plant-based diets (Statista, 2018a; Strecker, 2015). Many vegans and vegetarians select their diet and lifestyle based on health-related benefits that such diets bring (Appleby, Allen, & Key, 2011; Dyett, Sabate, Haddad, Rajaram, & Shavlik, 2013). A further motivation of following the vegan lifestyle is to participate in the mitigation of climate change by taking individual action to reduce carbon footprints through transitioning to a plant-based diet (Büchs, Saunders, Wallbridge, Smith, & Bardsley, 2015). These two prime drivers are often accompanied by ethical motives in connection with avoiding mass animal production and slaughter. Veganism can also be connected with an increasing interest in frugal lifestyles that can include voluntary moderation driven by ethical or environmental concerns, by health issues or by financial constraints that might limit the ability of some consumers to buy meat products (Statista, 2018a; Tiwari & Herstatt, 2020).

Veganism has been forecasted to be one of the megatrends by the popular press since 2018 (Banis, 2018). Recent studies have also shown that veganism is no longer a small niche within the western food culture, but is growing increasingly to become one of the mainstream global options (Harrington, Collis, & Dedehayir, 2018). The number of people buying meat substitutes (such as soya-based products) and vegetable spreads has grown globally between 2012 and 2016. According to global statistics in 2016, a vegetarian diet was followed by 19% of respondents in the Asia Pacific region, 16% in Africa/Middle East, 8% in Latin America, 6% in North America, and 5% in Europe (Statista, 2018a). A vegan diet meanwhile was followed by 9% of respondents in the Asia Pacific region, 6% in Africa/Middle East, 4% in Latin America, 2% in North America, and 2% in Europe (Statista, 2018b).

In numerous European countries, national health research organizations are actively promoting a plant-based diet to help citizens become healthier and to help the mitigation of climate change. This is in response to animal food production, which has increased exponentially in the past few decades, such as in Italy where the Mediterranean plant-based diet has traditionally been the prevalent diet. In 2017, the Italian Society of Human Nutrition published a study concluding that government agencies and health organizations should educate Italians to switch to a vegetarian diet (Agnoli et al., 2017). Meanwhile in Norway, researchers have found that providing information about the climate or health benefits of eating less meat has had a limited impact on consumers, and thus environmental policies are deemed necessary to guide Norwegian food consumers to make food choices that will benefit the climate (Austgulen et al., 2018). And a study conducted in Denmark found that Danish consumers are clearly divisible into those with a positive attitude and those with a negative attitude towards plant-based diets. This finding led researchers to recommend future consumer campaigns to address issues raised by

frequent meat eaters (e.g. the preparation, taste and doubts on low protein content of plant-based diets) to increase the consumption of plant-based foods (Reipurth et al., 2019).

The growing interest in veganism and plant-based diets not only impacts sustainable consumption behavior (Büchs et al., 2015) but is also being noticed by the food industry (Pojic, Misan, & Tiwari, 2018). Past research has indicated that changes in food-related lifestyles cause novel market segmentation and quicker cycles in product turnover. Companies have subsequently had to be prepared to launch novel products quickly in response to changing consumer demands (Traill & Meulenberg, 2002). This has meant that companies in the food sector have needed to create innovative products based on market research, while developing marketing competencies in addition to scientific and R&D capabilities.

The European Union has numerous policies that have influence on the production and consumption of food, e.g. the Common Agricultural Policy. In addition, local governments, farmers, consumers, and retailers play an important role in the whole food production system (Westhoek et al., 2011). However, such policies do not currently target the reduction of meat consumption nor do they encourage sustainable eating practices (Dagevos & Voordouw, 2013; Hansson et al., 2018; Westhoek et al., 2011). In the absence of effective incentives, producers that introduce new vegan products to the market seem to serve consumer demand and the growing vegan trend, save costs in their production, or address sustainability concerns through their own volition.

This paper focuses on three countries – Germany, the Netherlands, and Finland – where the vegan trend has been growing for both consumption and production. In 2017, the number of vegetarians and vegans in Germany amounted to 14% and 10% of young adults (18-24 years), respectively (Statista, 2019a). Leading product categories in Germany between 2011 and 2015

were meat substitutes (totaling 410 products) and vegetable spreads (totaling 239 products) (Statista, 2019b). In the Netherlands meanwhile, the number of flexitarians and vegetarians grew faster than the share of vegans according to the latest statistics (Statista, 2019c; van Velzen, 2019). Over 40% of respondents in a 2016 Dutch survey stated that they had reduced their meat consumption, with only 5% claiming that they ate more meat than five years ago (Statista, 2019d). The Dutch government is further advising its citizens to follow a plant-based diet so that the country can become a world leader in sustainability by 2030, with the Council for the Environment and Infrastructure recommending a national diet of 60% plant-based protein by 2030 (Sanchir, 2018). At the same time, a Dutch minister has been reported to have visited plant-based food startups in California in 2016, to strengthen cross-global collaborations (Sanchir, 2018). In Finland, the growth of non-meat eaters has been the strongest among 17-24 year olds, with the percentage of individuals choosing not to buy any meat almost doubling from 9.2% in 2012, to17.7% in 2016 (Lehto, 2018; Official Statistics of Finland, 2016). (Lehto, 2018; Official Statistics of Finland, 2016). There has also been a general rise in preference for a plant-based diet among Finns between 2015 and 2016, reflected in the 20% increase in sales of plant-based dairy substitutes and non-meat frozen products in a single year (Statista, 2019e).

3. Case descriptions

The following cases demonstrate the practices and strategies of food companies in Germany, the Netherlands and Finland to introduce vegan products. The focus of the case descriptions is on the market opportunity the producers have recognized and the innovations they have developed and adopted in their companies.

3.1. Case 1: Vegan products by a German meat producer

Carl Müller founded a butchery in 1834 in Rügenwalde which was moved to its present location in Bad Zwischenahn in 1956 (Ruegenwalder, 2019a). In 2017, Rügenwalder had some 549 employees (Ruegenwalder, 2019b) and a total turnover of 201 million EUR (Susonline, 2018). Roughly 10 years earlier, Rügenwalder had decided to enter the market for "non-meat" sausage products. The company initiated its product diversification into the vegetarian segment in 2012. Facing a lot of early internal resistance and overcoming challenges in product development, the first products were sold only at the end of 2014 (Förster, 2019).

Rügenwalder was the first major food manufacturer in Germany to replace meat with protein and milk fibers. A number of imitators have appeared in recent times, including several major meat processors (Grossarth, 2016). Today, the company's turnover share of vegetarian products is 25% with investments in the vegetarian/vegan product range amounting to 4.5 million EUR in 2017 (Förster, 2019). The strategic move was a success and Rügenwalder today ranks first among the most popular brands of vegetarian/vegan sausages and meat products in Germany (2015-2018) (Statista, 2019f). The company also ranks first in the German consumers' familiarity with producers of vegetarian products (Statista, 2019g).

Rügenwalder's journey commenced when it observed an early trend in Germany for an increasing demand for meat replacement products and responded to this demand by developing its range of non-meat products. But there were also other incentives for Rügenwalder: On the one hand, there was the growing world population and the increased demand for meat, which would be very difficult to handle. On the other hand, the company was aware that it had limited control over the conditions in mass livestock farming (Amann & Nezik, 2016). After the successful launch of the new product range, the Rügenwalder leadership became optimistic with regard to

the future expansion of the vegetarian/vegan product range. Today's chairman of the supervisory board, Christian Rauffuss, can imagine that in 20 years the company could be working completely without meat (Grossarth, 2016).

3.2. Case 2: Dutch company pioneering in the new plant-based protein food sector

The Vegetarian Butcher is a Dutch producer of plant-based protein founded in 2010 by former farmer Jaap Korteweg. The motivation behind the company's founding was Jaap's dramatic experience of the swine fever and mad cow disease outbreaks that led to his reconceptualization of cattle farming and meat production in its entirety. His new viewpoint was compounded by the realization of the crippling impact of animal farming on the environment, biodiversity, and climate. Transitioning to a vegetarian diet himself, Jaap soon pursued innovations in meat alternatives, collaborating with culinary experts in research and development. Focusing on product attributes such as taste, texture, bite, and nutritional value, The Vegetarian Butcher was able to deliver a product that outperformed many competitors and earned the firm growing interest from the media and public.

Since the year of its founding, the company has expanded rapidly to 3000 sales outlets in 14 countries in Europe and beyond, supplying greater than 40 meat substitute products (Ellwood, 2018). To support the growing demand, the firm also crowdsourced 2.5 mil. Euros in just three weeks in 2015 for the construction of a production facility.

Sustainability is at the forefront of The Vegetarian Butcher's business strategy which is evidenced by the raw ingredients used in its products. These are primarily either non-GMO (not genetically modified organism) soya or locally-grown lupin beans that is often mainly used as livestock fodder despite having been consumed as a high-protein food by humans for millennia

(Ross, 2011). These and other ingredients are brought together using emerging techniques and innovative recipes to produce meat replicas that many find difficult to distinguish from their meat references (Burt, 2012). The innovative techniques are the result of research and development in collaboration with the University of Wageningen. One example is the invention of a plant-based protein featuring a texture very close to that of steak. This invention – Shear Cell Technology – was announced in 2015, following research partnerships with research institutions (Michail, 2015).

Next, The Vegetarian Butcher moved into the global meat alternative sector, which was estimated at $4 billion in 2017. The firm had an annual turnover of $17.53 million, however, its success invited larger players to take interest in acquiring control of the company. And in fact, The Vegetarian Butcher was acquired by Unilever for an undisclosed amount in December 2018.

3.3. Case 3: Vegan products made from pulled oats in Finland

The founder of Gold&Green Foods, Maija Itkonen, had the idea of creating a plant-based protein food from Finnish oats in autumn 2014 (Mäntylä, 2017). When the first pilot batches of the pulled oats product were launched in January 2016 in Helsinki, the product was sold out in just 11 minutes (Mäntylä, 2017). The product became first known via social media among vegans, even though, the product was targeted towards flexitarians interested in reducing their meat consumption.

Gold&Green is fundamentally a technology company as its innovation is not a food recipe but a method that has been developed in a laboratory. The method involves the rubbing and heating of oats into a texture that is meat-like, tender but chewy (STT, 2016). The method is based on Chinese soya handling technology, appropriated by one of the three founding members,

a Chinese researcher specializing in oat and its nutritional characteristics. Gold&Green's product is patent eligible and has passed the European requirements of novelty and inventiveness (Mäntylä, 2017).

While full production commenced in spring 2016, the company was unable to deliver and satisfy consumer requirements, managing to respond to only 10% of the pulled oat demand (Talouselämä, 2016). This is one of the reasons why in September 2016 the company owners and shareholders sold 51% of the company to Paulig, a large, established Finnish company in the coffee and spice business (Lukkari, 2016). Paulig indeed appears to have made big investments towards the sustainable food segment having already acquired a Swedish company by the name of Risenta in 2015 that produces health food products, while also hosting an incubator that focuses on radical innovations. (Eronen, 2018).

At the end of 2017, Gold&Green Foods had 39 employees and reached a turnover of nearly 5M€ in its second full year of operation, despite also making net losses amounting to 5M€ (Asiakastieto, 2019). Its founder, Itkonen, has stated that the company wants to change the world and that profitability is not the first measure in their business, thus accepting that it will take some years before they will have a profitable business (Lundén, 2018).

4. Cross-case analysis

Each of the presented companies are founder-driven, and the motivation and rationale of the founders is predominantly associated with environmental concerns, cost-based concerns, the detrimental impact of meat consumption on the climate, as well as concerns about animal welfare. The case companies have interpreted the vegan trend to be a growing and sustainable movement as they make noticeable investments in developing and launching new plant-based

products. The companies can also be considered to have pioneering roles in bringing new innovative vegan products to mainstream consumers in their local national markets, by creating innovative products and production technologies.

The companies are at different stages of the sustainable innovation journey. Both the Vegetarian Butcher and Gold&Green have progressed through the early phase of planning a direction and establishing a goal. While the sustainable innovation journey of the Finnish company ends here, The Vegetarian Butcher has continued on further to the following stage of the journey, pivoting and searching for new directions, while concurrently experimenting as the institutional context changes. The outcome of this stage has been the company's rapid expansion, ultimately leading to its acquisition by Unilever. Meanwhile, despite being an incumbent in its industry, Rügenwalder Mühle has progressed furthest, having commenced its journey by responding to the vegan market segment quickly, partly due to exploding costs for meat and alternatives/substitutes to make sausages, which was also accompanied by sustainability concerns. In this regard Rügenwalder has looked for opportunities to design and market products which can be created by frugal and non-complex processes. The company launched products after it had solved its internal product development related challenges and has also made a clear strategic shift to increase its plant-based product range. Rügenwalder Mühle has completed its sustainable innovation journey by moving on from experimentation and learning activities onto a convergent cycle and innovation implementation that benefits from gained experiences. This journey has ultimately led to Rügenwalder Mühle's success in its home market.

The sustainable innovation journeys of the case companies are inevitably linked to market demand. With reference to Rogers's (2003) diffusion process theory, based on country-level statistical data on the numbers of vegan/vegetarian/flexitarian diets followed by consumers, it can

be noted that vegans still fall into the innovator category (less than 2.5% of users) in each of the three countries. However, when the consumers following a vegetarian or a flexitarian diet are combined with vegans in the population, the share of consumers in the target market of the vegan food producers reaches the early adopter category (over 13.5% of users). In Germany and the Netherlands, this aggregate group accounts for 19.3% and 16.7% of the populations, respectively, while in Finland the figure is 30%, which encroaches upon the early majority category (34%).

Notwithstanding these motivating market indicators, the magnitude and rate at which new vegan products will be adopted by consumers in the respective national contexts will depend on the characteristics of the food innovations. This commentary focuses on two product attributes – added value and compatibility – that Rogers (2003) suggests to be important determinants of the adoption rate of innovations. The added value of vegan products, in the eyes of consumers in each country (albeit with different ranking of significance), are derived from reduced meat consumption, and include health benefits, alleviation of environmental concerns, improvement of animal welfare, greater variation in meals, and for some, economic benefits (though it must be noted that meat alternatives are not always cheaper than meat). The compatibility of vegan products meanwhile relates to the alignment of these innovations with the established tastes and expectations of consumers. While the added value of vegan food innovations may be recognized by large segments of the market (e.g. early majority and late majority adopters), it is the lack of perceived compatibility that can halt the diffusion of these products beyond the earlier adopters into these segments (Dedehayir, Smidt, Riverola, & Velasquez, 2017). We therefore propose that vegan food innovations that are more familiar to consumers will attain higher compatibility and therefore have a greater likelihood of penetrating larger segments of the market, which may also include omnivorous consumers in time. Following this argument, we may see the plant-based

sausages commercialized by Rügenwalder Mühle to offer a lower degree of departure from what the general consumer is used to consuming (the traditional sausage), whereas the innovations of The Vegan Butcher and Gold&Green may be unfamiliar to consumers, presenting a high degree of departure from what is traditionally consumed. We would expect the latter innovations to have less compatibility and greater difficulty in penetrating larger market segments, beyond a smaller group of food enthusiasts (Dedehayir et al., 2017).

5. Future trends and opportunities

There are opportunities in the vegan food product market for different kinds of companies, whether they are new entrants or incumbents. According to prior literature, the most rational strategy is to gain a foothold in the highly enthusiastic and earliest segment called the 'innovators' (Moore, 1991) - likely to be vegans in the case of vegan food innovations (Dedehayir et al., 2017) - prior to attempting to cross the chasm to larger segments of the market. The case of Rügenwalder Mühle demonstrates that even a conservative incumbent can change its direction and follow this tactic in offering new products that align with the diets of different kinds of consumers. An innovative incumbent that has resources and existing capabilities in addition to competitive advantage gained from creating and delivering an innovative, sustainable product on the market cannot be easily overcome by its competitors. Thus, Rügenwalder Mühle being an incumbent is in a better position to create impact due to its existing resources and presence in the market. In contrast, Gold&Green and The Vegetarian Butcher and other new entrants in a similar situation, face an uncertain future given their vulnerability not only in gaining market traction but also facing acquisition by bigger players who may or may not have sustainability ambitions.

The cases indicate that the focus of the companies is currently on product innovations, as well as process innovations internal to the enterprise. This suggests that the industrial sector is still in its early phases of development and that there is no single dominant design that defines product standards for all players in the sector (Damanpour, 2001; Utterback & Abernathy, 1975). Thus, it is difficult to do more extensive analysis of the value chain as it has not been properly defined or studied so far. As the ecosystem surrounding the vegan food producers continues to evolve, we anticipate the influence of various technological innovations to assure sustainability in the value chain, such as blockchain technology that can add traceability and transparency (i.e. provenance) in the supply chain (Tian et al., 2016). As an important component of this ecosystem, sustainability-oriented policies are required for the food sector to guide producers and to help reach a dominant design, which is necessary for the institutionalization of vegan food products within the overarching food production and consumption regime.

The case descriptions also suggest that the institutional change in the food sector takes place at the microfoundations level, and is based on the innovating and pioneering companies' actions and practices (following the suggestions of Coleman, 1987) with which they follow the vegan trend and consumer behavior. In Figure 1, we portray a multi-level view of change in the food production and consumption system, initiated by changes in the landscape, namely, climate change.

[INSERT FIGURE 1 ABOUT HERE]

This figure presents a virtuous cycle towards environmental changes at the macro level initiated by individual consumers' activities and purchasing behaviors that influence the companies' activities at the meso level.

Figure 2, by comparison, presents a multi-level perspective of sociotechnical change of the food production and consumption system. This model of institutional change is driven by pioneering companies that respond to opportunities at the regime level (i.e. cultural, technological, industrial, and political norms and practices), by developing innovations for a niche segment of consumers.

[INSERT FIGURE 2 ABOUT HERE]

The figure shows that as more consumers try new innovations arising from meso-level activities, food innovators move towards more sustainable production practices and institutional change takes place at the macro level.

6. Conclusions

The aim of this paper has been to explore the sustainable innovation journeys of vegan food producers in three European countries where the vegan trend has developed and progressed to a noteworthy and impactful trend in the food sector over the last decade. In Germany, an incumbent meat producer has started to develop vegetarian/vegan sausages and thus adjusted its product and business strategy by using its existing technology in conjunction with new ingredients. Meanwhile two new entrants in the Netherlands and Finland have created innovative products not only through new recipes but also with the aid of new production technologies. The analysis of the three companies indicates how food producers with different backgrounds and products have proceeded along their sustainable innovation journeys. Interestingly, we find that the starting point of companies and their contexts have little influence on their experimentations. This highlights our postulated model that institutional change can happen with a heterogeneous

set of actors rather than always requiring new start-ups challenging incumbents or necessitating systematic market disruptions.

Our paper additionally underscores questions that can be addressed in future research, particularly associated with the true sustainability of vegan products and new production technologies. Industrial food production is regarded presently to have high potential for offering unlimited provisions of purely vegan, plant-based meat alternatives and dairy substitutes (Bar-El Dadon, Abbo, & Reifen, 2017). Consequently, there are high expectations of new vegan product solutions introduced to the markets, globally, but it may be that these solutions do not fulfill their anticipated sustainability potentials (van der Weele, Feindt, van der Goot, van Mierlo, & van Boekel, 2019). What is still called for is more foresight into consumption trends and how frugal innovations can respond to the vegan trend by promoting new, more sustainable ways to produce food (Tiwari, 2017). We believe that the following questions could guide some of this future research: Are plant-based meat replacements generally superior health-wise to meat products or are there specific nutritional contexts where this superiority is of little importance, e.g. in the fast food sector? Are vegan products safe and sustainable in a large-scale production and consumption system? How sustainable is the supply chain of vegan products? In addition to these questions, we believe that continued research is needed to establish a typology of sustainable innovation journeys of incumbents and new entrants. And another core issue to address in future research concerns consumer acceptance of novel and innovative vegan products in the mass markets. In many instances there are strong traditional path dependencies, based on habits, cultural practices, and economic considerations, that affect both demand and supply side and resist the acceptance of vegan products. Future research needs to assess how those path dependencies in consumer/supplier behaviour can be overcome by innovators.

The UN sustainable development goals of zero hunger (SDG 2) and sustainable consumption and production (SDG 12), including saving land and reducing greenhouse gas emissions, can only be met if societies, globally, would start eating nutritionally balanced diets that are higher in plant-based protein (Bahadur et al., 2018). Policies are additionally needed to help eliminate social, environmental, and economic barriers to the growth of plant-based food consumption. Public health programs targeted at promoting plant-based diets could be an example of a suitable climate change mitigation strategy.

Declarations of interest: none

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Fig. 1. Micro-level consumer activities can drive market change and steer firms to sustainable innovation journeys.

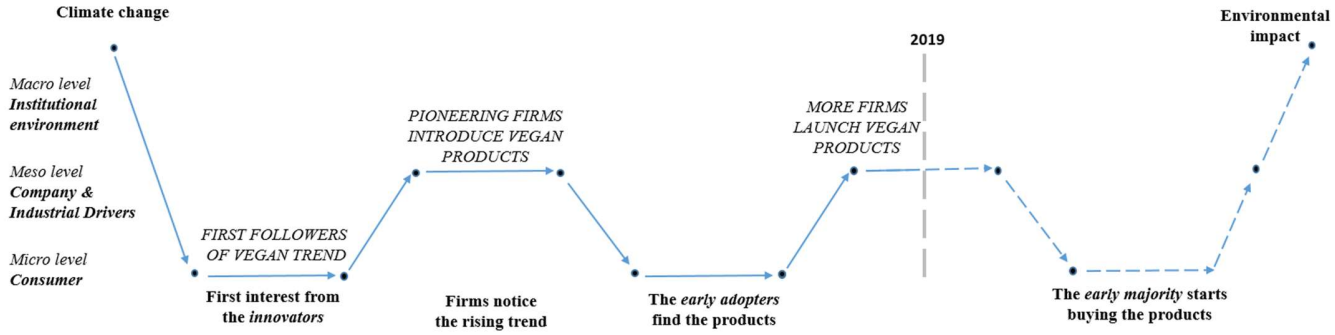
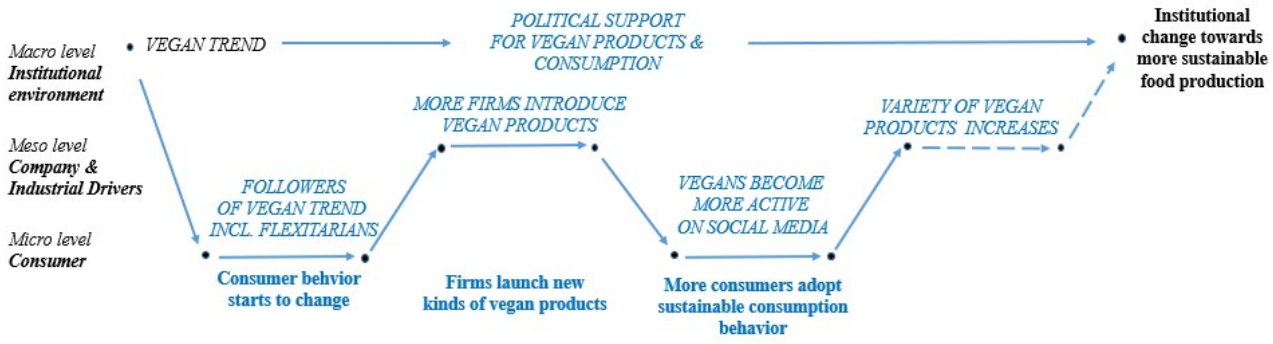


Fig. 2. Sustainable consumer behavior change on the micro level could also drive change on the macro level towards more sustainable food production with the support of appropriate policies



References

Agnoli, C., Baroni, L., Bertini, I., Ciappellano, S., Fabbri, A., Papa, M., ... & Sieri, S. (2017). Position paper on vegetarian diets from the working group of the Italian Society of Human Nutrition. *Nutrition, Metabolism and Cardiovascular Diseases*, 27(12), 1037-1052. doi:10.1016/j.numecd.2017.10.020

Amann, S., & Nezik, A.-K. (2016). Lebensmittelkonzern Rügenwalder Mühle. "Mensch, Papa, noch ne Wurst?". *Spiegel Online.* Retrieved from http://www.spiegel.de/spiegel/ruegenwalder-muehle-christian-rauffus-und-godo-roeben-im-spiegel-gespraech-a-1109666.html

Anand, S. S., Hawkes, C., de Souza, R. J., Mente, A., Dehghan, M., Nugent, R., . . . Popkin, B. M. (2015). Food Consumption and its Impact on Cardiovascular Disease: Importance of Solutions Focused on the Globalized Food System A Report From the Workshop

Convened by the World Heart Federation. *Journal of the American College of Cardiology, 66*(14), 1590-1614. doi:10.1016/j.jacc.2015.07.050

Appleby, P. N., Allen, N. E., & Key, T. J. (2011). Diet, vegetarianism, and cataract risk. *American Journal of Clinical Nutrition, 93*(5), 1128-1135. doi:10.3945/ajcn.110.004028

Asiakastieto. (2019). Gold&Green Foods Oy. Retrieved from https://www.asiakastieto.fi/yritykset/fi/gold-green-foods-oy/26854442/taloustiedot

Austgulen, M. H., Skuland, S. E., Schjøll, A., & Alfnes, F. (2018). Consumer readiness to reduce meat consumption for the purpose of environmental sustainability: insights from Norway. *Sustainability*, 10(9), 3058. doi:10.3390/su10093058

Baden, M. Y., Liu, G., Satija, A., Li, Y., Sun, Q., Fung, T. T., ... & Bhupathiraju, S. N. (2019). Changes in plant-based diet quality and total and cause-specific mortality. *Circulation*, 140(12), 979-991. doi: 10.1161/CIRCULATIONAHA.119.041014

Bahadur, K. C. K., Dias, G. M., Veeramani, A., Swanton, C. J., Fraser, D., Steinke, D., . . . Fraser, E. D. G. (2018). When too much isn't enough: Does current food production meet global nutritional needs? *Plos One, 13*(10). doi:10.1371/journal.pone.0205683

Banis, D. (2018). Everything Is Ready To Make 2019 The "Year Of The Vegan". Are you? *Forbes.* 31 Dec, 2018. Retrieved from https://www.forbes.com/sites/davidebanis/2018/12/31/everything-is-ready-to-make-2019-the-year-of-the-vegan-are-you/#3cca0c6757df

Bar-El Dadon, S., Abbo, S., & Reifen, R. (2017). Leveraging traditional crops for better nutrition and health - The case of chickpea. *Trends in Food Science & Technology, 64*, 39-47. doi:10.1016/j.tifs.2017.04.002

Beezhold, B., Radnitz, C., Rinne, A., & DiMatteo, J. (2015). Vegans report less stress and anxiety than omnivores. *Nutritional neuroscience*, 18(7), 289-296. doi:10.1179/1476830514Y.0000000164

Bouvard, V., Loomis, D., Guyton, K. Z., Grosse, Y., El Ghissassi, F., Benbrahim-Tallaa, L., . . . Int Agcy Res Canc, M. (2015). Carcinogenicity of consumption of red and processed meat. *Lancet Oncology, 16*(16), 1599-1600. doi:10.1016/s1470-2045(15)00444-1

Burt, K. (2012). Is this the end of meat? Retrieved from https://www.independent.co.uk/life-style/food-and-drink/features/is-this-the-end-of-meat-7765871.html

Büchs, M., Saunders, C., Wallbridge, R., Smith, G., & Bardsley, N. (2015). Identifying and explaining framing strategies of low carbon lifestyle movement organisations. *Global Environmental Change-Human and Policy Dimensions, 35*, 307-315. doi:10.1016/j.gloenvcha.2015.09.009

Cole, M. 2008. Asceticism and hedonism in research discourses of veg*anism. *British Food Journal*, 110(7): 706-716. doi: 10.1108/00070700810887176

Coleman, J. S. (1987). Microfoundations and Macrosocial Behavior. In J. C. Alexander, B. Giesen, R. Münch, & N. J. Smelser (Eds.), *The Micro-Macro Link* (pp. 153-173): University of California Press.

Dagevos, H., & Voordouw, J. (2013). Sustainability and meat consumption: is reduction realistic? *Sustainability: Science, Practice and Policy, 9*(2), 60-69. doi:10.1080/15487733.2013.11908115

Damanpour, F. (2001). The dynamics of the adoption of product and process innovations in organizations. *Journal of Management Studies, 38*(1), 45-65. doi:10.1111/1467-6486.00227

Deckers, J. 2009. Vegetarianism, sentimental or ethical? *Journal of Agricultural and Environmental Ethics*, 22: 573–597. doi: 10.1007/s10806-009-9176-3

Dedehayir, O., Smidt, M., Riverola, C., & Velasquez, S. (2017). *Unlocking the market with vegan food innovations.* Paper presented at the ISPIM Innovation Symposium, Manchester.

Dyett, P. A., Sabate, J., Haddad, E., Rajaram, S., & Shavlik, D. (2013). Vegan lifestyle behaviors. An exploration of congruence with health-related beliefs and assessed health indices. *Appetite, 67*, 119-124. doi:10.1016/j.appet.2013.03.015

Ellwood, M. (2018). The secret to making fake meat you want to eat. 14 Sep, 2018. Retrieved from https://www.bloomberg.com/news/articles/2018-09-14/vegetarian-butcher-s-secret-to-making-fake-meat-you-want-to-eat

Eronen, E. (2018). Paulig Group kadotti kasvun - saksalainen maustetalo teki tulokseen lähes 4 miljoonan euron loven. *Talouselämä.* 14 May, 2018. Retrieved from https://www.talouselama.fi/uutiset/paulig-group-kadotti-kasvun-saksalainen-maustetalo-teki-tulokseen-lahes-4-miljoonan-euron-loven/c9b53c7f-3879-3843-abeb-8eed899f31e9

Förster, U. (2019). Aufbruch ins Veggie-Universum. *Fleischwirtschaft.* 4 Jan, 2019. Retrieved from https://www.fleischwirtschaft.de/management/nachrichten/Digitale-Transformation-Aufbruch-ins-Veggie-Universum-38259?crefresh=1

Fresán, U., & Sabaté, J. (2019). Vegetarian diets: planetary health and its alignment with human health. *Advances in Nutrition*, 10 (Supplement_4), S380-S388. doi: 10.1093/advances/nmz019

Geels, F.W. 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research policy* 31 (8-9), 1257-1274. doi:10.1016/S0048-7333(02)00062-8

Geels, F.W, Hekkert, M. P., & Jacobsson, S. (2008). The dynamics of sustainable innovation journeys. *Technology Analysis & Strategic Management, 20*(5), 521-536. doi:10.1080/09537320802292982

Godfray, H. C. J., Aveyard, P., Garnett, T., Hall, J. W., Key, T. J., Lorimer, J., . . . Jebb, S. A. (2018). Meat consumption, health, and the environment. *Science, 361*(6399). doi:10.1126/science.aam5324

Goldstein, B., Hanse, S. F., Gjerris, M., Laurent, A., and Birkved, M. 2016. Ethical aspects of life cycle assessments of diets. *Food Policy*, 59: 139–151. doi:10.1016/j.foodpol.2016.01.006

Gordon, L., & Schoon, W. (2015). Meat Substitutes Going Mainstream in Germany: A New Era of Vegetarian Products? *Euromonitor International.* 1 Oct, 2015. Retrieved from https://blog.euromonitor.com/meat-substitutes-germany-vegetarian/

Grossarth, J. (2016). Veggie-Salami statt Teewurst: Ein Wurstfabrikant will weg vom Fleisch. *Frankfurter Allgemeine.* 14 Nov, 2016. Retrieved from https://www.faz.net/aktuell/wirtschaft/unternehmen/ruegenwalder-muehle-will-trend-zur-vegetarischen-wurst-ausbauen-14527466.html

Hansson, S., Aman, P., Becker, W., De Koning, D., Lagerkvist, C., Larsson, I., . . . Stymne, S. (2018). Breeding for public health: A strategy. *Trends in Food Science & Technology, 80*, 131-140. doi:10.1016/j.tifs.2018.07.023

Harrington, S., Collis, C., & Dedehayir, O. (2018). It's Not (Just) About the F-ckin' Animals. How Veganism is Changing, and Why that Matters. In M. Phillipov & K. Kirkwood

(Eds.), *Alternative Food Politics: From the Margins to the Mainstream* (pp. 135-150). New York, NY: Routledge.

Hartmann, C., & Siegrist, M. (2017). Consumer perception and behaviour regarding sustainable protein consumption: A systematic review. *Trends in Food Science & Technology, 61*, 11-25. doi:10.1016/j.tifs.2016.12.006

Hwang, K. A., & Choi, K. C. (2015). Anticarcinogenic effects of dietary phytoestrogens and their chemopreventive mechanisms. *Nutrition and cancer*, 67(5), 796-803. doi:10.1080/01635581.2015.1040516

Judge, M. and Wilson, M. S. 2015. Vegetarian Utopias: Visions of dietary patterns in future societies and support for social change. *Futures*, 71: 57–69. doi:10.1016/j.futures.2015.07.005

Kim, H., Caulfield, L. E., Garcia-Larsen, V., Steffen, L. M., Coresh, J., & Rebholz, C. M. (2019). Plant-Based diets are associated with a lower risk of incident cardiovascular disease, cardiovascular disease mortality, and All-Cause mortality in a general population of Middle-Aged adults. *Journal of the American Heart Association*, 8(16). doi: 10.1161/JAHA.119.012865

Lehto, J. (2018). Lihasta luovutaan pikkuhiljaa – myös muualla kuin pääkaupunki-seudulla. *Tilastokeskus.* 14 Aug, 2018. Retrieved from http://tilastokeskus.fi/tietotrendit/artikkelit/2018/lihasta-luovutaan-pikkuhiljaa-myos-muualla-kuin-paakaupunkiseudulla/

Loorbach, D., & Wijsman, K. (2013). Business transition management: exploring a new role for business in sustainability transitions. *Journal of Cleaner Production, 45*, 20-28. doi:10.1016/j.jclepro.2012.11.002

Luederitz, C., Schapke, N., Wiek, A., Lang, D., Bergmann, M., Bos, J., . . . Westley, F. (2017). Learning through evaluation - A tentative evaluative scheme for sustainability transition experiments. *Journal of Cleaner Production, 169*, 61-76. doi:10.1016/j.jclepro.2016.09.005

Lukkari, J. (2016). Paulig osti nyhtökauran valmistajan – Valloittaa seuraavaksi maailman. *Tekniikka&Talous.* 1 Sep, 2016. Retrieved from https://www.tekniikkatalous.fi/talous_uutiset/paulig-osti-nyhtokauran-valmistajan-valloittaa-seuraavaksi-maailman-6578843

Lundén, K. (2018). Härkiksen ja nyhtiksen valmistajien tappiot syvenivät vegebuumista huolimatta, "En ajattele, että vielä ensi vuonnakaan pääsisimme kannattavaksi". *Maaseudun Tulevaisuus.* 26 Sep, 2018. Retrieved from https://www.maaseuduntulevaisuus.fi/talous/artikkeli-1.306632

Madigan, M. & Karhu, E. (2018). The role of plant-based nutrition in cancer prevention. *Journal of Unexplored Med. Data*, 3, 9. doi:10.20517/2572-8180.2018.05

Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy, 41*(6), 955-967. doi:10.1016/j.respol.2012.02.013

Michail, N. (2015). Plant-based meat that matches steak for texture: 'The technology is unique in the world'. *Food Navigator.* 28 Oct, 2015. Retrieved from https://www.foodnavigator.com/Article/2015/10/28/Plant-based-meat-that-matches-steak-for-texture-The-technology-is-unique-in-the-world

Moore, G. A. (1991). *Crossing the Chasm*. New York: Harper Business Essentials.

Mróz, L. W., Chapman, G. E., Oliffe, J. L., & Bottorff, J. L. (2011). Men, food, and prostate cancer: gender influences on men's diets. *American Journal of Men's Health,* 5(2), 177-187. doi: 10.1177/1557988310379152

Mäntylä, J.-M. (2017). Näin syntyi hittituote: "Nyhtökauralinjaa ei ollut olemassa, se piti keksiä". *Talouselämä.* 1 Jan, 2017. Retrieved from https://www.talouselama.fi/uutiset/nain-syntyi-hittituote-nyhtokauralinjaa-ei-ollut-olemassa-se-piti-keksia/a331c0ef-db60-33bf-8a55-88d7ff563765

Null, G., & Pennesi, L. (2017). Diet and lifestyle intervention on chronic moderate to severe depression and anxiety and other chronic conditions. *Complementary therapies in clinical practice*, 29, 189-193. doi:10.1016/j.ctcp.2017.09.007

Official Statistics of Finland. (2016). Households' consumption. *Statistics Finland.* Retrieved from https://www.stat.fi/til/ktutk/index_en.html

Pojic, M., Misan, A., & Tiwari, B. (2018). Eco-innovative technologies for extraction of proteins for human consumption from renewable protein sources of plant origin. *Trends in Food Science & Technology, 75*, 93-104. doi:10.1016/j.tifs.2018.03.010

Radnitz, C., Beezhold, B., and DiMatteo, J. 2015. Investigation of lifestyle choices of individuals following a vegan diet for health and ethical reasons. *Appetite*, 90: 31–36. doi:10.1016/j.appet.2015.02.026

Reipurth, M. F., Hørby, L., Gregersen, C. G., Bonke, A., & Cueto, F. J. P. (2019). Barriers and facilitators towards adopting a more plant-based diet in a sample of Danish consumers. *Food quality and preference*, 73, 288-292. doi:10.1016/j.foodqual.2018.10.012

Richards, C., Lawrence, G, and Kim, C. (2012), Productivism, Culture, and the Challenges of Sustainable Beef Production in Australia, *Eco*, 16(1), 101-128.

Rogers, E. M. (2003). *Diffusion of innovations* (5 Ed.). New York: Free Press.

Ross, K. (2011). Soy substitute edges its way into European meals. *The New York Times.* 16 Nov, 2011. Retrieved from https://www.nytimes.com/2011/11/17/business/energy-environment/soy-substitute-edges-its-way-into-european-meals.html

Ruegenwalder. (2019a). Mein Opa hat noch in Rügenwalde Wurst gemacht. *Corporate Website.* Retrieved from https://www.ruegenwalder.de/unsere-geschichte

Ruegenwalder. (2019b). Rügenwalder Mühle at a glance. *Corporate Website.* Retrieved from https://www.ruegenwalder.de/en/facts-and-figures

Sanchir, A. (2018). Netherlands Aims to Shift to 60 Percent Plant-Based. *VegNews.* 4/2018. Retrieved from https://vegnews.com/2018/4/netherlands-aims-to-shift-to-60-percent-plant-based

Singer, P. 1990. *Animal Liberation*. 2nd ed. The New York Review of Books, New York (USA).

Springmann, M., Mason-D'Croz, D., Robinson, S., Garnett, T., Godfray, H. C. J., Gollin, D., . . . Scarborough, P. (2016). Global and regional health effects of future food production under climate change: a modelling study. *Lancet, 387*(10031), 1937-1946. doi:10.1016/s0140-6736(15)01156-3

Statista. (2018a). Veganism and Vegetarianism in Europe. Dossier. https://www.statista.com/study/41880/veganism-and-vegetarianism-in-europe/

Statista. (2018b). Vegan market. Dossier. https://www.statista.com/study/41316/vegan-market-statista-dossier/

Statista. (2019a). Share of individuals who are vegetarian or vegan in selected European countries in 2017. https://www.statista.com/statistics/768475/vegetarianism-and-veganism-among-young-adults-in-selected-european-countries/

Statista. (2019b). Number of new products launched for leading categories of vegan / vegetarian products in Germany from 2011 to 2015. https://www.statista.com/statistics/679544/new-vegetarian-product-categories-germany/

Statista. (2019c). Share of vegetarians in the Netherlands 2018, by age group. https://www.statista.com/statistics/909843/share-of-vegetarians-in-the-netherlands-by-age-group/

Statista. (2019d). Reasons for consumers to buy meat substitutes in the Netherlands 2017. https://www.statista.com/statistics/828345/reasons-for-consumers-to-buy-meat-substitutes-in-the-netherlands/

Statista. (2019e). Sales growth of plant-based food products at major grocery retailers in Finland from June 2015 to June 2016, by type. https://www.statista.com/statistics/751024/sales-growth-of-plant-based-food-products-at-major-retailers-in-finland/

Statista. (2019f). Ranking der beliebtesten Marken von Wurst- und Fleischwaren in Deutschland 2018. https://de.statista.com/statistik/daten/studie/171544/umfrage/beliebte-marken-von-fertigwurst-und-fleischwaren/

Statista. (2019g). Umfrage zur Markenbekanntheit von vegetarischen Produkten in Deutschland 2017. https://de.statista.com/statistik/daten/studie/722243/umfrage/markenbekanntheit-von-veggie-produkten-in-deutschland/

Strecker, T. (2015). Definitions of ‘vegan’ and ‘vegetarian’ in accordance with the EU Food Information Regulation. European Vegetarian Union, Berlin, Germany.

STT. (2016). Nyhtökaura harppasi isojen joukkoon - Pauligista Gold&Green Foodsin kumppani. *The press release of Gold&Green Foods & Paulig Group.* 1 Sep, 2016. Retrieved from

https://www.sttinfo.fi/tiedote/nyhtokaura-harppasi-isojen-joukkoon---pauligista-goldgreen-foodsin-kumppani?publisherId=50532794&releaseId=50541556

Susonline. (2018). Rügenwalder Mühle verzeichnet Umsatzrückgang. Retrieved from https://www.susonline.de/news/markt/ruegenwalder-muehle-verzeichnet-umsatzrueckgang-9387071.html

Talouselämä. (2016). Yle: 90% nyhtökauraa himoitsevista jää ilman. 13 May, 2016. Retrieved from https://www.talouselama.fi/uutiset/yle-90-nyhtokauraa-himoitsevista-jaa-ilman/237f1afd-ef2d-3ee6-9e32-f664e947b469

Tian, F., Yang, B., Chen, J., Cai, X., Qin, K., & Zhou, C. (2016). An Agri-food Supply Chain Traceability System for China Based on RFID & Blockchain Technology. *2016 13th International Conference on Service Systems and Service Management*.

Tiwari, R. (2017). *Propositions for a high-quality, affordable and sustainable 'Food Basket': scope of cooperation between India & Germany in areas relating to food processing industry*. Consulate General of India, Hamburg, Germany.

Tiwari, R. and C. Herstatt (2020). The Frugality 4.0 Paradigm: Why Frugal Innovations are transcending beyond Emerging Economies. In McMurray, A.J. & De Waal, G.A. (Eds.) *Frugal Innovation: A Cross Global Research Companion*. Routledge: 40-53.

Traill, W. B., & Meulenberg, M. (2002). Innovation in the food industry. *Agribusiness: an International Journal, 18*(1), 1-21. doi:10.1002/agr.10002

Turner-McGrievy, G., Mandes, T., & Crimarco, A. (2017). A plant-based diet for overweight and obesity prevention and treatment. *Journal of geriatric cardiology*: JGC, 14(5), 369. doi:10.11909/j.issn.1671-5411.2017.05.002

Utterback, J. M., & Abernathy, W. J. (1975). Dynamic Model of Process and Product Innovation. *Omega-International Journal of Management Science, 3*(6), 639-656. doi:10.1016/0305-0483(75)90068-7

van der Weele, C., Feindt, P., van der Goot, A., van Mierlo, B., & van Boekel, M. (2019). Meat alternatives: an integrative comparison. *Trends in Food Science & Technology, 88*, 505-512. doi:10.1016/j.tifs.2019.04.018

van Velzen, D. (2019). New Year message NVV to the animals / Nieuwjaarsboodschap NVV aan de dieren. *NVV Nederlandse Vereniging voor Veganisme.* 3 Jan, 2019. Retrieved from https://www.veganisme.org/nieuwjaarsboodschap-nvv-aan-de-dieren/

Westhoek, H., Rood, T., van den Berg, M., Janse, J., Nijdam, D., Reudink, M., & Woltjer, G. B. (2011). *The protein puzzle: the consumption and production of meat, dairy and fish in the European Union*. *Netherlands Environmental Assessment Agency.* No. 500166001.

Willett, W.; Rockström, J.; Loken, B.; Springmann, M.; Lang, T.; Vermeulen, S.; Garnett, T.; Tilman, D.; DeClerck, F.; Wood, A.; et al. Food in the Anthropocene: The EAT-Lancet Commission on healthy diets from sustainable food systems. *Lancet* 2019, 393, 447–492. doi:10.1016/S0140-6736(18)31788-4

World Economic Forum. (2019). *Meat: the Future dialogue series - Alternative Proteins*. Retrieved from: https://www.weforum.org/whitepapers/meat-the-future-series-alternative-proteins