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# INNOVATIONS FOR SUSTAINABLE PROTEIN SYSTEMS

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## **Abstract**

**Purpose:** Introduction of new, alternative protein sources and products for replacing conventional animal products requires many innovations at the product level and the system level. However, less attention has been given to analyzing the emergence of entrepreneurial and business responses to sustainable protein system. The purpose of the paper is to analyze the opportunities and challenges in food processing related to sustainable protein systems from the perspective of sustainable innovations and sustainable entrepreneurship.

**Design/methodology/approach:** Thematic qualitative interviews were conducted in Finnish food manufacturing companies during the first half of 2018. Nineteen (19) interviews were conducted, of which sixteen (16) were face-to-face and three (3) by telephone using a semi-structured guide. Half of the companies represented traditional and established protein industry, whereas the other half represented alternative smaller-scale protein industry. The tape-recorded interviews were transcribed, coded and analyzed using qualitative content analysis and abductive coding scheme.

**Findings:** The interviewees of the traditional protein industry generally favored incremental innovations, adjustments and improvements, whereas the interviewees of alternative protein industry emphasized more radical and systemic innovations. It was generally agreed that the global long-term challenges, including climate change and population growth, will provide increasing opportunities for a more diverse variety of protein sources and products.

**Research/practical implications:** Sustainable protein innovations can be incremental, radical, sustaining or disruptive, but their contribution to sustainable protein system differ. Future research could study in more detail the practices of providers of sustainable protein innovations and investigate spatial and cultural embeddedness of protein innovations.

**Originality/value:** Academic implications of the study lie in the exploration of the relevance of protein issues in the context of sustainable innovation and entrepreneurship literature. Practical implications of the study relate to raising awareness towards sustainable protein innovations in terms of new business models, value offerings and entrepreneurial practices.

**Keywords:** sustainable innovations, sustainable entrepreneurs, protein system, food industry

**JEL Codes:** L66, Q01, O31.

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## **Introduction**

Food systems are extremely vulnerable to a significant number of long-term challenges including climate change, water scarcity, natural resource scarcity, pollution, population growth and unsustainable consumption habits. On the other hand, a major proportion of the global environmental burden is caused by food-related human activities (de Boer et al., 2006). Promoting dietary shifts towards mostly plant-based foods is listed in the article *World Scientists' Warning to Humanity: A Second notice*, as one of the major steps to transition to sustainability, signed by 15 364 scientist from 184 countries (Ripple et al., 2017). However, animal products, such as meat and dairy products, are major dietary sources of protein in Europe and North America. (Beverland, 2014). Hence, replacing animal products requires alternative protein sources and new solutions. Food manufacturing companies are crucial actors in inventing new sustainable products and mainstreaming plant-based diets and the use of alternative protein sources in developed economies. Plant-based protein sources, such as fava beans, peas, quinoa, blue lupin, buckwheat, seed flax, turnip, rape and hemp can be used to meet the increasing protein demand more sustainably. In addition, mushrooms, insects, underutilized fish species and algae have significant potential to contribute to sustainable dietary shifts. At the same time, improvements in sustainability performance within the meat and dairy industry are urgently needed. This paper examines opportunities and challenges related to sustainable proteins from the perspective of food manufacturing companies. First, the relationship between sustainable protein systems, sustainable innovations and sustainable entrepreneurship is discussed. Second, the empirical results from nineteen thematic interviews among Finnish food manufacturing companies are presented and finally, conclusions on the role of innovations for sustainable protein systems are discussed.

### **1 Sustainable protein system, innovations and entrepreneurship**

Food systems encompass a number of activities, including producing food, processing food, packaging and distributing food and retailing and consuming food (Ingram, 2011). Protein systems can be considered as sub-systems of food systems that focus on producing, processing, packaging, distributing, retailing and consuming proteins. But why is the protein systems approach important? First, proteins are nutritionally crucial as essential macronutrients and as a source of necessary amino acids. Second, proteins are environmentally critical, since the current protein supply in western countries is based on

animal-based protein sources with significant global environmental impacts (Lang and Barling, 2013). It can be argued that much of the global environmental burden of the food systems is associated with the protein chain. The sustainable protein system, in turn, can be defined as a protein system that respects the health and prosperity of humans, communities, animals and the limits of the planet. This is linked to sustainability transition research, which assumes that system innovations and transitions start in niches and that under preferable circumstances, niche actors are capable of becoming mainstream suppliers serving mainstream markets (Boons et al., 2013). Alternative protein entrepreneurs are indeed niche actors aiming to mainstream plant-based diets or diversify protein sources, such as fungi, algae, insects, underutilized fish and lab-grown proteins.

Sustainable innovation can be defined as innovation that improves sustainability performance including ecological, economic and social criteria (Boons et al., 2013). Moreover, sustainable innovation can be considered as a process of developing new ideas, behaviors, products and processes to reach specific sustainability targets (Flores et al., 2008). According to Kuokkanen et al. (2018), practice-based view on sustainable innovation include both provider practices, including business models, value offerings and entrepreneurial practices, and user practices including consumption preferences, expectations and demand. In general, sustainable innovations can be divided into incremental and radical innovations. Incremental innovations are product- or process-based innovations, whereas radical innovations address a larger system. Alternatively, sustainable innovations can be divided into sustaining and disruptive innovations. Sustaining innovations do not create new markets or value networks, whereas disrupting innovations refer to disruptive technologies, business models and product innovations, which aim to create new markets and value networks. In a context of sustainable protein systems, sustainable protein innovation can refer to ensuring sufficient and healthy protein intake, respecting different food cultures, improving animal welfare and producing proteins using environmentally efficient processes. Hence, a rich set of culturally accepted sustainable protein innovations is needed (de Boer and Aiking, 2011).

In order to respect spatial differences in sustainability challenges, Boons et al. (2013) make a clear distinction between developed consumerist economies, emerging economies and so called Base-of-the-Pyramid economies. Developing sustainable protein systems is a challenge especially for developed consumerist economies due to an inherently inefficient conversion of meat protein production from feed to food (de Boer et al., 2006). Alternative protein products can be presented as disruptive sustainable innovations (Kuokkanen et al., 2018), which aim to reduce meat protein intake (Aiking, 2014) and to replace meat proteins

with plant, mushroom and algae protein products. In addition, sustainable innovations could aim to increase the diversity of animal-based proteins by shifting towards underutilized fish species and insects. Sustainable alternatives to animal protein can also be provided by startup companies focusing on new disruptive technologies for accelerating sustainability transitions and creating completely new markets, such as lab-grown proteins and cultivated in-vitro meat. Hence, sustainable innovation is in many cases a radical or disruptive innovation (Schaltegger and Wagner, 2010).

Sustainable entrepreneurship has a clear link to sustainable innovations. Schaltegger and Wagner (2010) present four categories of sustainability-oriented entrepreneurship including ecopreneurship, social entrepreneurship, institutional entrepreneurship and sustainable entrepreneurship. While the core motivation with ecopreneurship is to earn money through contributing to solving environmental problems, social entrepreneurship is concerned with achieving societal goals and securing its funding. On the other hand, institutional entrepreneurs initiate changes that contribute to transforming existing institutions or to creating new institutions. Finally, sustainable entrepreneurs contribute to sustainable development both within and beyond the organization, i.e. sustainable development of the market and society as a whole. In addition, Schaltegger and Wagner (2010) categorize firms according to high, medium or low priority of environmental and social issues as business goals.

## **2 Research approach**

Nineteen (19) thematic qualitative interviews were conducted in Finnish food manufacturing companies, representing two groups: old and new protein system. All interviews were made during the first half of 2018. Half of the companies represented traditional and established protein industry, including meat, dairy, bakery and convenience foods, whereas the other half represented new and alternative smaller-scale protein industry, including the processing of plant proteins, mushrooms, insects and under-utilized fish. Interviewees from the bigger companies were responsibility managers, innovation managers, product group managers, research and development managers, quality managers and product development managers. Interviewees from the smaller companies were mainly CEO's and/or founders. The general themes for all interviewees included the perceptions on the opportunities and challenges related to sustainable protein systems. Interviewees described their understanding of the sustainable protein system, the role of their company in the food system, their perceptions on

the future of animal-based, plant-based and other protein sources, consumer attitudes towards their products, institutional and political aspects as well as market circumstances. Since the interviewees of the new protein system often represented new startup companies and were entrepreneurs themselves, the themes for this group also included perceptions on opportunities and challenges of alternative protein entrepreneurship.

Out of the nineteen (19) interviews, sixteen (16) were conducted face-to-face and three (3) by telephone using a semi-structured guide. The tape-recorded interviews were transcribed, coded and analyzed using qualitative content analysis. The abductive coding scheme recognized both the earlier theory as well as purely data-based codes. Abductive analysis can be viewed as continually moving back and forth between a set of observations (interview data) and theoretical generalizations. Accordingly, the theory of sustainable innovations and sustainable entrepreneurship in a context of the sustainable protein system was analyzed and discussed in the light of empirical observations. The main limitations of the research were the relatively small sample size, subjective selection of respondents and limited national level focus. For example, interviewing only one person in a large organization may lead to data that is biased.

### **3 Empirical results**

Empirical results are here presented according to their relevance for sustainable innovations and sustainable entrepreneurship. Sustainable protein innovations are first discussed within the framework of incremental versus radical innovations and then within the framework of sustaining versus disruptive innovations. Sustainable protein entrepreneurship is analyzed in terms of the priority of sustainability goals. The results are summarized in Tables 1 and 2.

#### **3.1 Sustainable innovations**

##### **3.1.1 Incremental versus radical innovations**

It was generally agreed that global long term challenges, including climate change and population growth, will provide increasing opportunities for a more diverse variety of protein sources and products. However, the interviewees had considerably different perceptions regarding sustainable protein systems, especially regarding the need of radical innovations in the food system. They commonly agreed that dietary shift towards plant-based foods is currently occurring, but different strategies, policies and methods were suggested in order to achieve a sustainable protein system. Respondents of the old protein system preferred incremental innovations, adjustments and improvements whereas alternative protein

entrepreneurs emphasized the need of radical innovations. Sustainable protein systems were generally associated with environmental sustainability. Some interviewees, alternative protein entrepreneurs in particular, thought that sustainability is operationalized through a shift from animal-based products (secondary protein sources) to plant-based protein sources (primary protein sources). On the other hand, interviewees from meat and dairy companies emphasized the importance of grass-based animal production in Finland and unfavorable climate conditions for legume crop growing in majority of the country. Naturally, all companies of the new protein system were actively developing products based on alternative protein sources, but also all companies of the old protein system were aware of the new protein sources and some of them had already launched new products into market that include alternative protein sources. However, respondents did not believe that global meat consumption will decrease in the near future, but some of them anticipated that meat consumption in western countries may slowly and moderately decrease. Finnish consumers were perceived as ecologically and nutritionally aware, but also rather price-oriented.

### **3.1.2 Sustaining versus disruptive innovations**

Most of the sustainable innovations mentioned by the interviewees were sustaining rather than disruptive in nature. Hence, sustainable innovations were mostly marketed to existing markets. Among the companies interviewed, the most disruptive innovations occurred in a protein technology startup, insect companies and mushrooms companies. A protein technology startup working on lab grown proteins is disrupting the whole existing food system, as its protein does not require agricultural production, fishing, hunting or collecting food. Insect companies, in turn, are disrupting the existing food preferences of western consumers, as attitudes towards eating insects are generally negative in western countries. Mushroom companies disrupt the existing idea of a linear food supply chain by introducing the concept of circular economy, where everything is utilized with zero waste.

## **3.2 Sustainable entrepreneurship**

### **3.2.1 Sustainable proteins as a core business goal**

Most of the respondents within the alternative protein industry could be categorized as sustainable entrepreneurs due to their motivation towards sustainable protein systems. These alternative protein entrepreneurs or sustainable protein entrepreneurs had identified business opportunities related to environmental and nutritional impacts of protein sources, and changing consumption habits. For example, fish is an excellent source of nutrition and proteins, but there are also environmental concerns and substantial evidence that fish stocks

are in a dire state and farmed fish face aquaculture-related welfare issues. Hence, one of the respondents had started to utilize a small, wild and under-utilized lake fish called roach. Among consumers, roach has been undervalued due to lack of attractive roach products. The most important phase according to the entrepreneur was to develop a tasty roach product cost-efficiently. In addition, the entrepreneur emphasized the fact that fishing wild roach also means phosphorous is removed from the lake. Due to nutrient reduction and removal by fishing roach, the eutrophication in the lakes will decrease. Ultimately, the entrepreneur's approach was successful and the innovative product was awarded in national food competitions and found its place in the selections of major retailer chains. In many cases, however, the development of markets for niche products and mainstreaming alternative protein consumption were seen as major challenges by alternative protein entrepreneurs. For example, relatively high price of products based on alternative proteins (compared to animal-based products) was seen as a hindering factor by the respondents. In addition, alternative protein entrepreneurs found competition for shelf space in supermarkets and price-oriented competitive bidding of municipal food services as challenges. Companies focusing on alternative protein sources are generally small and have limited resources for research, product development and marketing. On the other hand, smaller companies have flexibility to make experiments dealing with new protein sources.

### **3.2.2 Sustainable proteins as complementary to core business**

Traditional, old protein industry, did address many sustainability goals regarding their practices, but sustainability goals were typically complementary to core business. Core business was associated with providing tasty and affordable proteins. Sustainability issues were managed by the department of corporate social responsibility or by other administrative practices, such as eco-labels and management systems. Their business models were based on strongly established supply chains from the field to the table as well as strongly established relationships with clients, such as retailers and food services. Reduction of animal-based protein production was not perceived as the major sustainability goal in the food system. Within meat industry, for example, interests towards more creative use of undervalued parts of animals were expressed, but this was motivated more by culinary issues than reduction of food waste. Moreover, improvements in feed efficiency were mentioned, but it was associated to economic efficiency rather than sustainability. In general, traditional companies are more likely followers rather than leaders in terms of new protein sources, partly due to dependency on large volume requirements and difficulties to operate in the niche markets.



**Tab. 1: Incremental and radical, sustaining and disruptive innovations in the sustainable protein system**

	Sustaining innovations	Disruptive innovations
Incremental innovations	Traditional protein sources with product/process -based adjustments with existing markets and value networks, E.g. improving feed efficiency in meat supply chains	Traditional protein sources with new markets and new value networks. E.g. new markets for undervalued parts of animals
Radical innovations	New protein sources with existing markets and value networks. E.g. replacing meat or milk with plant-based alternatives in familiar products	New protein sources with new markets and new value networks. E.g. plant-based convenience foods, edible insects, undervalued small fish, lab-grown proteins

Source: The author

**Tab. 2: Priority of sustainable proteins as a business goal in terms of business models and value offering**

	Sustainable proteins as complementary to core business	Sustainable proteins as a core business goal
Business model	Business model for sustaining the unsustainable protein system; focuses at the micro level of the company (animal-based model)	Business model for systemic change and outcome (sustainable protein system); focuses at the macro level (e.g. plant-based business model)
Value offering	Value offering to existing markets with price/quality -oriented value proposition (cheap/tasty protein-rich products)	Value offering to new markets with environmental and nutritional value proposition (attributes of new protein sources)

Source: The author

## Conclusion

This paper provides insight into the concept of a sustainable protein system for understanding and advancing sustainable protein innovations in the food system. Moreover, the paper

investigates sustainable protein innovations in relation to incremental and radical innovations as well as sustaining and disruptive innovations. Since sustainable entrepreneurship is closely linked to sustainable innovations, the paper also discusses sustainable proteins as a core business goal and as complementary goal to core business. Theoretical implication of the paper is related to further conceptualization of sustainable protein innovation and sustainable protein entrepreneurship. The key managerial implication of the paper is to improve the understanding of different types of sustainable innovations within protein industry as well as the degree of the priority of sustainable proteins with respect to core business.

Suggestions for future research include (1) studying the practices of providers of sustainable protein innovations and (2) investigating spatial and cultural embeddedness of sustainable protein innovations and sustainable protein entrepreneurship. Strengthening desired outcomes for sustainable protein system is dependent on appropriate business models, desired value offerings and innovative entrepreneurial practices. For example, measuring the degree to which a business model is aligned with climate change goals, nutritional goals and animal welfare, identifying variables of sustainable value propositions for alternative protein products and analyzing the relationship between consumers' changing expectations and entrepreneurial practices could be future research avenues. Promoting desired outcomes for sustainable protein system is also dependent on spatial and cultural embeddedness of sustainable protein innovations and sustainable protein entrepreneurship. For example, investigating differences in specific meanings in different contexts related to sustainable proteins and analyzing a range of ecological, economic and cultural conditions affecting national diets could be future studies undertaken. Hence, future research could involve, for example, comparisons of Northern, Southern, Western and Eastern European innovations and entrepreneurial practices for sustainable protein system.

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