




## Final scientific report (Version 02)

### NRP 69 "Healthy Nutrition and Sustainable Food Production"

|  |  |
|--|--|
| <b>Responsible applicant</b><br>Name, first name | Minsch, Jürg   |
| <b>Project number</b>                            | 406940 - 166764  |
| <b>Project title</b><br>(English)                | Innovations for a future-oriented consumption and animal production<br>NOVANIMAL     |
| <b>Place, date and signature</b>                 | Zurich, 28th April 2019  |
|  |  |

**Authors:** Baur, Priska & Minsch, Jürg

(with contributions of Fäh, David; Gross, Thomas; Meier, Matthias; Schluep, Isabelle; Spörri, Martina)

## 1. Lay summary of the project and results

### Searching for impact

The aim of the research project 'NOVANIMAL Innovations for a future-oriented consumption and animal production' (hereafter 'NOVANIMAL') is to search for innovations in Swiss food systems that have a potentially large positive impact on the environment and possibly also on public health. Therefore, the project focuses on both animal food products and out-of-home consumption and catering. **Animal food products** are important because the increase in global production and consumption thereof poses challenges for the environment and natural resources. Furthermore, **out-of-home** consumption is important because gastronomy has a strong influence on diet. The corresponding data for Switzerland illustrate the significance of animal products and of out-of-home catering: in Switzerland, the per capita supply of meat is approximately **twice** the global average, and dairy products **four times** as much, including estimated foreign purchases. Out-of-home catering accounts for **50%** of meat and dairy consumption in Switzerland and **40%** of average household expenses for food and beverages.

### Goals

In NOVANIMAL, we define an innovation as follows: a **change compared to current practice**, along and/or around food supply chains, which is **consciously** carried out by actors, and where an improvement in environmental, health and/or animal ethical aspects can be expected. The innovations pursue the following goals:

- 1) In agriculture: resource-efficient milk and meat production adapted to the local ecosystem boundaries, enabling the regeneration of soil, water and biodiversity.
- 2) In food processing: efficient use of energy, water and raw materials in the processing of milk, meat and vegetable substitutes.
- 3) In out-of-home consumption/catering:
  - a) guests eat more vegetable products and fewer animal food products than today
  - b) gastronomy is improving its range of attractive vegetarian and vegan meals (to facilitate the more frequent choice of vegetable products for guests)
  - c) chefs and hospitality specialists are both motivated and competent in cooking and recommending attractive vegetarian and vegan meals (to facilitate the supply of attractive, plant-based meals).

Further objectives are to identify the **drivers** of innovations along with the **constraints** that hinder their implementation, and, last but not least, to propose **solutions** to overcome these constraints. The main target groups are **professionals and those who are strategically responsible** in gastronomy and in associated education, in the food processing industry and in agriculture.

### Results

In NOVANIMAL, we propose 102 innovations, of which 22 are for agriculture, 18 for food processing, 41 for gastronomy and 21 for vocational education and further training (cf. <https://novanimal.ch/dialog/>). As far as impact is concerned, innovations that contribute to **lower consumption of meat and dairy products**, in combination with animal production adapted to local ecosystem boundaries, seem most promising to reduce the pressure on natural resources and to promote possible public health issues. Important NOVANIMAL results, summarised very briefly, are as follows:

- Animal production adapted to the **local ecosystem boundaries** in Switzerland means <sup>3/28</sup> 30 - 40% less cattle, 45 - 60% fewer pigs and over 80% less poultry. Cattle would be fed primarily or entirely by grassland. Pigs and poultry would be partly or entirely fed with by-products from the food industry. This would result in 40 - 50% less milk, 30 - 40% less beef, 50 - 70% less pork, over 90% less poultry and more than 80% fewer eggs.
- Full cost analyses of animal production (milk, suckler cows, cattle fattening) confirm **low economic profitability** (in earnings per hour) and large differences between farms.
- The implementation of **cleantech** measures in food processing can significantly reduce natural resource use and greenhouse gas emissions caused as a result of processing but these benefits are moderate compared to production and consumption.
- In a **field experiment** in two university canteens over a period of 12 weeks, an increase in the number of vegetarian and vegan meals was tested: the percentage of meat dishes sold dropped from 60% in 'normal' weeks to 44% in 'intervention' weeks. 'Only' 2% of canteen visitors always choose a meal containing meat. Female canteen visitors chose a meat dish less frequently than males (34% vs. 58%). It was not the case that canteen visitors were less frequently satisfied with their meal during the 'intervention' weeks. Respondents who brought their own food with them more frequently answered that they eat a vegetarian or flexitarian diet. Canteen visitors who chose a meat dish responded much less frequently in terms of worrying about the consequences of their diet for their health, the environment, animal protection or workers in the food chain.
- **Chefs and kitchen staff** have little background knowledge about the impact of nutrition on the environment and about today's animal husbandry. However, the majority of them have a positive view of Swiss agriculture, and Swiss food production is perceived as sustainable. The corresponding gaps in knowledge can be found in the teaching materials for chefs and hospitality specialists. The preparation of vegetarian or vegan meals is considered demanding and time-consuming.
- **Agricultural policy interventions** after the second World War (WW II) led to an impressive increase of pigmeat and chicken production. In contrast, the cattle population has not changed since before WW I. The same is true for Methane emissions. Although the price level in Switzerland is twice as high as in neighbouring Germany, per capita total meat supply (estimated foreign purchases included) is roughly the same.
- **Public health:** the topic of health risks of meat consumption is a controversial issue. However, the modelled 25%/50% reduction of meat would be better in line with most recommendations, e.g. of the Swiss Nutrition Society (SGE-SSN), the World Cancer Research Fund (WCRF) and the EAT-Lancet Commission (ELC). In contrast to meat, dairy consumption is considered to be healthy or neutral over a wider range. The modelled 25%/50% reduction of dairy products is below the recommendation of, e.g., the SGE-SSN and the ELC. However, taking into account the high percentage of cheese in Swiss dairy consumption, we assume that even with a 50% reduction, consumption still lies in a safe range.

Important **drivers** of innovations are technological development, competition, increasing resource prices and economic opportunities arising from a change in eating habits and food demand, and from attracting a new clientele in gastronomy, in particular female guests.

**Constraints** to implementing innovation:

- Constraints in agricultural production and food processing: habits & routines; meat and milk production subsidies; direct and indirect natural resource subsidies (water, energy, etc.); political regulations; in agriculture: political income support allows production to be maintained even if it is not profitable; in processing: efficiency gaps seem often to be perceived as 'minor problems' ('Geringfügigkeitsproblem').
- Constraints in consumer demand, gastronomy and education: nutrition and cooking habits & routines; the 4 Ns: meat is considered 'natural', 'normal', 'necessary' and 'nice'; meat is the most valuable item on the plate; the expectation is that vegetarian dishes should cost less; positive images of animal husbandry in Switzerland; local, regional or national products are preferred which means, for Switzerland, meat and dairy; meat is the rule, vegetarian the exception and vegan a disturbance; vegetarian/vegan is cooked and marketed for the minority of guests with a vegetarian/vegan lifestyle; kitchen hierarchy; vegetarian/vegan cuisine is more demanding and time consuming; lack of skills and knowledge; well-established meat supply chains; promotional meat predominates ('Aktionsfleisch'); widespread ideas about a balanced diet (each day and each meal has to be balanced); 'male chefs cook for male guests'.

**Conclusions**

- Agriculture and food processing: The decrease of livestock concerns primarily pigmeat and poultry. While production is adapted to the location, eco-efficiency per kilogram of product is reduced. The comparatively slow decline of the cattle population is justified by ecological, economic and ethological considerations. In food processing, there is a relevant cleantech-potential. An underestimated challenge is the small-scale production and processing structures in Switzerland which reduces efficiency. This issue is exacerbated by the large variety of products with various labels and local products.
- Dietary guidelines: Current Swiss dietary guidelines (SGE-SSN) are partially at odds with the scientific evidence, and the health potential of a more plant-based diet is not sufficiently recognised or translated into corresponding recommendations. We encourage a review of the guidelines against the background of new scientific findings and uncertainties.
- Consumer demand, gastronomy and education: The demand for vegetarian and vegan dishes seems greater than perceived by gastronomy. More people, especially in a wealthy country like Switzerland, care about a healthy diet, about the environment and animal protection. However, the culinary quality is often unsatisfactory. Gastronomy is at risk of missing the development. Conclusions are:
  - The vegetarian/vegan cuisine should no longer be a niche market and should become a part of everyday life because flexitarian eating habits with moderate meat consumption are becoming the norm.

- With more variety, female guests in particular can be catered for. The purchasing power of women is increasing as they are better educated, earn their own income and are better paid than in the past.
- The practice of more plant-based nutrition must start from caterers who are basically sensitised to sustainability, who can reach a larger audience and who have opportunities for specialisation (e.g. SV Schweiz, the largest Swiss caterer). Further, there are successful pioneers to learn from (e.g. Tibits and Hiltl).
- Specialisation in the kitchen is crucial. There are chefs who specialise in meat and fish cuisine which includes the competence to cook 'from nose to tail'. There are also chefs who specialise in preparing vegetarian and vegan dishes.
- A better education is not enough. A new apprenticeship for vegetarian/vegan cuisine, including specialised further training opportunities, could make a difference.

## 2. Executive Summary of research and results

### **Background: searching for impact**

The aim of the research project 'NOVANIMAL Innovations in nutrition' is to search for innovations in Swiss food systems that have a potentially large positive impact on the environment and possibly also on public health. Therefore, the project focuses on animal food products and out-of-home consumption and catering.

### **Main research question**

How can food systems be effectively altered towards resource-light production, processing and consumption of animal food products and towards healthy eating habits with fewer animal food products?

### **Main goals**

Identification of innovations for resource-lighter production, processing and consumption of animal food products in Switzerland; assessing environmental impacts of the Swiss agricultural milk, beef, pork and poultry production under different production intensities in different regions; assessing consumer demand for vegetarian or vegan meals (veg<sup>2</sup>-meals) within the experimental framework; finding out how to improve operating parameters and how to foster professional ambitions to plan and prepare attractive veg<sup>2</sup>-meals; assessing the importance of veg<sup>2</sup>-meals in vocational education and training of chefs and hospitality specialists; explaining from a historical perspective how policies in Switzerland have evolved and contributed to a diet centred around animal food products; giving an overview of the state of research concerning the effects of different per capita consumption on disease risk and public health.

### **Methods used**

Life cycle assessment and cost analysis of animal production and food processing; comparative static modelling of scenarios and system dynamics modelling; transdisciplinary field experiment in two university canteens (for a duration of 12 weeks); qualitative interviews and content analysis; quantitative written survey; online surveys; historical analysis (development of Swiss food culture);

literature analysis (analysis of trends in the «Bedürfnisfeld» nutrition; public health); NOVANIMAL dialogue with professionals.

## **Results**

### Agriculture and Food processing

Implementation of agricultural innovations leads to a decrease in milk and meat production (primarily pork and poultry) and, consequently, also in environmental pollution in Switzerland. While production is adapted to the location, eco-efficiency per kilogram of product is reduced. In food processing, there is a relevant cleantech-potential.

### Consumer demand, gastronomy and education

The demand for vegetarian and vegan dishes seems greater than is perceived by gastronomy. However, the culinary quality is often unsatisfactory. Constraints for improving vegetarian/vegan meal offers: meat is the rule, vegetarian the exception and vegan a disturbance; vegetarian/vegan is cooked and marketed for the minority of guests with a vegetarian/vegan lifestyle; vegetarian/vegan cuisine is more demanding and time consuming; positive image of animal husbandry; local, regional or national products are preferred which means, for Switzerland, meat and dairy; 'male chefs cook for male guests'.

## **Implications and recommendations**

In NOVANIMAL, we propose 102 innovations, of which 22 are for agriculture, 18 for food processing, 41 for gastronomy and 21 for vocational education and further training.

### Agriculture and food processing

Maintaining a comparatively high cattle population is justified by ecological, economic and ethological considerations. An underestimated challenge is the small-scale production and processing structures in Switzerland. This reduces efficiency. The issues is exacerbated by the large variety of products with various labels and local products.

### Consumer demand, gastronomy and education

Gastronomy is at risk of missing the development. Female customers are an economically interesting target group that may have been neglected so far. Gastronomy is 'scout and guide' on the way to more plant-based eating habits. New specialists are needed in the kitchen. A better education is not enough. A new apprenticeship for vegetarian/vegan cuisine, including specialised further training opportunities, could make a difference. Current Swiss dietary guidelines (SGE-SSN) are conflicting; they should be reviewed and revised.

## **3. Objectives of the research project, hypothesis and methods**

### **Main research questions and objectives**

How can food systems be effectively altered towards resource-light production, processing and consumption of animal food products and towards healthy eating habits with fewer animal food products? Which innovations in agriculture, in the food processing industry, in gastronomy, and in associated education might contribute to significantly decreasing the detrimental impacts on the environment and use of natural resources and on public health? Which are the most important

constraints and how can they be surmounted? The primary objective of the project is to propose innovations, and to develop ideas and solutions to overcome constraints and to foster the implementation of innovations.

### Specific objectives

- Research Focus RF I 'Innovations & scenarios': identification of innovations and construction of scenarios; construction of a system dynamics model and simulation of scenarios.
- RF II 'Production & processing': assessing environmental impacts of Swiss agricultural milk, dairy, beef, pork and poultry production and processing considering different innovations; estimation of full costs of production and processing of milk, beef, pork and poultry.
- RF III 'Demand & consumption': designing the menu choice experiment together with the canteen team; assessing consumer demand for vegetarian or vegan meals within the experimental framework; assessing consumers' reasons for meal choice and their satisfaction; understanding menu production decisions of chefs and strategic decision-makers in catering; finding out how to improve operating parameters and how to foster professional ambitions to plan and prepare attractive vegetarian or vegan meals (veg<sup>2</sup>-meals); assessing the importance of veg<sup>2</sup>-meals in vocational education and training of chefs and hospitality specialists; finding out how the young, prospective chefs can be motivated to acquire the know-how to cook attractive veg<sup>2</sup>-meals.
- RF IV 'Policy & Public health': explaining from a historical perspective how policies in Switzerland have evolved and contributed to a diet centred around animal food products; giving an overview of the state of research concerning the impact of meat and milk/dairy consumption on disease risk and public health; identification of the important controversies about health effects of the consumption of animal food products with a specific focus on Switzerland.
- RF V 'Synthesis & implementation': cf. overall objective; communicating and disseminating results.

### Hypotheses

NOVANIMAL starts from the normative premise that in a liberal society and a social market economy, **consumers have freedom of choice (consumer sovereignty)**. This is why the innovation ideas primarily address **economic actors along the food supply chain**. Hypotheses that guide the search for innovations are:

- Eating habits: Eating habits in Switzerland are characterised by a high proportion of animal food products. The path to resource-lighter eating habits that are less harmful to the environment is based on an understanding of how today's eating cultures came into being.
- Agricultural production: Conventional life cycle assessments measure the environmental impact per kilogram of product (eco-efficiency). For a comprehensive assessment, eco-efficiency needs to be combined with the local ecosystem boundaries.
- Food processing: Numerous analyses show that food processing causes less environmental pollution than production. This entails the risk that the potential for cleaner processing is underestimated.

- **Gastronomy:** The better the range of attractive resource-light menus on offer, the more frequently they are chosen. In NOVANIMAL, a meal is defined as ‘resource-light’ if it contains a reduced number of, or no, animal food products. The resource-light supply is operationalised by the number and share of vegetarian and vegan meals. The more vegetarian/vegan meals are consumed, the less harmful to the environment and potentially healthier the diet is.

## Methods and overview of datasets and models

NOVANIMAL builds on the ‘Bedürfnisfeld’ (needs field) approach, an action-oriented, inter- and transdisciplinary sustainability research framework (Minsch & Mogalle, 1998; Mogalle, 2000; Häberli, Gessler, Grossenbacher-Mansuy, & Lehmann Pollheimer, 2002). **The ‘Bedürfnisfeld’ nutrition is conceived as an innovation system.**

Different methods have been applied: life cycle assessments; cost analyses; expert workshops; comparative static scenario modelling; system dynamics modelling; experiments (transdisciplinary field experiment in two university canteens; NOVANIMAL dialogue with professionals); qualitative interviews and content analysis; quantitative written surveys; online surveys; historical analysis (development of Swiss food culture); and literature analysis (analysis of trends in the ‘Bedürfnisfeld’ nutrition; public health). The following is an overview of the collected and modelled data, the available data sets and the developed models. (The researcher principally responsible is given in bracket.)

### Collected data and datasets

**Field experiment in two university canteens**, autumn semester 2017 (12 weeks). Resulting datasets (Gian-Andrea Egeler, ZHAW):

- Total of 26,234 transactions, of which 22,696 (86.5%) paid with the CampusCard (multifunctional badge for students and staff) and of which 21,723 (82.8%) contain information about gender, age, and university affiliation (student, staff).
- Total of 1560 campus card owners that visited the university canteen at least once during the 12 weeks with information about all their meal purchases. 1503 of these contain information about gender, age, and university affiliation (student, staff).

**Quantitative written survey during field experiment** in two university canteens, autumn semester 2017, on the basis of a preliminary qualitative survey in June 2017 (Gian-Andrea Egeler, ZHAW). Resulting datasets (Flavio von Rickenbach, ZHAW):

- Of 1323 questionnaires, 1203 were returned (response rate 90.9%) and 1176 are usable.
- Individual answers were collected and their content analysed.

Additional questions from NOVANIMAL could be integrated in an **online survey of SV Schweiz and Facility Management ZHAW** about satisfaction of ZHAW students and staff with canteens.

Three **psychological online meal choice experiments** with ZHAW students with 90 ‘real’ meals from the field experiment. Resulting datasets (Helene von Gugelberg, ZHAW):



- December 2017: Of 11,276 students from the ZHAW, except those studying on the campus where the field experiment was conducted, 1054 participated in the online experiment (response rate 9.4%).
- March 2018: Of 1571 students from the ZHAW studying on the campus where the field experiment was conducted, 151 participated in the online experiment (response rate 9.6%).
- December 2018: Of 13,200 students from the ZHAW, 923 participated in the online experiment (response rate 7.0%).

**Semi-structured interviews with chefs, restaurant and hotel owners and gastronomy managers.** Resulting dataset (Mara Figini, ZHAW): 20 fully transcribed protocols of audio-recording. Qualitative content analysis, coding with ATLAS.ti.

**Online survey of chefs, restaurant and hotel owners and gastronomy managers** on the basis of the qualitative survey. Resulting dataset (Jacqueline Frick, ZHAW): 9273 addresses were contacted. 9042 contacts were valid. 905 answered (response rate: 10%) and 771 are usable. Additional questions from NOVANIMAL could be integrated in an **online survey of GastroSuisse** with consumers and GastroSuisse members. Resulting datasets (Jacqueline Frick, ZHAW):

- 1000 consumers, of which 834 respondents answered our key questions.
- 2380 restaurateurs, of which 1883 respondents answered our key questions.

**Semi-structured interviews were conducted with 6 vocational teachers and 12 group interviews with 79 apprentices** from 6 vocational classes (chefs, kitchen employees, hospitality specialists). Two classes (chefs and hospitality specialists) wrote essays on the interview topics. Resulting datasets (Sonja Trachsel, ZHAW):

- 6 fully transcribed protocols of audiorecordings. Qualitative content analysis, coding with ATLAS.ti.
- 12 fully transcribed protocols of videorecordings. Qualitative content analysis, coding with ATLAS.ti.
- 27 essays written by 15 prospective hospitality specialists and 12 prospective chefs. Qualitative content analysis.

**Semi-structured interviews with 19 senior experts** from policy fields relevant to nutrition . Resulting dataset (Isabelle Schluep, CCRS/UZH): Interview protocols.

#### Modelled data and datasets

**Animal production and animal production potential data** (reference year 2015): cattle, pig and poultry in different bio-geographic regions in Switzerland and with different production systems (Matthias Meier & Simon Moakes, FiBL).

**Life cycle assessment of animal production in the different bio-geographic regions for beef, veal, milk, pork, broiler and eggs (Matthias Meier & Simon Moakes, FiBL).**

**Life cycle assessment of processed food** (UBP, GWP): milk, cheese, butter, beef (Paolo Ferrara, FHNW).

**Full cost analysis of animal production on farm enterprise level** based on Swiss farm-level accountancy data: milk, suckler cows, beef, pork, egg (Martina Spörri, Agroscope).

**Cost analysis of food processing:** milk, cheese, butter, beef (Paolo Ferrara, FHNW).

**Life cycle assessment (UBP, GWP, ILCD Indicators) of 93 menus from the field experiment** in two university canteens (Karen Muir, ZHAW).

**Nutritional balance assessment of 93 menus from the field experiment** in two university canteens using two methods: 1. EBP-model (Ernährungsphysiologische Balancepunkte) based on the nutrient profiling of the UK Food Standard Agency; plate-model (Tellermodell), based on the 'optimal plate' by the SGE-SSN (Claudia Müller, ZHAW).

### Models

**Excel-based farm model** for the environmental impact assessment of animal production accounting for the farm-internal nutrient flow from plant to animal and back to plant production to simulate various NOVANIMAL scenarios (Matthias Meier & Simon Moakes, FiBL).

**Excel-based model of animal product processing** to simulate various NOVANIMAL scenarios (Paolo Ferrara, FHNW).

**Swiss Beef and Dairy Production and Consumption system dynamics model** (SwissBeDaPaC) to simulate relevant indicators of supply chains up to 2050 (Lize Duminy, BFH).

## **4. Results, including how do results compare to international state of the art**

In NOVANIMAL, we propose 102 innovations, of which 22 are for agriculture (Spörri, Meier, Heer, & Moakes, 2018), 18 are for food processing (Ferrara, Gross, & Hugi, 2018), 41 are for gastronomy (Baur & Egeler, 2019; Frick, 2019; both in preparation) and 21 are for vocational education and further training (Trachsel, von Rickenbach, & Baur, 2019). These 102 innovation ideas have been developed in five of twelve NOVANIMAL sub-projects. Each of the twelve NOVANIMAL sub-projects provides a wealth of individual results which this scientific report cannot do justice to. First, we give a brief summary of NOVANIMAL results and conclusions (Section 4.1). Secondly, we point out differences between NOVANIMAL results and common positions in international research (Section 4.2).

### **4.1 Results and conclusions**

The results and conclusions will be summarised as follows: a) results from life cycle assessment, modelling, field experiment etc., b) drivers of innovations, c) constraints to implementing innovations, d) solutions to overcome constraints in consumption and gastronomy, e) general conclusions and f) conclusions concerning transdisciplinary research.

## a) Results from life cycle assessment, modelling, field experiment, interviews and surveys

### Significant decrease in livestock

Animal production adapted to local ecosystem boundaries leads to a significant decrease in livestock (30 - 40% for cattle, 45 - 60% for pigs and over 80% for poultry) and consequently also of environmental pollution from livestock production in Switzerland (from 25 to over 90% fewer impacts depending on the animal production system). This results in 40 - 50% less milk, 30 - 40% less beef, 50 - 70% less pork, over 90% less poultry and more than 80% fewer eggs (Gross et al., 2019; Meier & Moakes, 2019; both in preparation).

### Low economic profitability of animal production

Full cost analyses of animal production systems (milk, suckler cows, beef, pork, egg) confirm that economic profitability in earnings per hour is low and differences between farms are large (Hoop, Spörri, Zorn, Gazzarin, & Lips, 2017; Zorn et al., 2018), while lower-input dairy production systems perform better economically (Spörri, Hoop, & Heer, 2018).

### Significant reduction of natural resource use by implementing cleantech measures

The implementation of cleantech measures in food processing can significantly reduce natural resource use and global warming potential (GWP) of processing. For instance, a complete transformation to renewable energies, including electricity (e.g. photovoltaics) and heat (e.g. wood pellets), could potentially reduce the GWP of processing by up to 90% depending on the product (e.g. milk, cheese etc.). A major hinderance is the return-on-investment (ROI) between over ten (heat) to over twenty (electricity) years (Gross et al., 2019; in preparation). However, the potential benefits of implementing cleantech measures in processing are moderate compared to those in production and consumption.

### Results of field experiment in two university canteens

In a field experiment in two university canteens lasting for 12 weeks, a range of innovations was implemented: abolition of the vegetarian menu; randomised offering of meat, fish, vegetarian and vegan meals in the menu; no explicit marketing of vegetarian and vegan menus; for 6 weeks vegetarian and vegan meal offers were increased (intervention weeks). Results (Egeler & Baur, 2019a, 2019b; Egeler, von Rickenbach, & Baur, 2019; Muir, 2018; Müller & Egeler, 2018):

#### ***As a result of the increase of vegetarian and vegan offer, percentage of meat-/fish-meals dropped to 44%***

- There was no effect of interventions on total number of menus sold and sales.
- The percentage of meat or fish dishes sold dropped from 60% in 'normal' weeks to 44% in 'intervention' weeks.

#### ***Female canteen visitors less frequently chose meat dishes***

- Female canteen visitors did not chose a meat dish as frequently as males (34% vs. 58%).
- Female canteen visitors are less often 'meat-eaters' or 'meat lovers' than males (30% vs. 64%).

### **Good acceptance of veg<sup>2</sup>-dishes despite 'normal' diet patterns (96% of canteen visitors eat meat)**

- Diet patterns of canteen visitors (cf. NOVANIMAL definition): 2% 'buffetarians' (always from hot & cold buffet); 2% 'never meat' (0% meat dish); 24% 'veg-flexitarians' (<= 25% meat dish); 21% 'meat-flexitarians' (> 25% to <= 50% meat dish); 31% 'meat-eaters' (> 50% to <= 75% meat dish); 18% 'meat lovers' (>75% to <100% meat dish); 2% 'always meat' (100% meat dish).

### **Good acceptance of 'expensive' veg<sup>2</sup>-dishes**

- Canteen visitors bought – surprisingly for the kitchen team – vegetarian and vegan meals from the more expensive 'menu line'.

### **Veg<sup>2</sup>-meals less polluting but not 'balanced' according to the SGE\_SSN**

- Meals without meat have, on average, less environmental impact (life cycle assessment) (Muir, 2018)
- SGE-SSN's 'optimal plate-model' evaluates meat meals better than veg<sup>2</sup>-meals because plant proteins are neglected (Müller & Egeler, 2018).

### Results of survey during field experiment

The written survey conducted during the field experiment, delivered responses of 874 canteen visitors and of 302 people that brought their own food (von Rickenbach, 2019; in preparation):

#### **People preferring vegetarian meals visit the canteen less frequently**

- Compared to males, females brought their own food more frequently instead of going to the canteen (students: 45% vs. 23%; staff 12% vs. 6%).
- Compared to respondents who had eaten in the canteen, respondents who had brought their own food more often said they eat a vegetarian (never meat) or flexitarian diet (meat max. 1 or 2 times a week) (bringing own food: 53%, canteen visitors: 38%).

#### **High satisfaction despite decrease of the offer of meat dishes**

- There was no difference in terms of satisfaction with the menu for canteen visitors during the intervention weeks compared to during the base weeks.

#### **Canteen visitors choosing a meat dish less frequently worry about sustainability**

Canteen visitors who chose a meat dish worried less frequently about the consequences of their diet for

- their health (meat dish: 33% vs. no meat dish: 55%)
- the environment (meat dish: 20% vs. no meat dish: 49%)
- animal protection (meat dish: 46% vs. no meat dish: 66%)
- workers in the food chain (meat dish: 15% vs. no meat dish: 32%)

### Little knowledge in gastronomy about environmental impact of animal food products

Chefs and kitchen staff have little background knowledge about the impact of nutrition on the environment and about today's animal husbandry. However, the majority of them have a positive view of Swiss agriculture and Swiss food production is perceived as sustainable (Figini, 2019; Frick, 2019b; Trachsel, von Rickenbach, & Jenny, 2019; Trachsel, von Rickenbach, Matyas, & Jenny, 2019). The corresponding gaps in knowledge can be found in the teaching materials for

chefs and hospitality specialists (Jenny, Trachsel, & Baur, 2017). The preparation of vegetarian or vegan meals is considered demanding and time-consuming.

#### Agricultural policy promotes animal production

Agricultural policy interventions after the second World War (WW II) led to an impressive increase firstly in pigmeat and secondly in chicken production (Schluep, Baur, & Minsch, 2019). In contrast, there is no difference in cattle population compared to before WW I. The same is true for Methane emissions (BAFU, 2017, pp. 57, 58).

#### Elevated meat consumption despite high price levels

Although the price level in Switzerland is twice as high as in neighbouring Germany, per capita meat supply (estimated foreign purchases included) is roughly the same (Baur, Egeler, & von Rickenbach, 2018a).

#### Public health:

##### ***Little information on meat and dairy consumption***

- One basic problem when exploring the public health impact of diet is that there is little valid and reliable information on meat and dairy consumption for Switzerland (Baur, Egeler, & von Rickenbach, 2018b; Baur et al., 2018a).

##### ***Partly conflicting evidence on health risks***

- Existing evidence on the health risks of meat consumption is partly conflicting (Krieger, 2018; Krieger, Fäh, Egeler, & Baur, 2018). However, a 25%-/50%-reduction to 56-83g meat per day (reference: self-declared consumption in menuCH 2014/15) as postulated in the demand reduction scenarios would be better in line with most recommendations, e.g., of the Swiss Nutrition Society (SGE-SSN), the World Cancer Research Fund (WCRF) and the EAT-Lancet Commission (ELC).
- Less controversial is dairy consumption, because dairy is considered healthy or neutral over a wide range (Krieger, 2018; Krieger, Fäh, Egeler, & Baur, 2018). A greater problem is the large variety of dairy products, and the 'hidden' dairy in many foods, which makes it difficult to assess, compare and interpret consumption data. The postulated 25%-/50%-reduction to 140-200g dairy products per day (reference: assumed consumption, on the basis of available data; without butter or cream) is below the recommendations of, e.g., the SGE-SSN and the ELC. However, taking into account the high percentage of cheese in Swiss dairy consumption, we assume that even with a 50% reduction, consumption lies in a safe range (one portion: 30-60g cheese, 150-200g yoghurt or 200 ml milk).

#### **b) Drivers of innovations**

- From 13 **megatrends** that we consider to be relevant to nutrition, we expect seven – Gender Shift, Health, Knowledge Culture, Neo-Ecology & Smart New Green, Security, Silver Society & Millennials, Urbanisation – to motivate a moderate animal food products consumption, and four – Globalisation, Global Scarcity of Natural Resources, Neo-Ecology & Smart New Green, urbanisation – to promote resource-efficient production and processing (Baur, Schluep, & Minsch, 2017).

- Specific drivers in agriculture and food processing: economic opportunities arising from a change in nutrition habits and food demand; technological development; competition; increasing resource prices.
- Specific drivers in demand, gastronomy and vocational education: economic opportunities arising from changing eating habits and attracting a new clientele, in particular women; emergence of a global society; competition; chef's professional ambitions.

### **c) Constraints to implementing innovations**

#### Constraints in agriculture and food processing

habits & routines; meat and milk production subsidies; direct and indirect natural resource subsidies (water, energy, etc.); political regulations; in agriculture: income support allows production to be maintained even if it is not profitable; in processing: efficiency gaps seem often to be perceived as 'minor problems' ('Geringfügigkeitsproblem').

#### Constraints in consumption, gastronomy and education

nutrition and cooking habits & routines; the 4 Ns: meat is considered 'natural', 'normal', 'necessary' and 'nice'; meat is the most valuable item on the plate; the expectation is that vegetarian dishes should cost less; positive images of animal husbandry in Switzerland; local, regional or national products are preferred which means, for Switzerland, meat and dairy; meat is the rule, vegetarian the exception and vegan a disturbance; vegetarian/vegan is cooked and marketed for the minority of guests with vegetarian/vegan lifestyle; kitchen hierarchy; vegetarian/vegan cuisine is more demanding and time consuming; lack of skills and knowledge; well-established supply chains; promotional meat predominates ('Aktionsfleisch'); widespread ideas about a balanced diet (each day and each meal has to be 'balanced'); 'male chefs cook for male guests'.

### **d) Solutions to overcome constraints in consumption, gastronomy and education**

#### Professionalisation and specialisation in the kitchen

New specialists are needed in the kitchen. A better education is not enough. A new apprenticeship for vegetarian/vegan cuisine, including specialised further training opportunities, could make a difference.

#### Role models and inspirations

Dishes rich in enjoyment and with little or no animal food products can be inspired by a person's own traditions (e.g. 'grandma's apple pie') and eating cultures in other parts of the world. Prominent celebrity chefs who are passionate about vegetarian/vegan cuisine can be role models.

#### Places with potential and pioneers

The practice of increased plant-based nutrition must start with caterers who are basically sensitised to sustainability, who can reach a larger audience and who have opportunities for specialisation. Further, there are successful pioneers to learn from (e.g., Tibits and Hiltl).

### New products and supply networks

A greater variety of high quality precursors is needed which make it easier to prepare delicious vegetarian/vegan dishes. This also means new supply networks.

### Revision of the Swiss dietary guidelines (SGE-SSN)

Current guidelines are outdated and only partially in line with the scientific evidence. The potential of an increasingly plant-based diet is not sufficiently recognised or translated into recommendations. We encourage guidelines to be reviewed and revised against the background of new scientific findings and uncertainties. The aim should be to develop more evidence-based recommendations for guests and those responsible for catering considering effective eating habits.

## **e) General conclusions**

### Agriculture

As a consequence of the implementation of agricultural innovations, animal production systems in Switzerland are less intensive. Extensification leads to a decrease in milk, meat and egg production and also in total environmental pollution. While production is adapted to the local ecosystem boundaries, eco-efficiency of pork and poultry (environmental impact per kilogram) decreases. Even though the eco-efficiency of beef is lower than of pork and poultry, grass-based milk and beef production adapted to the local ecosystem boundaries improves eco-efficiency for many environmental impact categories. While pig stock declines by 45 - 60% and poultry by over 80%, the cattle population adapted to the local ecosystem boundaries is falling by 'only' 30 to 40% because Switzerland has large grassland resources. Several arguments are in favour of maintaining a comparatively high cattle population in Switzerland:

- Economy: Swiss agriculture has a comparative advantage in producing grassland fed milk and beef.
- Animal protection: In Switzerland, it is comparatively easy to keep cattle in a species-appropriate manner. There is also the advantage that for cattle, fewer individual animals are needed for the same amount of meat.
- Climate policy: Swiss Methane emissions are the same as before WW I (1910). Today, agricultural Methane emissions of 4.15 million tons CO<sub>2</sub>-eq account for 9% of all greenhouse gases (2015; excluding aviation with 5.08 million tons CO<sub>2</sub>-eq). Methane, in contrast to CO<sub>2</sub>, is not accumulated in the atmosphere.
- Competition with human nutrition: The only way of turning permanent grassland into human edible food is via ruminants. Pork and poultry production, on the other hand, rely on arable land which can be used directly and much more efficiently for human consumption.

### Food processing

There is a relevant cleantech-potential which can be cost-saving in the long term. Nevertheless, these benefits are minor along the entire food supply chain (Gross et al., 2019). An underestimated challenge is the small-scale production and processing structures in Switzerland. This reduces efficiency and is an issue which is exacerbated by the large variety of products with various labels and local products.

### Consumer demand, gastronomy and education

#### **The demand for vegetarian and vegan dishes seems greater than perceived by gastronomy.**

More people, especially in a wealthy country like Switzerland, care about a healthy diet, about the environment and animal protection. However, the culinary quality is often unsatisfactory.

Gastronomy is at risk of missing the development. Conclusions are:

- The vegetarian/vegan cuisine should no longer be a niche market and should become a part of everyday life because **flexitarian eating habits** with moderate meat consumption are becoming the norm.
- With more variety, **female guests** in particular can be catered for. The purchasing power of women is increasing as they are better educated, earn their own income and are better paid than in the past. Female customers are an economically interesting target group that seems to have been neglected thus far.
- Rising out-of-home consumption increases catering industries' economic opportunities but also their responsibilities, all the more so because while guests make spontaneous and pleasure-related decisions, gastronomy is in a position to make rational strategic decisions about which dishes to offer to guests. **Gastronomy is 'scout and guide' on the way to more plant-based eating habits.**
- **Specialisation in the kitchen is crucial.** There are chefs who specialise in meat and fish cuisine which includes the competence to cook 'from nose to tail'. There are also chefs who specialise in preparing vegetarian and vegan dishes.
- A better education is not enough. A **new apprenticeship for vegetarian/vegan cuisine**, including specialised further training opportunities, could make a difference.

#### **f) Conclusions concerning transdisciplinary research in the field experiment**

- The challenge to develop and conduct a research project in close cooperation with the partners in practice was underestimated (organisational, financial, legal aspects). E.g. it took a whole year to prepare the field experiment in two university canteens which had not been foreseen.
- Research in close cooperation with practice is time-consuming and demanding yet fruitful and instructive for all involved. It seems to be a promising way to promote innovation (e.g. impressive learning processes for all involved parties).

#### **4.2 Differences between NOVANIMAL and common positions in international research**

Two recent publications in renowned journals confirm the relevance of the research questions addressed in NOVANIMAL and summarise common positions. The article by Godfray et al. (2018) published in *Science* presents an up-to-date overview of negative environmental and health impacts of animal production. The contribution of Willett et al. (2019) in *Lancet* goes further in giving detailed dietary prescriptions for environmentally sustainable and healthy nutrition. Differences



between NOVANIMAL and common positions concern the following topics: political postulates and appeals, 'action knowledge', gastronomy, cattle vs. poultry, health effects of meat, and milk consumption and animal protection:

#### **a) Political postulates and appeals**

Scientific research often leads to political postulates and appeals. Unlike many projects, NOVANIMAL starts 1) from the normative premise that in a liberal society and a social market economy, it is above all the private economic actors who are responsible for innovations and 2) from an innovation theoretical framework that integrates all relevant actors in the innovation system. Consequently, most innovation ideas are aimed at commercial enterprises along the food supply chains.

#### **b) 'Action knowledge'**

Many research projects increase system and target knowledge. In contrast, NOVANIMAL focuses on action knowledge and starts where many projects end. For example, while Godfray et al. (2018) and Willett et al. (2019) call for a reduction in meat consumption and in natural resource use, in NOVANIMAL, the questions are how meat consumption can be reduced and how animal production can be adapted to the location.

#### **c) Gastronomy**

Out-of-home consumption/catering seem to be blind spots in sustainability research although their importance is high today and will probably increase in the future. We believe that therein lies the greatest gap in terms of knowledge, research and practical implementation (Frick, 2017). Searching for impact, NOVANIMAL research addresses gastronomy in particular.

#### **d) Cattle vs. poultry**

Cattle has a negative image in the current sustainability debate which often focuses on climate gas emissions. Since poultry is most efficient in terms of feed to food conversion and, therefore, has a relatively low carbon footprint per kilogram of meat, and since chicken also has a positive health image, the general position today is to reduce cattle and promote poultry. In NOVANIMAL, in contrast, we conclude that in the Swiss context (relatively little arable land and a great deal of permanent grassland), grassland-fed cattle is ecologically and economically more sustainable, if livestock density is adapted to the local ecosystem boundaries, rather than producing pork and chicken on the basis of imported fodder. This conclusion is confirmed by two further arguments: In Switzerland, today total Methane emissions equal emissions before WWI (1910); Methane is a greenhouse gas with a high global warming potential, but the long term effect is, compared to CO<sub>2</sub>, smaller due to a shorter half-life in the atmosphere.

#### **e) Health effects of meat consumption**

In the current health debate, red meat has a negative image. In NOVANIMAL, we are not afraid to discuss the consumption of meat controversially. We conclude that in Switzerland the average (self-declared) consumption of red meat is not within the health risk range. In contrast, processed meat consumption is too high which may increase population health risks.

### f) Health effects of milk and dairy consumption

In the current health debate, milk and dairy (excluding cream and butter) mostly have a positive image. In NOVANIMAL, we criticise the scientific basis of both, the general positive image of milk and dairy, and the negative image of cream and butter. One critical point is the common aggregation of very different dairy products, such as milk, yoghurt and cheese, which is neither adequate from an environmental nor from a health perspective. Another criticism relates to the neglect of invisible milk components which are finely distributed in many processed foods. From an environmental point of view, it would be better to consume less milk. This raises the question of which consumption of which milk and dairy products are minimally necessary from a health point of view. We conclude that the existing data is not sufficient to call for a consumption of 3-4 portions per day, as recommended by the SGE-SSN, nor to define a necessary consumption to minimise health risks. Therefore, it is incomprehensible why the SGE-SSN is calling on the Swiss population to consume more milk and dairy products. The available supply data suggest that the Swiss population has one of the highest consumptions worldwide.

### g) Animal husbandry/protection

In current debates concerning healthy nutrition and sustainable food production, animal protection is a marginal issue. In NOVANIMAL, we have taken into account animal husbandry and protection from the beginning because of different reasons:

- Animal protection is **important** for many people. Therefore, it could **motivate**
  - consumers to reduce animal food product consumption
  - gastronomy to increase quantitative and qualitative vegetarian/vegan and 'less is more'-offers
- **Conflicting objectives** between environmental sustainability and health, and animal protection: Today, there seems to be a broad consensus to recommend resource-efficiently produced 'healthy' chicken instead of beef, thus potentially resolving the conflict at the expense of the animals.
- **Systemic risks** of resource-efficiently produced pig meat and chicken: Resource-efficient means highly specialised 'factory farming' with elevated epidemiological and zoonose risks and antibiotics use

In NOVANIMAL, we aim at **innovations with synergies** between environment, health (systemic health risks included) and animal protection.

## 5. Comparison between actual outputs and expected outputs and reasons for deviance

### More output than expected

#### WPI.2 'Simulation model & scenario analysis'

Additional to system dynamics modelling, two excel-based models were developed to simulate different scenarios.

#### RFIII: 'Demand & consumption'

Integration of questions concerning animal husbandry and animal protection in all interviews and surveys.

WPIII.1 'Menu choice'

There were favourable opportunities for addressing additional research questions:

- Quantitative written survey during the field experiment with qualitative prestudy
- Integrating NOVANIMAL questions into an online survey by SV Schweiz and Facility Management ZHAW
- Life cycle assessment of 93 menus in the field experiment
- Assessing the nutritional balance of 93 menus in the field experiment with two methods
- Cooperation with ZHAW Division of Applied Cognitive Psychology: 3 differing online meal choice experiments with menus from the field experiment

WPIII.2 'Meal offer'

Integrating NOVANIMAL questions into an online survey by GastroSuisse.

WPIII.3 'Vocational education'

Extending investigation of chef's vocational education to hospitality specialists.

WPV.1 'Synthesis & implementation'

Further outputs were generated through coordination meetings with the two other NRP 69 phase 2-projects (Erkman; Stolze) initiated by NOVANIMAL:

- The first coordination meeting was organised by NOVANIMAL on 23<sup>rd</sup> November 2016 at the BFH, Bern.
- The second coordination meeting, combined with the SNF Site Visit, was organised together with the Stolze project on 19<sup>th</sup> January 2018, at FiBL, Frick.

WPV.2 'Communication & dissemination'

Preparation of fact sheets on key topics (uploaded on the NOVANIMAL website):

- Nr. 1 Meat production and consumption in Switzerland (Baur et al., 2018a),
- Nr. 2 Milk and dairy production and consumption in Switzerland (Baur et al., 2018b),
- Nr. 3 Environmental pollution through nutrition (Meier, Baur, & Egeler, 2018),
- Nr. 4 Health and nutrition (Krieger et al., 2018),
- Nr. 5 Animal husbandry in Switzerland (Baur & von Rickenbach, 2018).

More fact sheets are planned, e.g., Household expenses for food.

**Other output than expected**WPII.1 'Lifecycle assessment/modelling agricultural production'

The initial plan to model the environmental impact of animal production was to build a farm model based on the Farm Accountancy Data Network (FADN). This could not be realised due to missing, geographically differentiated data. Instead, statistical data on a community level were used to model animal production in different biogeographic zones.

WPII.1 'Life cycle assessment/modelling biodiversity'

It was planned to model biodiversity as a separate impact category in the life cycle assessment of agricultural production. Therefore, a model to assess the impacts of agricultural production on biodiversity in lowlands should have been transferred to mountain areas using data from the Swiss biodiversity monitoring scheme. Because of data incompatibility, however, this plan failed.

Nevertheless, by using the critical nitrogen loads (CLN) levels in the biogeographic zones as proxy for the local ecosystem boundaries and linking them with the nitrogen depositions from agricultural production, we were able to include biodiversity.

#### WP IV.1 'Policy analysis'

Part of the initial plan was to assess the effects of current agricultural policy on the environment and on health, to investigate how agricultural policy might be further developed to facilitate and leverage innovations in the animal product chains, and to explore the potential of a more independent agricultural research funding. Instead, we explored more in-depth how agricultural production, food processing industries and eating habits developed historically over the last two centuries and the reasons why (Schluep et al., 2019). Additional interviews with senior experts from all nutrition-relevant policy fields complemented the analysis (Schluep, 2019). Final conclusions address important research questions as to how to develop agricultural policy (cf. Section 8 'Identify gaps in the research agenda covered by the goals of NRP 69').

#### WP IV.3 'Dialogic policy making'

Instead of establishing a dialogue between political stakeholders, we organised the experimental dialogue 'NOVANIMAL Innovationen – Dialog mit der Praxis' with professionals from enterprises along the supply chains to discuss the NOVANIMAL innovation ideas (Minsch, Baur, Egeler, von Rickenbach, & Matyas, 2018).

#### WP V.2 'Communication & dissemination'

We focussed on establishing a NOVANIMAL website (<https://novanimal.ch/>). We developed a corporate design and specific NOVANIMAL Formats: Working Papers, 'Faktenblätter', 'Innovationsposter', 'Innovationsblätter' and 'Kurzberichte' to make the project results available as soon as possible for the specific addressees (e.g., in gastronomy, education) and for the civil society (e.g. NGOs, media). The goal was to conduct research in a most transparent way ('gläsernes Forschungsprojekt'). In close cooperation with the team, a cartoonist developed cartoons with relevant messages to awaken people's interest and to make them think (<https://novanimal.ch/cartoons/>).

#### **Less output than expected**

- System dynamics modelling: Beef, veal and dairy production, processing and consumption were simulated in a system dynamics model (Duminy, Heer, Strasser, & Brechbühler Peskova, 2019). The project's realized output, the SwissBeDaPaC system dynamics model, can be adapted to include poultry and pork as soon as data are available.
- Integrated cost analyses of production and processing of dairy, beef, pork and poultry along the supply chains were not feasible because of incongruent production and processing data.
- Life cycle assessment and cost analyses of food processing: Industries could not be motivated to deliver the desired (sensitive) data. Therefore, data had to be obtained from other sources (literature, business reports).
- Work Package WP II.3 'Resource-light menus and their costs': This work package was cancelled soon after the beginning of the project when it was clear that the preparation of the transdisciplinary field experiment needed more time than had been foreseen.

- Elaboration of didactic principles for teaching resource-light cooking: Because of a lack of time and competencies in the team, we renounced this part of WP III.3 'Vocational education'.
- Definition and discussion of public health implications of different scenarios: The scenarios were modelled too late to realise this objective.
- Videos for communication: Two years were too short to implement results in the videos. The idea now is to create videos in a follow-up project. The filmmaker has been familiar with NOVANIMAL since the start and attended the project during the two-day, midterm-creativity workshop.

## **6. Recommendations for policy makers and professionals from the practice; implementation activities that were undertaken to transfer the outputs to the practice**

### **Recommendations**

Concerning recommendations from research, we do not primarily rely on politics. In particular, we do not propose any new political interventions. Our focus is on the 'Bedürfnisfeld' nutrition as an innovation system. However, a few questions and hypotheses concerning the responsibility of policymakers are formulated (cf. Section 8 'Identify gaps in the research agenda covered by the goals of NRP 69').

Concerning recommendations for professionals from practice, we refer to the 102 innovation ideas: cf. five innovation posters (NOVANIMAL Innovationsposter; <https://novanimal.ch/>) and corresponding five innovation sheets (Baur & Egeler, 2019; Ferrara et al., 2018; Frick, 2019a; Spörri, Meier, et al., 2018; Trachsel, von Rickenbach, & Baur, 2019).

Further, we refer to the 'Additional summary with inputs for the NRP 69 synthesis' attached to this report (cf. agreement with the NRP 69 program manager Marjory Hunt).

### **Implementation activities up until December 2018**

- Presenting and discussing NOVANIMAL innovations: NOVANIMAL Dialogue with practice professionals, 10<sup>th</sup> September 2018, Basel (<https://novanimal.ch/dialog/>).
- Transdisciplinary field experiment: More than nine meetings with SV Schweiz AG and Facility Management ZHAW to design, prepare, conduct and evaluate the field experiment. Three of these (18<sup>th</sup> February 2018, 6<sup>th</sup> July 2018, 7<sup>th</sup> December 2018) took place after completion of the field experiment in order to exchange experiences, to present results, to propose innovations and to discuss next steps.
- Presenting NOVANIMAL in several ZHAW teaching courses as well as working with data from the field experiment in two university canteens in ZHAW statistics seminar.

## **7. Contribution to answering the 3 key questions of NRP 69<sup>(1)</sup>; what is the added value of the project's outputs for NRP 69**

- <sup>(1)</sup> a) *How can healthy eating be encouraged in Switzerland?*  
 b) *How can enough and safe food products be made available at affordable prices?*  
 c) *How can the production, processing and distribution of food be managed efficiently with the least impact on the environment ?*

a) NOVANIMAL contribution

Gastronomy is an important and underestimated learning location ('Lernort') to encourage healthier and ecologically more sustainable eating, and is a key player in the supply chain. In particular, community catering (company and school canteens) have a high potential and responsibility for practicing more plant-based, resource-lighter eating habits. (cf. **41 innovations in gastronomy, 21 innovations in vocational education and further training**)

b) NOVANIMAL contribution and hypothesis (from WPIV.1 'Policy analysis')

To make enough and safe food products available at affordable prices, the reduction of border control and the further opening of agricultural markets are a requirement that should be discussed open-minded and unbiased. Switzerland is highly dependent on imports, both food and intermediate inputs for agricultural production. Further, household spending on nutrition in Switzerland is higher than generally communicated: In 2016, the average Swiss household spent 16.1% of its available income on food (77%) and beverages (23%) (BFS, 2018). Low income households spend an even higher proportion of their income on food.

c) NOVANIMAL contribution and hypothesis

Animal production should be adapted to the local ecosystem boundaries, and animal product processing should implement cleantech options. (cf. **22 innovations in agriculture, 18 innovations in food processing**) Further, analysis should take place for which agricultural market policies, direct and indirect subsidies, and low fees or price advantages for natural resources favour domestic production and processing at high economic and environmental costs. Harmful policies and subsidies should be abolished, reduced or modified.

The hypotheses in b) and c) are also addressed in the following section (Section 8).

## 8. Identify gaps in the research agenda covered by the goals of NRP 69

Possible gaps in the NRP 69 research agenda relate to agricultural markets, that are strongly regulated by interventionist policies, and to the economic cost of agricultural policy. An important objective of Swiss agricultural policy is to maintain agricultural production on the current level of 23 300 TJ (Der Bundesrat, 2017, p. 17). Therefore, Swiss agricultural policy promotes the production and sale of animal food products with tariff and non-tariff border protection measures, direct payments and subsidies, for instance, for meat advertising campaigns, disposal of slaughterhouse waste or to reduce prices of milk used in cheese-making. As a result, the hypothetical degree of self-sufficiency (produced calories/available calories) is 100% for animal food products, compared to 40% for vegetables (BLW, 2018). The Confederation's agricultural budget for 2018-2021 is CHF 13.6 billion (CHF 3390 million/year). When market price support of CHF 3730 million/year (2016) (OECD, 2018) is added, economic costs total CHF 7120 million/year. Avenir Suisse estimates the total annual economic cost of agricultural policy at CHF 19,860 million/year, of which environmental cost is CHF 7940 million (Dümmler & Roten, 2018).

We would like to bring the report to a close with questions and hypotheses concerning the responsibility of policymakers for healthy nutrition and sustainable food production in Switzerland in the context of agricultural market policies, consumer perception of Swiss production, and

agricultural research and education. The questions and hypotheses result from the findings and also the original research questions of WP IV.1 'Policy analysis'.

### **Questions and hypotheses relating to effects of current agricultural market policies**

#### How do relatively high meat price levels influence food choice?

We hypothesise that they do not significantly reduce meat consumption, but rather encourage consumption of lower-priced processed meat and of meat from animal husbandry that is neither ecologically sustainable nor species-appropriate. This holds true most of all in gastronomy.

#### How do relatively high prices for fruit and vegetables influence food choice?

We hypothesise that they contribute to the rather low fruit and vegetable consumption in Switzerland.

#### How does the current sophisticated border control phase system for fruit and vegetables (BLW, n.d.) influence food choice?

We hypothesise that it makes seasonal fruit and vegetables more expensive and does not promote seasonal consumption.

#### How would market opening affect animal production?

We hypothesise that domestic production would decrease and ecological and ethological quality of domestic products would increase.

#### How would market opening affect the consumption of animal food products?

We hypothesise that total consumption of animal food products would not increase further because megatrends influencing consumption (e.g. Gender Shift, Health, Knowledge Culture, Silver Society & Millennials, Urbanisation) tend towards eating less meat and dairy.

#### How would market opening affect the process quality of animal food products?

We hypothesise that the ecological and ethological quality of animal product supply would not decrease because the importance of ecological and ethological production is also apparent in the export countries. Switzerland imports mainly from the EU, most of all from Germany and France. Total impacts on the environment and animal husbandry also depend on food importer strategies.

#### How would market opening affect plant production?

We hypothesise that quantity of plant production would decrease but that a greater diversity would be cultivated and that ecological product quality would increase.

#### How would market opening affect the consumption of plant products?

We hypothesise that total consumption and plant product diversity would increase because megatrends influencing consumption (e.g. Gender Shift, Health, Knowledge Culture, Silver Society & Millennials, Urbanisation) tend towards eating a more plant based diet.

## **Questions and hypotheses relating to consumer perception of agricultural production in Switzerland**

### How does so-called consumer patriotism (Konsumpatriotismus) influence demand and consumption?

We hypothesise that the widespread preference of so-called 'regional' food encourages the consumption of meat and dairy products because Swiss agriculture is specialised in the production of animal food products.

### How does the positive image of animal husbandry in Switzerland influence meat demand and consumption?

We hypothesise that it encourages meat consumption because meat can then be eaten with a clear conscience ('psychological rebound effect').

## **Questions and hypotheses relating to agricultural research and education**

### How would more independent agricultural (and food) research in Switzerland change the focus and outcomes of that research?

We hypothesise that more independent research would focus on research that is economically and ecologically more relevant for Switzerland. The reason behind this is that current Federal research in Agroscope focuses almost solely on agricultural production and neglects consumer and food industry interests. Agroscope, with a staff of more than 1000 people, is subordinated to the Federal Office for Agriculture and the research is guided by the administration.

### How can agricultural education be developed to better prepare farmers for the current and expected development of markets?

We hypothesise that current vocational education focuses mostly on technical production and on optimising direct income transfers, and thus does not prepare young professionals sufficiently to produce economically and in line with market opportunities. Market opportunities for Swiss farmers relate to products with high product quality and high ecological and ethological process quality.

These hypotheses partly contradict widespread beliefs and preanalytic visions. We suggest that they be investigated in-depth in further research projects.

## **9. Usage of funding (consumables, salaries, meetings, others)**

The financial report will be available on 28<sup>th</sup> February 2019.



## 10. References

- BAFU. (2017). *Kenngrossen zur Entwicklung der Treibhausgasemissionen in der Schweiz, 1990-2015*. Bern: BAFU.
- Baur, P., & Egeler, G. (2019). *Innovationen im Menü-Angebot: Was es braucht, damit die Gäste von sich aus weniger umweltbelastend essen – und dies mit Genuss* (NOVANIMAL Innovationsblatt). Wädenswil: ZHAW. (in preparation)
- Baur, P., Egeler, G., & von Rickenbach, F. (2018a). *Produktion und Konsum von Milch/-produkten in der Schweiz. Statistische Daten, Schätzungen und Fragen* (NOVANIMAL Faktenblatt No. 2). Wädenswil: ZHAW. Retrieved from [https://novanimal.ch/wp-content/uploads/2018/10/Faktenblatt\\_Milchprodukte-1.pdf](https://novanimal.ch/wp-content/uploads/2018/10/Faktenblatt_Milchprodukte-1.pdf)
- Baur, P., Egeler, G.-A., & von Rickenbach, F. (2018b). *Produktion und Konsum von Fleisch in der Schweiz. Statistische Daten, Schätzungen und Fragen* (NOVANIMAL Faktenblatt No. 1). Wädenswil: ZHAW. Retrieved from [https://novanimal.ch/wp-content/uploads/2018/10/Faktenblatt\\_Fleisch-1.pdf](https://novanimal.ch/wp-content/uploads/2018/10/Faktenblatt_Fleisch-1.pdf)
- Baur, P., Schluep, I., & Minsch, J. (2017). *Trends im Bedürfnisfeld Ernährung. Treiber und Hemmnisse auf dem Weg zu ressourcenleichten Esskulturen* (NOVANIMAL Working Paper No. 1). Wädenswil: ZHAW. Retrieved from <https://novanimal.ch/2018/07/27/novanimal-working-paper-nr-1/>
- Baur, P., & von Rickenbach, F. (2018). *Nutztiere in der Schweiz. Statistische Daten, Schätzungen und Fragen* (NOVANIMAL Faktenblatt No. Nr. 5). Wädenswil: ZHAW. Retrieved from [https://novanimal.ch/wp-content/uploads/2018/10/Faktenblatt\\_Nutztiere.pdf](https://novanimal.ch/wp-content/uploads/2018/10/Faktenblatt_Nutztiere.pdf)
- BFS. (2018). Haushaltsbudgeterhebung (HABE). Retrieved from <https://www.bfs.admin.ch/bfs/de/home/statistiken/wirtschaftliche-soziale-situation-bevoelkerung/erhebungen/habe.html>
- BLW. (2018). *Selbstversorgungsgrad* (Agrarbericht). Bern: BLW. Retrieved from <https://www.agrarbericht.ch/de/markt/marktentwicklungen/selbstversorgungsgrad>
- BLW. (n.d.). Wie ist die Einfuhr von frischem Obst und frischen Gemüsen geregelt? Retrieved 15 February 2019, from <https://www.blw.admin.ch/blw/de/home/markt/einfuhr-von-agrarprodukten/gemuese-und-obst.html>
- Der Bundesrat. (2017). *Gesamtschau zur mittelfristigen Weiterentwicklung der Agrarpolitik*. Bern. Retrieved from <https://www.newsd.admin.ch/newsd/message/attachments/50150.pdf>
- Duminy, L., Heer, I., Strasser, R., & Brechbühler Peskova, M. (2019). *Modelling Swiss beef and dairy production and consumption using system dynamics* (NOVANIMAL Kurzbericht). Bern: BFH. (in preparation)
- Dümmler, P., & Roten, N. (2018). *Eine Agrarpolitik mit Zukunft. Eine Zehn-Punkte-Strategie für Konsumenten, Steuerzahler und landwirtschaftliche Unternehmer* (avenir debate). Zürich: avenir suisse.
- Egeler, G., & Baur, P. (2019). *Transdisziplinäres Feldexperiment in zwei Hochschulmensen: Gewählte Menüs während 12 Wochen* (NOVANIMAL Working Paper). Wädenswil: ZHAW. (in preparation)

- Egeler, G., von Rickenbach, F., & Baur, P. (2019). *Transdisziplinäres Feldexperiment in zwei Hochschulmensen: Design, Vorbereitung und Durchführung* (NOVANIMAL Kurzbericht). Wädenswil: ZHAW. (in preparation)
- Ferrara, P., Gross, T., & Hugi, C. (2018). *Innovationen Nahrungsmittelverarbeitung: Cleantech-Optionen für die Milch- und Fleischindustrie* (NOVANIMAL Innovationsblatt). Muttenz: FHNW.
- Figini, M. (2019). *Vegetarische und vegane Küche in der deutschen Schweiz: Gespräche mit 20 KöchInnen, RestaurantbesitzerInnen und Gastronomieverantwortlichen* (NOVANIMAL Kurzbericht). Wädenswil: ZHAW. (in preparation)
- Frick, J. (2017). *Literature review on meal choice and meal offering* (NOVANIMAL Working Paper No. 2). Wädenswil: ZHAW. Retrieved from [https://novanimal.ch/wp-content/uploads/2018/06/literatur\\_review\\_180118\\_final\\_DC.pdf](https://novanimal.ch/wp-content/uploads/2018/06/literatur_review_180118_final_DC.pdf)
- Frick, J. (2019a). *Innovationen im Gastro-Unternehmen: Wie die Unternehmen ihr Angebot an ökologischeren, tiergerechteren und potentiell gesünderen Menüs verbessern können* (NOVANIMAL Innovationsblatt). Wädenswil: ZHAW. (in preparation)
- Frick, J. (2019b). *Vegetarische und vegane Küche in der deutschen Schweiz: Online-Befragung von Köchen und Gastronomieverantwortlichen* (NOVANIMAL Kurzbericht). Wädenswil: ZHAW. (in preparation)
- Godfray, H. C. J., Aveyard, P., Garnett, T., Hall, J. W., Key, T. J., Lorimer, J., ... Jebb, S. A. (2018). Meat consumption, health, and the environment. *Science*, 361(6399), eaam5324. <https://doi.org/10.1126/science.aam5324>
- Gross, T., Meier, M. S., Brechbühler Peskova, M., Duminy, L., Ferrara, P., Heer, I., ... Hugi, C. (2019). *Resource lighter production and processing of meat and dairy products in Switzerland: Demand coverage and environmental trade-offs* (NOVANIMAL Kurzbericht). Muttenz, Frick, Bern, Tänikon: FHNW, FiBL, BFH, Agroscope. (in preparation)
- Häberli, R., Gessler, R., Grossenbacher-Mansuy, W., & Lehmann Pollheimer, D. (2002). *Vision Lebensqualität: Nachhaltige Entwicklung - ökologisch notwendig, wirtschaftlich klug, gesellschaftlich möglich. Synthesebericht des Schwerpunktprogramms Umwelt Schweiz*. Zürich: vdf Hochschulverlag AG an der ETH Zürich.
- Hoop, D., Spörri, M., Zorn, A., Gazzarin, C., & Lips, M. (2017). *Wirtschaftlichkeitsrechnungen auf Betriebszweigesebene* (Agroscope Science No. 53) (pp. 51–77). Tänikon: Agroscope.
- Jenny, M., Trachsel, S., & Baur, P. (2017). *Umwelt, Gesundheit und Tiere in Lehrmitteln für Köchinnen und Köche und Restaurationsfachleute* (NOVANIMAL Working Paper No. 3). Wädenswil: ZHAW. Retrieved from <https://novanimal.ch/2018/03/12/novanimal-working-paper-nr-3/>
- Krieger, J.-P. (2018). *Les effets sur la santé des produits laitiers et carnés: que disent les données épidémiologiques?* (NOVANIMAL Working Paper No. 4). Zurich: Université de Zurich.
- Krieger, J.-P., Fäh, D., Egeler, G., & Baur, P. (2018). *Gesundheit und Ernährung. Gesundheitsrisiken im Zusammenhang mit dem Konsum von Milch/-produkten und Fleisch* (NOVANIMAL Faktenblatt No. 4). Wädenswil: ZHAW. Retrieved from [https://novanimal.ch/wp-content/uploads/2018/12/2018\\_krieger\\_novanimal\\_faktenblatt.pdf](https://novanimal.ch/wp-content/uploads/2018/12/2018_krieger_novanimal_faktenblatt.pdf)

- Meier, M. S., Baur, P., & Egeler, G. (2018). *Umweltbelastung durch Ernährung. Perspektiven Gesamtkonsum, Inland/Ausland und Nahrungsmittel-Versorgungskette* (NOVANIMAL Faktenblatt No. 3). Wädenswil: ZHAW.
- Meier, M. S., & Moakes, S. (2019). *Swiss animal production adapted to local ecosystem boundaries: Production potential and eco-efficiency within different bio-geographic regions in Switzerland* (NOVANIMAL Kurzbericht). Frick: FiBL. (in preparation)
- Minsch, J., Baur, P., Egeler, G., von Rickenbach, F., & Matyas, J. (2018). *NOVANIMAL-Innovationen. Dialog mit der Praxis, 10. September 2018, Markthalle Basel*. Wädenswil: ZHAW. Retrieved from <https://novanimal.ch/dialog/>
- Minsch, J., & Mogalle, M. (1998). Wie ist Transdisziplinarität möglich? Der Bedürfnisfeldansatz in der Nachhaltigkeitsforschung. *Ökologisch Wirtschaften*.
- Mogalle, M. (2000). Der Bedürfnisfeld-Ansatz. Ein handlungsorientierter Forschungsansatz für eine transdisziplinäre Nachhaltigkeitsforschung. *GAIA - Ecological Perspectives for Science and Society*, 9(3), 204–210.
- Muir, K. (2018). *Transdisziplinäres Feldexperiment in zwei Hochschulmensen: Umweltbewertung von 93 Menüs* (NOVANIMAL Kurzbericht). Wädenswil: ZHAW. (in preparation)
- Müller, C., & Egeler, G. (2018). *Transdisziplinäres Feldexperiment in zwei Hochschulmensen: Beurteilung der ernährungsphysiologischen Ausgewogenheit von 93 Menüs* (NOVANIMAL Kurzbericht). Wädenswil: ZHAW.
- OECD. (2018). OECD.Stat 2018 - Monitoring and evaluation : Reference Tables. Retrieved from [https://stats.oecd.org/viewhtml.aspx?datasetcode=MON2018\\_REFERENCE\\_TABLE&lang=en#](https://stats.oecd.org/viewhtml.aspx?datasetcode=MON2018_REFERENCE_TABLE&lang=en#)
- Schluep, I. (2019). *Stimmen aus ernährungsrelevanten Politikbereichen* (NOVANIMAL Working Paper). Zürich: CCRS. (in preparation)
- Schluep, I., Baur, P., & Minsch, J. (2019). *Prägende Epochen der Schweizer Esskultur* (NOVANIMAL Working Paper). Zürich, Wädenswil: CCRS, ZHAW. (in preparation)
- Spörri, M., Hoop, D., & Heer, I. (2018). Neue Erkenntnisse zur Milchviehhaltung unter zukünftig restriktiveren Rahmenbedingungen (pp. 12–14). Presented at the 58. Jahrestagung der GEWISOLA, Kiel.
- Spörri, M., Meier, M. S., Heer, I., & Moakes, S. (2018). *Innovationen Landwirtschaft: Ideen für eine ressourceneffiziente und standortangepasste Milch- und Fleischproduktion* (NOVANIMAL Innovationsblatt). Tänikon, Frick, Bern: Agroscope, FiBL, BFH.
- Trachsel, S., von Rickenbach, F., & Baur, P. (2019). *Innovationen in der Berufs- und Weiterbildung: Wie KöchInnen und Restaurationsfachleute motivierter und kompetenter werden, ökologischere, tiergerechtere und potentiell gesündere Menüs zu kochen und zu empfehlen* (NOVANIMAL Innovationsblatt). Wädenswil: ZHAW. (in preparation)
- Trachsel, S., von Rickenbach, F., & Jenny, M. (2019). *Berufsbildung in der Gastronomie: Was wissen angehende KöchInnen, Restaurationsfachleute, Küchenangestellte und ihre Lehrpersonen über die Zusammenhänge zwischen Ernährung und Umwelt, Gesundheit, Tieren?* (NOVANIMAL Kurzbericht). Wädenswil: ZHAW. (in preparation)

- Trachsel, S., von Rickenbach, F., Matyas, J., & Jenny, M. (2019). *Berufsbildung in der Gastronomie: Meinungen und Einstellungen von angehenden KöchInnen, Restaurationsfachleuten, Küchenangestellten und ihren Lehrpersonen zur vegetarischen und veganen Küche* (NOVANIMAL Kurzbericht). Wädenswil: ZHAW. (in preparation)
- Von Rickenbach, F., & Baur, P. (2019). *Transdisziplinäres Feldexperiment in zwei Hochschulmensen: Gästebefragung* (NOVANIMAL Working Paper). Wädenswil: ZHAW. (in preparation)
- Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., ... Murray, C. J. L. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, 393(10170), 447–492.  
[https://doi.org/10.1016/S0140-6736\(18\)31788-4](https://doi.org/10.1016/S0140-6736(18)31788-4)
- Zorn, A., Bertoni, A., Nofer, N., Hoop, D., Spörri, M., & Lips, M. (2018). *Wirtschaftlichkeit der Betriebszweige der tierischen Veredlung* (Agroscope Science No. 70) (pp. 1–84). Tänikon: Agroscope.