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Division Programmes
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Full Proposal: scientific part, second call
NRP 69 "Healthy Nutrition"

Division IV, National Research Programmes (NRP)

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Project title (English)	Innovations for a future-oriented consumption and animal production NOVANIMAL
Project focus	☒ Integration along the food chain, from primary production to consumption ☒ Integration of sustainable food production, processing and distribution with public health nutrition Addresses a specific gap in the coverage of the programme: ☒ Economic determinants of the food chain ☐ Nutrition in aged population ☒ Food policies and implementation strategies ☐ Linking recommendations on diet and sustainability ☒ Food consumer behaviour

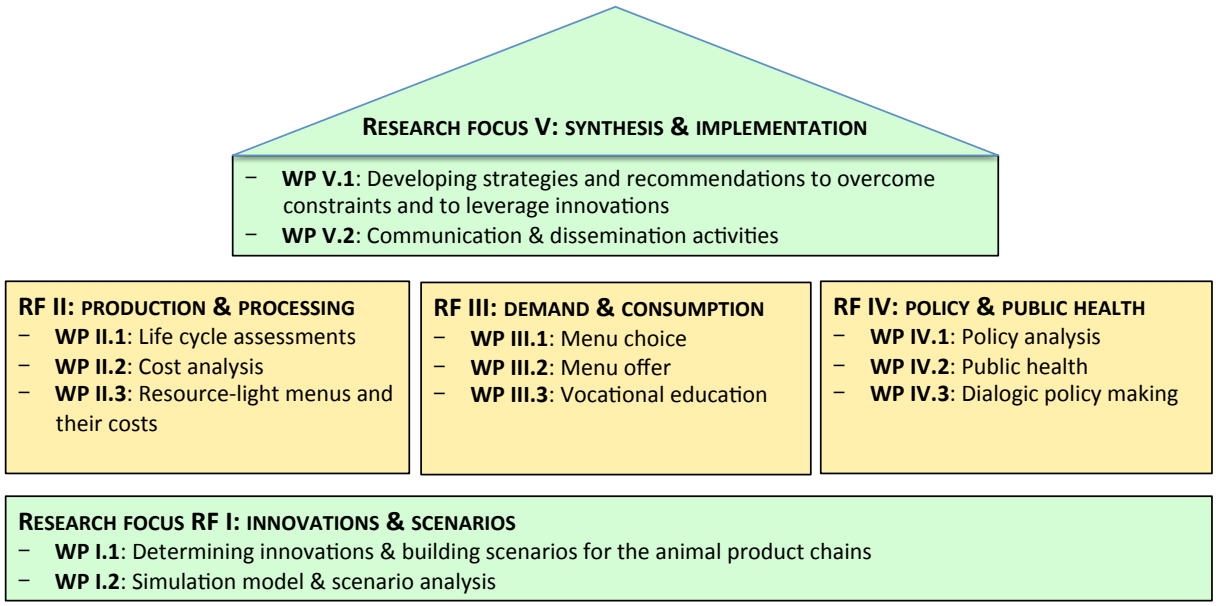
To be completed in English. Maximum length from chapter 1 to 3 is 20 A4-pages, all included. Use font size 10 minimum.

1. Research

This full proposal relates to a combined project that has emerged from two project pre-proposals submitted in the first stage of the second NRP69 call. The integration of these previous pre-proposals «Sustainable milk production and processing» and «Creating resource-light eating» allows a reframing of the objectives and the system boundaries. This project addresses the whole **animal product value chains** from production to processing to consumption of milk, dairy products and meat (beef, pork, and poultry) in Switzerland. It focuses on **innovations** along these animal product value chains, aimed at lowering significantly the negative impacts on the environment and the use of natural resources, as well as on public health. Furthermore, the project identifies and analyses the **constraints** that could hinder these innovations and it investigates how these innovations could be implemented. The primary objective of the project is to develop **strategies** and **recommendations** to foster the implementation of innovations in animal product value chains and to overcome constraints.

The project is organised in five research focuses (RF) with thirteen work packages (WP) (Figure 1). **RF I innovation & scenarios** provides the basis for the project. In work package WP I.1, the research group jointly will determine effective innovations along the animal product value chains to be investigated, such as resource-efficient and cleaner production systems, resource-light menus in gastronomy etc. Secondly, the research group will define criteria to build scenarios (e.g. consumption trends, technological progress, development of global markets) and establish a selection of relevant scenarios. In WP I.2 a system model is to be constructed to simulate these scenarios.

Figure 1 Project structure



RF II production & processing analyses the environmental impacts and economic costs of milk and dairy products, beef, pork and poultry, and assesses the effects of innovations. **RF III demand & consumption** will experimentally and empirically investigate how consumption of animal products might be influenced in gastronomy by innovations in menu creation and marketing, in operating parameters for chefs, and in vocational education. **RF IV policy & public health** analyses the public health implications of different scenarios and the effects of current agricultural policy on the environment and health, and investigates how agricultural policy might be further developed to facilitate and leverage innovations in the animal product chains.

Implementation activities, for instance workshops with stakeholders and publications of selected results in different media, are already an integrated part of most work packages. In **RF V**

synthesis & implementation, the findings and conclusions will be synoptically discussed and interpreted. Strategies to overcome constraints and to leverage innovations will be proposed. Evidence based recommendations, guidelines, and tools for stakeholders of the animal product value chains, i.e. in agriculture and food processing, decision makers in gastronomy and chefs, instructors in vocational education, players in agricultural and related policies, will be developed and finalised. The final results are coordinated communicated and disseminated.

1.1 State of research in the field

The project focuses on animal products for the following reasons:

Nutrition habits: Swiss diets – and Western diets in general – are characterised by a high intake of animal products. Swiss consumers are almost world champions with an annual per capita consumption of 380 kg of dairy products in 2013 (swissmilk 2014). Meat consumption amounts to nearly 80 kg (slaughter weight, 2011), which is double the global average (FAOSTAT).

Public health: Excessive consumption of specific animal products may increase morbidity and the mortality rate in the population. For example, the intake of red and processed red meat has been linked to an increased risk of cardio-vascular diseases, diabetes mellitus and some types of cancer (Walker *et al.* 2005). In Switzerland, the intake of these products is unequally distributed over the population, potentially reinforcing health inequalities. Evaluation of the public health significance of the consumption of animal product could reveal substantial prevention potential.

Environment: The «ecological footprint» of the current animal production, i.e. the use of natural resources (land, water, energy) and the negative impacts on the environment (greenhouse gas emissions, eutrophication, acidification, landscape deterioration and biodiversity decline, water pollution, etc.) are significant (e.g. Stöcklin *et al.* 2007, BAFU & BLW 2008, Lachat *et al.* 2010, Westhoek *et al.* 2014, FOEN 2016). In Switzerland, the livestock is the main reason for the nitrogen surplus (Jan *et al.* 2013) and the methane emissions.

Food economy: The entire agricultural and food sector has a share of ca. 9% of the gross domestic product (GDP), of ca. 14% of employees and of ca. 18% of the enterprises (BFS 2010, Baur 2015). Animal products are a relevant part of the sector.

Agriculture: 85% of the 54,000 Swiss farms (2014) are engaged in animal production. The value of the animal production is 54% of the total agricultural production (FSO 2015).

With the focus in this project on milk and dairy products, beef, pork and poultry, more than 95% of the animal products consumed in Switzerland are covered (FSO 2015).

The production of animal products and their consumption is not just relevant for Switzerland but is a **global issue**: The annual global per capita consumption of animal products is continuously rising (FAOSTAT). This poses challenges for the environment and natural resources, and possibly public health. These are not new findings (concerning natural resources: e.g. FAO 2003; concerning health risks: e.g. Demeyer *et al.* 2008), but how **food cultures** with a moderate consumption of animal products can be encouraged has not been put on political agendas yet.

This project integrates the Swiss **animal product chains** from agriculture, to food processing to consumers. In Switzerland, already half of principal meals are consumed away from home. This trend seems to be underestimated in the public health and sustainability discourses. At the end of the animal product chains the project therefore focuses on the **gastronomy** as a key sector for a healthy nutrition and sustainable food production.

Historically, Switzerland has a longstanding tradition of government subsidising of production and consumption of animal products. Even though Swiss agriculture has competitive disadvantages, Switzerland is «self-sufficient» in most important animal products and even exports dairy products such as cheese. This is due to price support by import restrictions and tariffs, and direct income payments. Globally, Switzerland occupies a leading position with respect to the support of agriculture, as measured by the OECD Producer Support Estimate (OECD 2015).

1.1.1 State of research in RF I: innovations & scenarios

Simulation and scenario analyses have become popular for organizational planning and participatory exercises (e.g. Grösser & Bürgi 2014, Grösser & Jovy 2015). However, they are still little used in environmental impact assessment (Duinker & Lorne 2007). The authors recommend simulation and scenario analysis as a suitable method to explore options for environmentally friendlier futures and encourage researchers to use this technique. System Dynamics (SD), which is used as a simulation technique in this project, is a computer modelling methodology to represent and analyse complex nonlinear dynamic feedback systems to generate insights and improve system performance (Morecroft 1984, Warren 2008, Grösser 2012, 2015). The SD modelling follows a scientific process (Grösser & Schwaninger 2012): definition of the problem; development of the mental model; development of alternative scenarios and calculation of potential improvements; validation of the model; quantification of the model; collection, analysis and interpretation of the simulation data; evaluation and provision of implications for improvements.

An integration of sustainability aspects including economic, environmental and public health criteria as suggested in the Sustainable Development Goals (UN 2015) along the food chain has rarely been attempted. Such a comparison of sustainability attributes of current and possible innovative new value chains and their critical reflection and discussion with stakeholders provides a basis to develop recommendations for policy making and for stakeholders along the chain, for instance in gastronomy, to promote more environmentally-friendly meals.

1.1.2 State of research in RF II: PRODUCTION & PROCESSING

The entire food chain encompasses agriculture, suppliers, food processers, traders, retailers, gastronomy and the final consumers. In Switzerland, more than 500,000 employees work in the food chain (BFS 2010) and from a total of 100,000 workplaces, more than 50,000 are farms and ca. 2,500 are food processors. Agricultural production and food processing are characterised by oligopolistic market structures. For instance in the dairy market, in 2014, the 22,500 dairy farmers produced 3.54 million tons of marketed milk while four processors shared 57% of the dairy market (SMP 2015). The oligopolistic market structures facilitate the value chain analysis.

In RF II production & processing, the environmental impacts of production and processing of animal products along the food chain are assessed by life cycle impact assessment methods (LCA). LCA has been used internationally for meat and dairy products (e.g. Cederberg & Mattsson 2000; Basset-Mens & van der Werf 2005; Thomassen *et al.* 2008), in Switzerland for instance for beef, pork and poultry (Alig *et al.* 2012) and dairy farms (Hersener *et al.* 2011). At each stage along the food chain, options to reduce environmental impacts can be identified and compared by LCA. Most studies focus on the *status quo* conditions and only a few compare alternative scenarios. Using such a scenario-based approach Basset-Mens & van der Werf (2005) compare environmental impacts of different pig production systems in France and identify relevant processes for improvement. Alig *et al.* (2012) provide references for optimization of beef, pork and poultry fattening systems in Switzerland.

A weakness of current LCA for agricultural systems is that land use related impacts on biodiversity have so far not been adequately integrated and trade-offs between production intensity and biodiversity are not made transparent. The existing approaches tend to oversimplify the dynamics and complexity of interactions between species and habitats (Souza *et al.* 2014).

A great share of the agricultural land use related impacts on biodiversity is caused by intensive animal production, for example through ammonia emissions and a shift from forage towards concentrate-based animal production systems, not only in the low lands but also in mountainous regions, thereby bringing additional nitrogen into sensitive ecosystems (Stöcklin *et al.* 2007). A reduction in intensity of the animal production systems is indispensable to reduce the nitrogen surplus (Jan *et al.* 2013) and to mitigate associated impacts on biodiversity and other environmental categories.

The need to include agricultural land use related impacts on biodiversity in LCA is particularly evident in Swiss milk and beef production, because 60% to 75% (without and including alpine pastures, respectively) of the agricultural land in Switzerland are permanent grassland, mainly used for cattle. The current trend is towards more intensive production systems (BLW 2014). Arable land is increasingly used for animal feed, while permanent grassland is either abandoned or intensified. On the one hand, in sub-alpine to alpine regions about one third of pastures have been abandoned between 1980 and 2000 (Gotsch *et al.* 2004). This leads to land cover changes (Baur *et al.* 2006) including encroachment by nitrogen fixing species such as green alder (*Alnus viridis*) influencing the water budget, nitrogen inputs and biodiversity (Inauen *et al.* 2013; Hiltbrunner *et al.* 2014). On the other hand, in the mountain regions an intensification can be observed, similar to that in the Swiss plateau in the 1960ties and 1970ties (Stöcklin *et al.* 2007). Both developments lead to biodiversity losses (Niedrist *et al.* 2008) affecting vulnerable biodiversity hotspots.

Most environmental impacts of the animal production occur at the farm level (e.g. Jungbluth *et al.* 2015). However, processing of meat and dairy products is also relevant for the use of natural resources, such as energy, water, etc. Environmental impacts of industrial milk, dairy and meat processing can be analysed using a resource efficient and cleaner production (RECP) approach where optimisation potentials of different processes are identified and compared (UNEP 1996) using LCA indicators. For production processes, this involves, among other things, conservation of raw materials, reduction of emissions and elimination of toxic raw materials (UNEP and DEPA 2000). As an example, slaughtering of cattle involves washing of trucks, requiring large amounts of water, stunning and bleeding producing effluent with high organic contamination and refrigeration with high electricity consumption. RECP has been used for various dairy and meat processing activities, such as poultry slaughterhouses (Kist *et al.* 2009), fish processing (Thrane *et al.* 2009) and milk processing (Özbay & Demirer 2007).

1.1.3 State of research in RF III: DEMAND & CONSUMPTION

Human actions and decisions in daily life are affected and shaped by «resource cultures», standards, routines and practices that are the fundamental drivers of resource consumption (KRU 2014). To approach resource-light food patterns, the standards, routines and practices affecting and shaping every day actions and decisions around food have to be transformed. Behavioral economics and applied psychology address the question of how to alter actions and decisions. There are a broad variety of psychological and other behavioral models, and techniques to initiate and stimulate behavioral changes (e.g. Kaufmann-Hayoz *et al.* 2001, Bartholomew *et al.* 2011, Michie 2014). In classification systems, a basic distinction is made between techniques changing preferences and techniques activating behavioral change (Mosler & Tobias 2007). In this study we focus on models and techniques aiming at directly activating behavioral change.

Tobias (2015) differentiates between two kinds of action determinants: preconditions of an action and evaluation of action consequences. Important preconditions are awareness (of a problem, a situation) and feasibility (of, for instance, resource-light eating alternatives). Four categories of evaluating action consequences that belong either to the realm of rationality or that of emotion are distinguished: instrumental evaluation (rational), affective evaluation (emotional), norms and values (rational), and needs and tension states (emotional). Tobias (2015) proposes three starting points to change psychological action determinants – situation, person, and population – and three starting points to change objective characteristics – infrastructure, market, and rules. In this study we are interested in those aspects that promise a direct impact on the behavior of consumers and chefs. These are those problem characteristics and those techniques that relate to **feasibility** and appeal to **emotions**. The objective is to establish action preconditions, that resource-light eating and cooking is easily feasible, highly enjoyable and satisfying.

Despite these suggestions from psychological models, many policy instruments rely exclusively on information and therefore require that consumers make a motivated, voluntary choice

to reduce the negative side-effects of their consumption behaviour. The available evidence suggests that although consumer awareness is improving (e.g., Siegrist *et al.* 2015), purely information-based policy instruments may never become sufficiently effective to reach the policy goals they are intended to promote (e.g., see Aschemann-Witzel 2014; Grunert & Wills 2007; Orquin & Scholderer 2015; Reisch *et al.* 2013; Thøgersen 2014). User oriented innovations are needed (Grunert *et al.* 2008).

We found a single study that investigated the relationship between the (labelled) environmental impact of meals, consumer demand for meals and customer satisfaction with meals in a real-life food service setting (Visschers & Siegrist 2015; the study was part of the ETH and SV Group initiative «Sustainable catering at ETH Zurich»). No robust relationship was found between labelled environmental impact on the one hand and consumer demand or customer satisfaction on the other.

The literature on the acceptability of complex meals can be divided into four streams: (1) studies that predict the overall acceptability of multi-course canteen meals from the acceptability of their component dishes (e.g., Hedderley & Meiselman 1995); (2) detailed sensory evaluations of specific product-product combinations (e.g., Aaslyng & Frøst 2008; Paulsen *et al.*, 2012); (3) investigations of situational influences on food choice and consumption that used open-ended response formats (e.g., Jaeger *et al.* 2009, 2011) and (4) studies of the «fit» between the meal centres, side dishes and beverages that constitute a complex meal (e.g., Scholderer *et al.* 2013).

A recent behavioral economics online survey in Switzerland shows that away from home, consumers are less inclined to pay attention to sustainability arguments (Kamm *et al.* 2015). The positive effects of an aesthetic presentation and illustration on food choice are verified by Kamm *et al.* and by Stöckli *et al.* (forthcoming 2016). Both experimental investigations validate the importance of focusing on **positive emotions**.

The demand for innovative resource-light meals has to be met by a corresponding supply. The catering industry and the chefs are key actors. However, sustainability criteria appear to play a negligible role in the recipe formulation and service planning processes of restaurant and canteen chefs (e.g., see Kawasaki *et al.* 2015; Ottenbacher & Hatherington 2009). We found only single studies investigating the behaviour of chefs and decision-makers in the food service industry explicitly linked to reducing or replacing animal products (e.g., Summers 2013). There is more literature available on healthy menu production in general, but this usually relates to multiple issues like salt, sugar, fat, or cholesterol reduction, increase of wholegrain products, or more generally to portion size or calorie reduction (e.g., Reichler & Dalton 1998). Hardly any studies include environmental motivations for reducing animal products or increasing fruit and vegetables. Among the most important obstacles to producing healthier menus is customer expectation, in particular regarding taste, presentation (labelling), familiarity, and portion size (Condrasky *et al.* 2007). Furthermore, inflexible guidelines, storage problems (short shelf life, Glanz *et al.* 2007), staff skills, and training and costs (Obbagy *et al.* 2011) are mentioned. In general, chefs are aware of environmental issues and express positive attitudes and their responsibility to offer healthy menus (e.g., World Association of Chefs Societies 2015), but that ultimately, customers should be self-responsible and not restricted in their choice (e.g., Middleton 2000).

The Swiss vocational education system is generally appraised as highly relevant for the economic success of the country. Yet, empirical studies are rare and results controversial (Wettstein *et al.* 2014). Concerning gastronomy and the catering industry, we could not find any empirical research studying effects and impacts of vocational education of e.g. chefs.

1.1.4 State of research in RF IV: POLICY & PUBLIC HEALTH

Recent research suggests that the consumption of some animal products (e.g. red meat) is associated with an increased risk of non-communicable disease (NCD) such as cardiovascular disease, diabetes and cancer (Micha *et al.* 2012; Abete *et al.* 2014; Bouvard *et al.* 2015). In light of the growing and the ageing population, NCDs will substantially gain importance in the future

(BAG 2015). Differences in diet may contribute to the unequal distribution of diseases in the population (Faeh *et al.* 2010, 2011). The current scientific evidence suggests that the so-called «Mediterranean diet» pattern has the largest potential for reducing the risk of NCDs and reducing their burden on the population (Estruch *et al.* 2014). The Mediterranean diet recommends the consumption of only limited amounts of red meat and moderate amounts of dairy products. However, these recommendations seem not to fully apply to Switzerland (Vormund *et al.* 2015).

While the often detrimental effects of agricultural policy on the use of natural resources and the environment are well known (e.g. OECD 2015) and thoroughly investigated for Switzerland (e.g. Bosshard *et al.* 2011), it is less clear how government policies affect, for example via agricultural commodity markets, the consumption choices, diet patterns and human nutrition outcomes. A study by Rickard *et al.* 2013 indicates for the United States that the stimulating influence of agricultural policies on caloric intake has diminished over time. In the EU context, a study by Civic Consulting (2014) modelled different diets and performed a cost-benefit analysis of selected policy options. The conclusion is that the switch to healthier and more sustainable diets would lower greenhouse gas emissions and the prevalence of obesity.

Presumptions about the relationships between policies and health, such as «cheap food leads to obesity», are implicit or explicit in public policy discussions. Yet, there is no robust empirical evidence and the effects of food and (agricultural) policies on food preferences, diet and health (inequalities) are not well understood. More attention needs to be paid to understanding and promoting policy actions that support nutrition-enhancing food systems as a whole.

We are not aware of any scientific study analysing the consequences of a decreased demand for animal products. Such a development would affect the agriculture and food sector in a similar way to a continued market opening. Various studies have investigated the effects of partial liberalisations (e.g. ETHZ 2010, BAK Basel 2012). Results indicate that structural change in agriculture and in the entire food value chain would accelerate. A decline of the domestic demand would be a major challenge for agriculture, the entire food sector and policymakers.

To fully realize the potential benefits from a reduced consumption and production of animal products, wise policy-making (and the will to do it) is necessary. To overcome existing prejudices and policy stalemates (Baur 2014) new forms of communication and dialogue are needed (Pörksen & Schulz von Thun 2014, Plate 2015). In the EU context, Walls *et al.* (2016) suggest that there is a need for communication and agreement of clear high-level nutrition guidelines to address nutrition-related health concerns via policy, particularly obesity and non-communicable disease in the EU.

1.2 Personal contribution to research in the field

The project builds on the **«Bedürfnisfeld»**(need field)-approach, an action oriented inter- and transdisciplinary sustainability research approach that was developed during the SNF «Schwerpunktprogramm Umwelt SPPU» between 1992 and 2002 (Minsch *et al.* 1996; Mogalle 2000; Häberli *et al.* 2002). In this approach, the problem setting is conceptualised by human needs («Bedürfnisse»), such as nutrition, housing, mobility, etc. The present project builds on the «need field» nutrition (Minsch & Mogalle 1998, 2000; Mogalle 2000). The analysis relates to the nutrition system and includes the environmental, economic, political, cultural and public health context.

For a future-oriented animal production, food processing, consumption and healthy nutrition, innovations along the entire food chains are required. Minsch *et al.* (1996) identify four types of **innovation** perspectives: process-, product-, function- and need («Bedürfnis»)-oriented innovations. Potentially beneficial innovations for public health, the environment and natural resources are often not successful due to **constraints**. Minsch *et al.* (1996) distinguish between four kinds of constraints: technical, cost, utility and percipience (including cultural) constraints.

1.2.1 Personal contributions in RF I: INNOVATIONS & SCENARIOS

A scenario analysis that was conducted to investigate the scope for an animal production in Switzerland, guided by austere ecological restrictions, showed that the production of meat would diminish by ca. 50% and the production of milk by ca. 20% (Baur 2012a). A further preliminary study indicates that the orientation of Swiss agricultural production on dietary guidelines could lead to a significant decrease of the natural resource use (Baur 2012b).

1.2.2 Personal contributions in RF II: PRODUCTION & PROCESSING

At FiBL a new Life Cycle Impact Assessment (LCIA) method has been developed to assess agricultural land use related biodiversity impacts of different production intensities (Meier *et al.* 2015a; Meier in prep.). Since the method takes into account landscape structural parameters, regionalized impact assessments of agricultural land use are feasible, allowing spatial planning of agricultural production and biodiversity conservation. Furthermore, FiBL has profound expertise in the environmental sustainability assessment of farming systems using LCA. Besides carrying out LCA of agricultural processes and products including animal production systems (Schader *et al.* 2011, Schader *et al.* 2012, Meier *et al.* 2014a, Schader *et al.* 2014) the main research focus has been on adapting and improving LCA to better differentiate farming systems of different production intensities (Meier *et al.* 2012, Meier *et al.* 2014b, Meier *et al.* 2015b).

At Agroscope, standard costs for all common dairy production systems for sizes between 20 and 100 milk cows have been developed at the full cost basis (Gazzarin *et al.* 2005). Standard costs may differ substantially from actual or historical costs (Lips *et al.* 2015). Therefore, based on the Swiss Farm Accountancy Data Network (FADN), Lips (2014) derived full costs for dairy production applying a disproportional indirect cost allocation. Compared to Thomassen *et al.* (2009), who focussed on the gross value added, this approach can address indirect cost items such as labour, machinery or buildings, which together account for around 72% of the full costs of dairy production (Zorn *et al.* 2015).

At the Institute for Ecopreneurship at the FHNW, research and development activities encompass the optimisation of production processes in terms of material and energy use and substitutions, the development of new products and devices and life cycle and risk assessments. LCA, Resource Efficient and Cleaner Production and cost-benefit approaches have been applied in various fields, including the removal of organic micropollutants such as antibiotics from wastewater and drinking water (Gross *et al.* 2015; Remy *et al.* 2015), in an on-going UNIDO-funded project on RECP in the Ukraine including food processing industries, in RECP consultancy services for Swiss companies through Reffnet.ch (confidential) and in LCAs of organic photovoltaics for energy production (Zimmermann *et al.* 2012).

1.2.3 Personal contributions in RF III: DEMAND & CONSUMPTION

Scholderer has published more than 50 peer-reviewed journal articles on food choice and consumption, many of them with a focus on health and sustainability, and most of them focusing on meat or dairy products. Of particular relevance to the proposed project is his work on acceptability and choice of complex meals. He has developed various survey methods and statistical modelling techniques for choices of complex meals (e.g., Scholderer *et al.* 2013; Fenger & Scholderer 2015). He has also built up experimental and observation laboratories in which complex meal choices are regularly studied, including ConsumerLab and its successor, the AU Cognition and Behavior Lab at Aarhus University and FoodObservatory (a commercial research canteen with experimental kitchen, automated customer tracking and surveying, sales data linkage and video observation systems) at AgroFoodPark, Aarhus. One of the products the FoodObservatory team optimised was a soy-based meat-replacement product with low environmental impact (Soy4You, Agger Foods A/S) that afterwards won the Danish Innovation Prize.

1.2.4 Personal contributions in RF IV: POLICY & PUBLIC HEALTH

Baur has investigated the relationships between agricultural policy, structural change in agriculture and the environment in Switzerland since the 1990s, with a growing emphasis on the constraints that impede environmentally beneficial policy reforms (Baur 1995, 1998, 1999, 2000, 2003, 2005, 2006, 2011, 2012a,b, 2014, 2015; Baur *et al.* 1995, 2006, 2007; Baur & Nitsch 2013; Gellrich & Baur *et al.* 2006, 2007, 2008; Rentsch & Baur 2008).

Minsch has explored and discussed prerequisites and approaches of a participatory policy making and of institutional innovations for sustainable development (Minsch *et al.* 1998, Minsch 2001, Minsch *et al.* 2011, Held & Minsch 2013).

Schluep Campo has on several occasions analysed the impact of agricultural (trade) policies on dietary patterns in the Swiss context. Her policy work has focused on animal products (Schluep Campo & Jörin 2005, Schluep Campo & Beghin 2006, Schluep Campo & Jörin 2008, Schluep Campo & Jörin 2009).

Fäh has examined the potential impact of trends in diet over the past 30 years on changes in mortality in Switzerland and derived possible public health implications from these results. He has also analysed the association of educational level, income and occupational class on NCD mortality and diet as well as the cultural variations of these associations within the country (i.e. between language regions) (Faeh *et al.* 2010; Faeh *et al.* 2011).

1.3 Detailed research plan

The research plan is first outlined for the entire project and then developed in detail for each work package specifically.

1.3.1 Research plan of the entire project

Defining the Problem

From an environmental perspective, it seems advisable that Swiss agriculture should become ecologically more sustainable and that in particular, livestock density should be reduced. From a public health perspective, it seems appropriate that the Swiss population reduces the per capita consumption of animal products. However, reduced consumption will inevitably result in lower domestic demand for animal products and this in turn will have economic consequences for the whole food chain, from consumption back to catering industry, retailers, processing industries, farmers and the associated supply chain actors such as the feed industry.

In this project we will look at the environmental, economic and public health implications associated with animal production and consumption and possible future scenarios from both sides of the food chain: from the demand and in particular the growing away-from-home consumption side, and from the agricultural production side, including the associated processing industry. The project focuses on innovations for a future-oriented consumption and animal production. Innovations include activities in the «need field» nutrition that might significantly lower the negative impacts on the environment and natural resource use, and public health.

Leading research questions and objectives

How can, in a liberal society, food patterns be effectively altered towards resource-light and healthy eating habits with fewer animal products? What consequences and developments can be expected from lower domestic demand for animal products, in particular in the agricultural sector, where the production of meat and dairy generates the major part of the farm's income? What is the need for action along the animal product value chains of milk and dairy products and meat (beef, pork, and poultry)? Which innovations in the catering industry, in the food processing industry, in agriculture and in associated educations, as well as in the (agricultural) policy and governance sphere might contribute to significantly decreasing the detrimental impacts on environment and use of natural resources and on public health? Which are the most important constraints for those innovations and how can they be surmounted? How can the food economy and

agriculture be incentivized and supported by government to adapt to a future-oriented food culture and to a lower domestic demand for animal products?

The primary objective of the project is to develop strategies and recommendations to overcome constraints and to foster the implementation of innovations in the animal products value chains that are beneficial for environment and use of natural resource and for public health.

Hypotheses

Policy: The current agricultural policy that supports the farm sector and stimulates animal production has broad acceptance. Incoherent and conflicting agricultural and related policies are major constraints for innovations with positive impacts on the environment and public health. The potential synergies between environmental and health objectives are significant.

Economy: Agriculture and the animal product food processors produce mainly for Swiss consumers. If the demand for Swiss animal products decreases as a consequence of changed nutrition habits, this would accelerate the structural change in the entire food chain and in particular in agriculture that depends to a major extent on the production of milk and meat.

Society: The sympathies for the farm sector and the preferences for regional and national products that can be observed in most countries, favour animal production and consumption in Switzerland. Nevertheless, the potential for innovations in the food chain and for corresponding significant impacts on public health and environment is considerable. Main reasons are: growing prosperity, education and health concerns.

Food culture: Swiss food culture is traditionally based on animal products; a change of food culture faces serious obstacles: habits, pleasure, emotions, identity, nostalgia – food means «to be home». The main obstacle to beneficial innovations thus is the deep-rooted Swiss food culture, characterised by standards, routines and practices that affect individual everyday actions as well as economic decisions in the animal product chains and in policy making.

«Climate change» in the gastronomy: The development of a resource-light and healthy food culture with fewer or without animal products requires a «climate change» in the food service industry. Strategies to overcome constraints and to foster the implementation of innovations have to be found on several levels: business, policy, consumers, education, and civil society.

Research approach

Our research approach is inter- and transdisciplinary in that it builds upon a collaborative framework of engineers, agricultural, social, environmental and economic scientists involving important stakeholders along the animal product value chains from producer associations (e.g. Swiss Milk), to major companies in the food industry (e.g. Emmi) and the food service industry (e.g. SV Group, chefs) and to vocational education (e.g. schools, instructors).

Target audience

The specific target audiences are: meat and dairy processors; operational decision makers (chefs) and strategic decision makers (head chefs, head of culinary development or menu planning) of major gastronomy providers, caterers, smaller and larger restaurants and take-aways; instructors in vocational education; policy makers in the fields of agriculture, trade, nutrition, public health, research and (vocational) education; NGOs; broad public.

Expected results

The project results are strategies to overcome constraints and to foster the implementation of innovations in the animal product value chains. In particular, we aim at developing evidence-based recommendations, guidelines and tools for the target audiences.

1.3.2 Detailed research plan in RF I: INNOVATIONS & SCENARIOS

In the research focus RF I the following research questions will be addressed:

Innovations: What is the state of process-, product- functional- and need(«bedürfnis»)-oriented innovations in the value chains of production, processing and consumption of milk, dairy products and meat in Switzerland and in Europe? Which innovations do we look at in the project?

Exogenous trends: Which national and global trends are relevant for the project, e.g. technology, market (EU, global), policy (agriculture, environment, trade, health, animal welfare), pressure groups (lobbies, NGOs), lifestyle and consumption habits (convenience food, away from home consumption, dietary guidelines), natural resources use (energy, land, water) and the environment (eutrophication, acidification, global warming potential, biodiversity), health (multi-resistant bacteria, obesity), population growth? Which trends do we consider?
Scenarios: Which innovations and trends do we combine to relevant scenarios and how? What is a reasonable time horizon for the scenarios?
System model and simulating scenarios: How has the system model to be constructed to represent and map the relevant activities in the animal product chains (system boundaries, elements, relations)? Which are the relevant activities concerning natural resource use and economic performance? How has the system model to be designed to take into account innovations in consumption, food processing, agricultural production and policy? Which tangible information (data, assumptions) is necessary?

Detailed research plan WP I.1: Determining innovations and scenario building (FHNW)

The objectives of WP I.1 are: (1) to identify innovations in the animal product food chains, (2) to decide which exogenous trends we will consider for scenario building and (3) to construct scenarios that we will analyse in this project.

We will focus on innovations coming from both ends of the food chain: **process oriented innovations**, e.g.: enhancing resource and energy efficiency, such as milking with heat recovery; water saving appliances; reducing loss and waste production; using technologies such as phytase to reduce the excretion of phosphorus in pork production; **product oriented innovations**, e.g.: products with reduced environmental and public health impacts, for instance grassland milk; lowering animal fat contents in convenience products; **function oriented innovations**, e.g.: limiting livestock production to pastures and by-products (Röös *et al.* 2016, Baur 2012a); substituting animal products in menus, for instance by vegan sausages or a vegan Fondue; **need oriented innovations**, e.g.: decreasing the demand for animal products, for instance by increasing the offer of attractive menus in gastronomy, with less or without animal products.

We will identify innovations and select exogenous trends on the basis of (1) literature research, (2) interviews with experts and (3) a workshop with selected stakeholders from the food chain. Selected innovations and trends will then be combined to at least three scenarios: a business as usual scenario (BAU), a best case scenario where ecologically favourable trends and beneficial innovations optimally interact (BEST CASE) and a worst case scenario where ecologically undesirable trends dominate and innovations can only partially be implemented (WORST CASE). The best case scenario is characterised by e.g.: a decrease of the per capita and the total consumption of animal products, a decrease of energy and water consumption, by an agricultural land use that is compliant with biodiversity conservation goals. Most important is a clear, transparent and reproducible description of the assumptions underlying the scenarios.

Detailed research plan WP I.2: Simulation model and scenario analysis (BFH)

The objectives of WP I.2 are: (1) to construct a system dynamic simulation model of the meat and dairy products value chains from production to consumption (gastronomy) and (2) to simulate the defined scenarios.

In the first stage, the mental model/qualitative model and its structure will be elaborated in workshops with the whole research team participating. The drafted model structure will afterwards be presented and discussed with the relevant stakeholders (such as Swiss Milk, Emmi, Proviande, Bell, Micarna, etc.) in a model validation workshop. The following task is to quantify the relationships within the model and to finalise it for the simulation (baseline model). The models of the value chains milk and dairy products, beef, pork, and poultry will be quantified partly with the help of secondary data (e.g., Proviande 2014) and partly with data from this project.

When the data have been collected and entered into the model, the first step will be to simulate the status quo (BASIS). The scenarios (BAU, BEST CASE, WORST CASE) will be simulated using the results in particular of the work packages WP II.1, WP II.2 and WP II.3 in the research focus II PRODUCTION & PROCESSING. Thus, environmental impacts and financial costs of agricultural production and animal product processing along the value chain can be used to simulate and compare the status quo (BASIS) and the different scenarios (BAU, BEST CASE, WORST CASE).

1.3.3 Detailed research plan in RF II: production & processing

In the research focus RF II the following research questions will be addressed:
Environmental impacts along the food chain: What are the environmental impacts of the agricultural production of animal products (milk, beef, pork, poultry) and processing of these products on the natural resources use (energy, land, water) and on the environment (eutrophication, acidification, global warming potential, human toxicity, ecotoxicity and biodiversity), in Switzerland and in countries where imported concentrates are produced? How do the scenarios defined in WP I.1 differ along the food chain and which are impact hot spots? What production intensity is appropriate for different regions in Switzerland?
Production costs along the food chain: What are the full costs of agricultural milk, beef, pork and poultry production and processing of these products? How do the scenarios defined in WP I.1 differ along the food chain and which are most important cost drivers? What are the costs of specific measures to reduce environmental impacts?
Resource-light menus and their cost: How do menu options differ in their ecological footprint and what is the specific contribution of milk, dairy and meat products? Does the agricultural production method of animal products significantly affect the ecological footprint of meals? What is the cost to reduce the footprint of a specific meal by x%? Which are important synergies and trade-offs of the defined scenarios between different environmental goals?

Detailed research plan WP II.1: LCA agricultural production (FiBL) and food processing (FHNW)

The objectives of WP II.1 are: (1) to assess the environmental impacts of the Swiss agricultural milk, beef, pork, and poultry production under different production intensities in different regions in Switzerland, with a special emphasis on land use related impacts on biodiversity using LCA (FiBL); and (2) the processing of these products (FHNW) under previously defined scenarios (WP I.1) making transparent synergies and trade-offs between different environmental goals.

Agricultural production (FiBL): Impacts on the environment, especially biodiversity, of different production intensities of milk and beef production (suckler cow, forage or concentrate based systems) in several representative landscapes in the Swiss plateau, the Alps and the Jura mountains will be assessed in order to identify the production intensity that can still be maintained in the different regions assessed under the given biodiversity protection goals. Pork and poultry production systems are mainly located in the Swiss plateau and rely on concentrate imports. Their impacts on biodiversity also occur in the areas where the fodder is produced. For these systems, impacts on biodiversity and other environmental indicators for different production intensities will be assessed under the assumption of fixed origins for the production of the different fodder components within the ration. To assess land use related impacts on biodiversity, we will apply a newly developed LCIA (Life Cycle Impact Assessment) method that is derived from empirical data (Meier *et al.* 2015a; Meier, in prep.). It combines land use intensity (nitrogen, pesticide input) and landscape structure parameters (area based percentage of semi-natural habitats within a landscape, geo data integrated via GIS) to assess the impact on species groups.

To identify trade-offs and the potential for optimising the system environmental sustainability, the biodiversity assessment will be complemented by the quantification of further relevant impact categories (energy use, global warming potential, eutrophication and acidification potential, human toxicity and ecotoxicity).

Since milk and beef production in Switzerland are still interlinked and a change in output in the milk production system will affect meat production, a consequential LCA approach will be applied. A consequential LCA approach has been suggested for the assessment of milk production systems as it provides a more conclusive picture of the environmental sustainability (Kristensen *et al.* 2011; Flysjö *et al.* 2012; Zehetmeier *et al.* 2012; Meier *et al.* 2015b).

Food processing (FHNW): Environmental impacts of milk and meat processing will be analysed using a resource efficient and cleaner production (RECP) approach to highlight optimisation potential with regard to environmental trade-offs such as energy and water demand at company level. Cleaner production (CP) has been defined by the United Nations Environmental Programme as 'the continuous application of an integrated preventive environmental strategy applied to processes, products and services to increase overall efficiency and reduce risks to humans and the environment' (UNEP 1996). The engineering based CP assessments of milk and meat processing (UNEP and DEPA 2000) will deliver environmental profiles of milk and meat processing of *status quo* compared to best available technologies (BAT) in the industry.

Detailed research plan WP II.2: Cost analysis of agricultural production (Agroscope) and food processing (FHNW)

The objective of WP II.2 is to estimate the full costs of (1) the agricultural milk, beef, pork and poultry production (Agroscope) and (2) the processing of these products (FHNW) under previously defined scenarios (WP I.1) to estimate trade-offs between different scenarios.

Agricultural production (Agroscope): Full cost analyses will be carried out distinguishing two costing types. Firstly, standard costs, indicating target costs under efficient operating conditions, will be derived taking advantage of Agroscope's standard costs calculation system including all common dairy production systems for sizes between 20 and 100 milk cows (Gazzarin *et al.* 2005). Secondly, based on the Swiss Farm Accountancy Data Network (FADN), full costs for dairy production will be derived, representing actual costs, also denoted as real or historical costs (Lips *et al.* 2015). The framework developed in the ECON'ENTAL project in NRP69 (Jan 2013) consisting of an economic-environmental assessment will be applied. Furthermore, we will derive conclusions about cost-effective strategies to reduce intensity in animal production.

Food processing (FHNW): At the milk and meat processing level, optimisation potentials such as e.g. more water-efficient approaches will be compared with *status quo* in terms of cost per relevant unit processes, e.g. per m^3 milk produced. Cost of processes will be estimated based on literature values as well as in-house expert knowledge at FHNW and verified through interaction with relevant industries in the Swiss food processing such as Swiss Milk, Emmi and Micarna.

Detailed research plan WP II.3: Resource-light menus and their cost (FHNW)

The objective of WP II.3 is to integrate the results from the LCAs and costing analyses over the value chain and compare different scenarios calculated for specific menus.

Whole food chains of milk, dairy products and meat including at least fodder production, milk and meat production (farm), milk and meat processing in the food industry and catering (transport, cooling, processing, packaging) (e.g. Binder *et al.* 2012) will be analysed and compared in terms of environmental impacts and economic costs. The environmental impact will be calculated on a per menu basis as a link to WP III.1 ('menu choice'), WP III.2 ('menu offer') and WP III.3 ('vocational education').

This WP II.3 will run in parallel to WP II.1 and WP II.2 in order to guarantee an integrative and consistent analysis along the food chains allowing (i) identifying the most important environmental impacts along the entire food chains, (ii) considering alternatives to mitigate such impacts and (iii) calculating costs of scenarios. Environmental impacts of non-animal products (vegetables, salads etc.) in each meal will be estimated based on available literature values.

1.3.4 Detailed research plan in RF III: DEMAND & CONSUMPTION

In the research focus RF III the following research questions will be addressed:

Consumers: How can the consumer's menu choice be influenced in such a way as to motivate them to choose resource-light dishes with fewer or without animal products more frequently?
Chefs (operational level): What is it that determines a chef's menu production decision? How can the decisions of chefs be influenced in ways such that they substantially increase the offer of attractive dishes with fewer or without animal products? What is needed to foster professional ambitions to prepare attractive resource-light menus in all gastronomic sectors, from the fast food take away to the five star gourmet cuisine?
Decision makers (strategic level): What do the cuisine guidelines of the decision makers in catering depend on? How can they be influenced in order to improve the operating parameters to prepare attractive dishes with less or without animal products?
Vocational education (long-term perspective): What is the actual importance of a cuisine that incorporates fewer or no animal products in the vocational education of chefs? How can the vocational education be developed so as to enhance the prospective professional's motivation and know-how to cook with fewer or without animal products? How can the knowledge that is required to prepare resource-light menus best be taught and communicated?

Detailed research plan WP III.1: Menu choice (ZHAW/CCRS/SV Group)

The objectives of WP III.1 are: (1) to design the menu choice experiment (recipes, marketing, etc.) together with the canteen team (chefs, strategic decision makers); (2) to assess consumer demand for innovative, resource-light meals within the experimental framework; (3) to assess the consumers reasons for menu choice and their satisfaction.

The leading working hypothesis postulates: The larger in number and the more (natural) appealing the offer of attractive menus with fewer or without animal products is, the more frequently such menus will be chosen. The experiment is based on the more recent approach that «the right choice is also the best choice»: The aim is to raise the quality of the resource-light menus to a level where they are clearly superior to their less desirable alternatives by appropriate menu design and recipe formulation (Frøst *et al.* 2015, Kawasaki & Shimomura 2015, Olsen 2015).

First, the recipes, the design and marketing of the menus will be elaborated in a transdisciplinary process with the chefs and the strategic decision maker of the canteen.

Secondly, the menus will be test-marketed during a time window of altogether three months (using a multi-period crossover design) in a canteen operated by SV Group Switzerland. The test market will follow a multi-period ABABAB cross-over design. The basis period in the design will consist of two working weeks (= 2x5 days). In each basis period, the same basic sets of menu choices will be offered in the same time sequence, cycling through for two weeks until the schedule is completed and then starting anew. Recipes and preparation protocols for each condition and meal will be standardised over the different repetition periods. Throughout, ingredient use in the canteen kitchen will be monitored and logged. The basis for estimating consumer demand will be the sales transactions extracted from the cash register database. The data will be analysed by means of random logit models, stratified according to the days in the basis period of the crossover design. Available customer IDs will be utilised to assess the degree to which demand for resource-light meals is concentrated in particular customer segments.

Thirdly, data about the menu choice, meal satisfaction and ratings of sensory acceptability will be collected on site, using computer-assisted personal interviewing (with a minimum sample size of n = 50 per day).

Detailed research plan WP III.2: Menu offer (ZHAW)

The objectives of WP III.2 are: (1) to understand menu production decisions of chefs and strategic decision makers in catering; (2) to find out how to improve operating parameters and how to foster professional ambitions to plan and prepare attractive menus without or with fewer animal products.

First, in-depth qualitative personal semi-structured interviews with 20 chefs and 10 strategic decision makers will be conducted. With an inductive approach, motives, habits, expectations,

competences of the interviewees as well as structural barriers or facilitations in their work or organisational environment (infrastructure, organisational guidelines, planning tools) will be explored and content-analytically analysed. These behaviour determinants will be interpreted in the context of explanatory models from environmental and health psychology (e.g., attitude formation, action and decision theories). From this analysis, we will derive a set of basic hypotheses on (a) how decisions are formed and how behaviour is affected, and (b) which target measures to foster changes in menu offer are most promising. (For example, contextual measures related to work conditions, regulations, infrastructure or measures addressing the decision-maker's motivation directly. Expected relevant decision and behaviour determinants are: education and know-how, individual preferences, professional ambitions, curiosity to explore new trends, expectations about the guests' requests, general environmental, health-related and cultural knowledge, attitudes, and values, role of social and professional network, infrastructure, institutional guidelines and accessibility, availability, variety and prices of products.

In a second research phase, these hypotheses will be tested in a broad sample of chefs (n = 200) and strategic decision makers (n=30). A mostly standardized and structured survey will be conducted by e-mail. Participants will be reached through organizations and professional networks (e.g., national associations, hotel unions, guilds). The relative strength of the determinants and the potential of possible measures and related obstacles will be assessed using regression-analytic methods, and restaurant types are compared.

The result of study 1 (qualitative interviews) will be a set of behaviour determinants described for the two target audiences (chefs and strategic decision maker) in detail. The results of study 2 (survey) will be a model describing the interrelation and quantified relative strength of the behaviour determinants as well as the starting-points of possible behaviour changing measures.

Detailed research plan WP III.3: Vocational education (ZHAW)

The objectives of WP III.3 are: (1) to asses the actual importance of a cuisine that incorporates fewer or no animal products in the vocational education and training of chefs; (2) to find out how the young prospective chefs can be motivated to acquire know-how to cook with fewer or without animal products; (3) to elaborate didactic principles for teaching resource-light cooking.

The empirical research will be conducted in a vocational training school, in a transdisciplinary process, together with the management of the school (schoolmaster), the teachers and instructors and the apprentices, i.e. the prospective chefs.

In a first step, curricula (e.g. BBT 2009, BBT 2012) and teaching materials will be analysed from an environmental and health perspective with an emphasis on the significance of animal products in the education.

Secondly, in-depth qualitative personal semi-structured interviews with teachers and instructors and apprentices will be conducted. The interviews will be prepared and analysed in close cooperation with WP III.2 and partly WP III.1, methodically and thematically. The scope of the interviewed apprentices spans from the beginning of the training until the first years of professional practice after graduating. The data material will be explored following the evaluative qualitative content analysis. Furthermore, previously developed hypotheses will be checked and discussed (Kuckartz 2012). The result will be a description of attitudes, mind-sets and motivation of the trainees and the trainers, and an identification of factors that enhance motivation of the trainees and their competences to reflect upon their actions.

Thirdly, on the basis of the previous findings (analyses of curricula and teaching materials, interviews), a series of workshops and focus groups with the trainees and the trainers will be conducted to discuss the findings and to jointly develop solutions and strategies.

The results will be: an identification of the economic, social, cultural constraints that make it difficult to learn to cook with fewer animal products; ideas and concepts regarding how to overcome these constraints; didactic propositions of how to develop curricula and teaching materials.

1.3.5 Detailed research plan in RF IV: POLICY & PUBLIC HEALTH

In the research focus RF IV the following research questions will be addressed:
Agricultural and related policies: How, in Switzerland, have agricultural and related policies historically evolved and over time contributed to a diet centred around dairy and meat products? What is the current state of policies (agricultural and others)? What are the impacts of the different innovations and scenarios such as the liberalisation of the meat and dairy sectors? How should agricultural policy be further developed to become more in line with resource-light diets? Whether and how could a change in agricultural research funding support ecological innovations in agriculture, with a reduced focus on animal-sourced foods?
Public health implications: Which are the trends in consumption of animal products in Switzerland and which projections can be made? What are the possible effects of these trends, based on known associated health risks? Which public health impact can be derived from past and expected future consumption in the Swiss population regarding the prevention of NCDs? Which public health recommendations can be derived to reduce NCDs and health inequalities with an adaptation of amount and quality of animal products consumption?
Dialogic policy making: What are the prerequisites for dialogic policy making? How can stakeholders be motivated to solve problems together? What is needed to initiate a true policy dialog? What can be learned from other policy fields such as the «energy trialog» in Switzerland? What can be learned from civil society experiments such as the «denkallmend», a project to foster creativity in democratic processes?

Detailed research plan WP IV.1: Policy analysis (CCRS/ZHAW)

The objectives of WP IV.1 are: (1) to explain from a historical perspective how policies in Switzerland have evolved and contributed to a diet centred around animal products; (2) to provide an overview of the current policies and their primary impacts; (3) to assess the effects of political innovations on food consumption and nutrition of different income groups; (4) to propose strategies that bring agricultural and related policies more in line with resource-light food patterns; (5) to explore the potential of a more independent agricultural research funding.

The central hypothesis postulates that coherence among the different policy fields such as agriculture, public health or trade is necessary to achieve food patterns with fewer animal products. The primary methodologies are in-depth desk research and microeconomic policy analysis.

The historical analysis of agricultural and related policies is inspired by Popkin (2011). The overview of current policies and how they affect the environment, consumption, nutrition and possibly public health partly build on studies by Baur (e.g. 2005, 2006, 2014, 2015) and on a study by Schluep Campo & Jörin (2008). A special emphasis is on the global trend to liberalise markets and the consequences for Swiss food culture, the environment and health. This part draws from Rickard *et al.* (2013); demand elasticities are taken from Abdulai (2002) and Aeppli (2014). Starting from Aerni (2016) and his critical assessment of the theory and practice of payments for ecosystem services, propositions to bring policies more in line with resource-light food patterns are discussed. Finally, it is explored how an independent agricultural research could contribute to innovations with a reduced focus on animal-sourced foods. A study on the investment in agricultural research in Switzerland (Barjolle *et al.* 2014) provides the starting point.

Detailed research plan WP IV.2: Public health (Uni ZH/BFH)

The objectives of WP IV.2 are: (1) to give an overview of the state of research concerning the effects of different animal product per capita utilisation/consumption on disease risk and public health; (2) to identify the important controversies about health implications on animal products consumption; (3) to define and discuss public health implications of the analysed scenarios considering empirical evidence and scientific controversies.

There is a significant unexploited public health potential lying in an adaptation in animal food consumption in the Swiss population. However, the challenge will be to reach the most vul-

nerable part of the population (i.e. those with low socio-economic status) in order to reduce health inequalities. This requires a broad and integrated public health approach considering all elements implicated from field to dish. Importantly, the diet should develop towards a «Mediterranean diet» type which has been shown to be the most promising in meeting these objectives (Estruch et al. 2013). Available data sources will be explored and collected in order to determine prevalence rates, distribution and trends of animal products consumption. Literature review will contribute to determine relative risks associated with the consumption of animal products. Assessment of public health impact will be conducted using calculations on Disability-Adjusted Life Year (DALY), life expectancy (Rate Advanced Periods) and number of preventable NCD cases.

Detailed research plan WP IV.3: Dialogic policy making (ZHAW)

The objectives of WP IV.3 are: (1) to investigate the prerequisites for a dialogic policy making in highly controversial fields with strong economic, political and cultural path dependencies; (2) to analyse what is needed to initiate a true policy dialog for NOVAnimal; (3) to find out what can be learned from other policy fields or civil society experiments.

First, experiences from other controversial policy fields will be evaluated. Secondly, in an experimental design, about a dozen stakeholders with various interests, backgrounds, attitudes and ideals will be assembled. Over a year, the same group of people will meet every two months to enter and deepen a dialog. The participants will be invited to explain to each other their conception of the world. The process will be professionally moderated and observed. It will be experimentally investigated and tested whether the ability and the willingness of the participants to compromise augment, how this process might be enforced and how the scope for dialogic policy making evolves, on the national level and in NOVAnimal specific milieus.

1.3.6 Detailed research plan in RF V: SYNTHESIS & IMPLEMENTATION (ZHAW/FHNW)

The synthesis starts from the leading questions of the entire project (cf 1.3.1 Research plan of the entire project). The objectives are (1) to develop strategies and recommendations to overcome constraints and to leverage innovations (WP V.1); (2) to communicate and disseminate the results (WP V.2).

The synthesis is a work package of the entire project team and will start with a one-day project kick-off workshop. A precondition for a successful cooperation in this inter- and transdisciplinary project is to work from the very beginning at the common understanding of the leading questions and objectives, of the economical, political, social and cultural context of the project, of the fundamental hypotheses and the various methodical approaches, and of the expected results. The project kick-off workshop will support this common understanding.

The second synthesis workshop will be organised in the midterm of the project. It aims at working on and reflecting upon novel paths and solutions, and how the expected results may be synthesised and implemented. This creativity workshop will be held over one and a half days at an inspiring location, and will be accompanied and guided by a professional moderator.

Towards the end of the project, in the final one-day synthesis workshop the findings and conclusions will be synoptically discussed and interpreted. It is the responsibility of the core team to propose the strategies to overcome constraints and to leverage innovations and to finalise evidence-based recommendations, guidelines and tools for specific target audiences.

The research questions and objectives of WP V.2 Communication and dissemination of results are: How can professionals and the general public become more familiar with resource-light eating habits? How can their interest be awakened? How can theoretical knowledge and practical know-how be effectively communicated? The objective is (1) to develop ideas, concepts and instruments for education and communication purposes and (2) to put them into practice. Different media serve to communicate about the project, the subjects, the people involved and the results in a competent, clear and vivid way. The communication and dissemination activities will be coordinated by the core team (for details compare chapter 2.2 Activities planned.)

1.4 Timetable and milestones (*= implementation activity)

2. Implementation

2.1 Previous achievements in knowledge and technology transfer

The project team has broad experience in transdisciplinary research and implementation activities, some examples are given subsequently.

Contract research projects for governments and private customers: Federal and cantonal administrations: Federal Office of Agriculture (Baur, Lips, Meier, Schluep Campo), Federal Office of Environment (Baur, Hugi, Minsch), Federal Office of Public Health (Schluep), Federal Offfice for Spatial Development ARE (Hugi), Cantons (ZH: Baur, Hugi, Minsch); Austria: Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (Minsch); German government: Enquête Kommission Mensch und Umwelt (Minsch); Italy: Europäische Akademie Bozen (Baur); EU: European Commission Directorate General Environment (Hugi); Private Associations and NGOs: Pro Natura, Greenpeace (Baur), Avenir Suisse, economiesuisse (Baur)

Workshops and conferences and dialog with stakeholders, practitioners, politicians, etc.: Switzerland: NRP48 (Baur), SNF-SPPU (Minsch), Denk-Allmend (Minsch), Land policy (Baur); Austria: MONE (Minsch); Germany: Enquête Kommission (Minsch); Interreg (Hugi)

Training and summer schools: Trainer courses on RECP: in Switzerland, Ukraine, Lithuania, and Romania (Hugi); Stakeholder workshops: in Upper Rhine Region (Hugi); Watershed management course: in India (Hugi); Summer schools: in CH (YES, Minsch), Austria (Minsch)

Building up research infrastructures: RECP centre in Ukraine (Hugi); Experimental and observation labs for meal choices in Denmark (Scholderer); Research net ÖFAV in Austria (Minsch).

Conducting exhibitions, contests (ideas): Denk-Allmend (Minsch); Olma (Baur)

Public Appearances/Media: Radio (Baur, Hugi, Minsch); TV (Baur, Lips, Minsch); print media for practitioners and broad public (Baur, Fäh, Lips, Minsch, Schluep); Blogs (Fäh, Lips, Minsch)

2.2 Activities planned

This project follows an inter- and transdisciplinary research approach. In most work packages, activities with stakeholders are scheduled; they are an integral part of the project and are therefore listed in 1.4 Timetable and milestones. Other expected results and practical outcomes, such as the evidence-based recommendations, guidelines and tools for specific target audiences are also an integral part of the project and tabulated in 1.4. We distinguish in this project between the typical and novel implementation activities. The typical activities can be foreseen and planned, the final decision about novel activities will be an outcome of the project.

Typical implementation activities

We envisage scientific publications, articles in the specialised press and popular science contributions, per work package at least one publication in each category. Furthermore, we plan to present project results at international scientific conferences and at national stakeholder events, e.g. the eco.naturkongress in Basel. Finally, a closing conference is scheduled, possibly in cooperation with other NRP 69 projects. An integrating idea could be to organise the conference topics along the food value chain from (sustainable) production to (healthy) nutrition and consumption.

Novel implementation activities

The scope of novel implementation activities is shaped by our previous implementation achievements, e.g.: a touring exhibition; a market stall at OLMA 2018; film(s) (contacts to professionals are established); contests (ideas for resource-light menus); an interactive map of best practice caterers, food processors and farmers; conception of teaching materials for schools; organising a crowd funded campaign for «new Swiss cooking» (poster, social media); presenting project results in the special parliament clubs (e.g. agriculture, gastro), a combined cooking and eating event; etc. Each of these activities would have to be realised with experts in the field. The final decision what and how will be taken at the midterm workshop in 2017.

2.3 Timetable and milestones

Cf. 1.4 Timetable and milestones.

3. Significance

3.1 Scientific significance

This project conceptualises the animal product value chains as an integrated innovation system. It brings together the stakeholder oriented «Bedürfnisfeld» approach with dynamic system modelling. It contributes to the development of methods and knowledge along the animal product value chains. The scientific new approaches in various fields are summarised below:
Innovations: identifying strategic innovations along the animal product food chains on the micro- (single business), meso- (branch, sector) and macro level (policy, education); **System modelling**: modelling animal product food chains, including possible future scenarios; **LCA**: integrating impacts on biodiversity into LCA and defining production intensities that are compatible with biodiversity conservation goals; **Agricultural cost analysis (CH)**: collecting real cost data in specialised beef, pork and poultry production; **LCA food processing**: systematic application of RECP on animal product processing comparing environmental improvement scenarios within an entire food chain; **Catering**: integrated research on menu choice, menu offer and chefs education in Switzerland; **Resource-light**: introducing the concept of resource-light menu with less or without animal products; **«The right choice is the best choice»**: application of this more recent approach to promote a sustainable behaviour; **Menu choice**: experimentally analysing the choice of complex meals in a real-life food service setting; **Menu offer**: empirically investigating menu production decisions of chefs and strategic decision makers; **Vocational education**: empirically investigating the motivations of young prospective chefs to prepare menus with fewer or without animal products; **Agricultural and related policies**: combination of historical and economical analysis to understand current conflicts and inconsistencies in food-related policy fields; **Public health and nutrition**: discussing public health consequences of a reduced animal products consumption; **Dialogic policy making**: experimental policy making in highly controversial fields; **Constraints for future-oriented consumption and animal production**: identifying constraints that hinder innovations along the animal product chains on the micro- (single business), meso- (branch, sector) and macro level (policy, education, culture); **Food culture**: conceptualising food culture as both a research field and a powerful constraint to a resource-light nutrition.

3.2 Social and economic significance

Nutrition habits in Switzerland centre around dairy products and meat. By world standards, the per capita consumption of animal products is high and Switzerland is not a good example for a sustainable food culture. Moreover, Swiss agriculture is specialised in animal production and a relevant share of the food processing industry as well. A possible decrease of the dairy and meat consumption would be a significant challenge for the whole sector. Additionally, Swiss agricultural policy has a long tradition in fostering animal production; policy reforms that would abolish or further diminish the support perhaps are an even greater challenge.

Despite the economic, social and cultural prominence of meat and dairy consumption and production, most people agree that a moderate consumption of animal products is a reasonable and desirable goal because of the related positive impacts on the environment, possibly on public health, and last but not least on animal welfare. However, food cultures are deeply rooted and cannot easily be changed.

The project explicitly addresses the challenges of how to decrease the dairy and meat consumption in a liberal and democratic society that counts on consumer sovereignty and individual responsibility. Food cultures should be transformed on the basis of voluntary consumer decisions for the «right» product, i.e. for the «resource-light» and less polluting product.

The objective of the project is to contribute to a transformation of the Swiss food culture. If the dairy and meat per capita consumption declines over the coming years, Switzerland could become an interesting role model of how with growing income and prosperity, and knowledge and education, animal products consumption can return to an ecologically sustainable level.

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