NOVANIMAL

Innovations for a future-oriented consumption and animal production

NOVANIMAL Innovations for a future-oriented consumption and animal production

Problems, methods, results and recommendations,
prepared for the NRP 69 sounding board
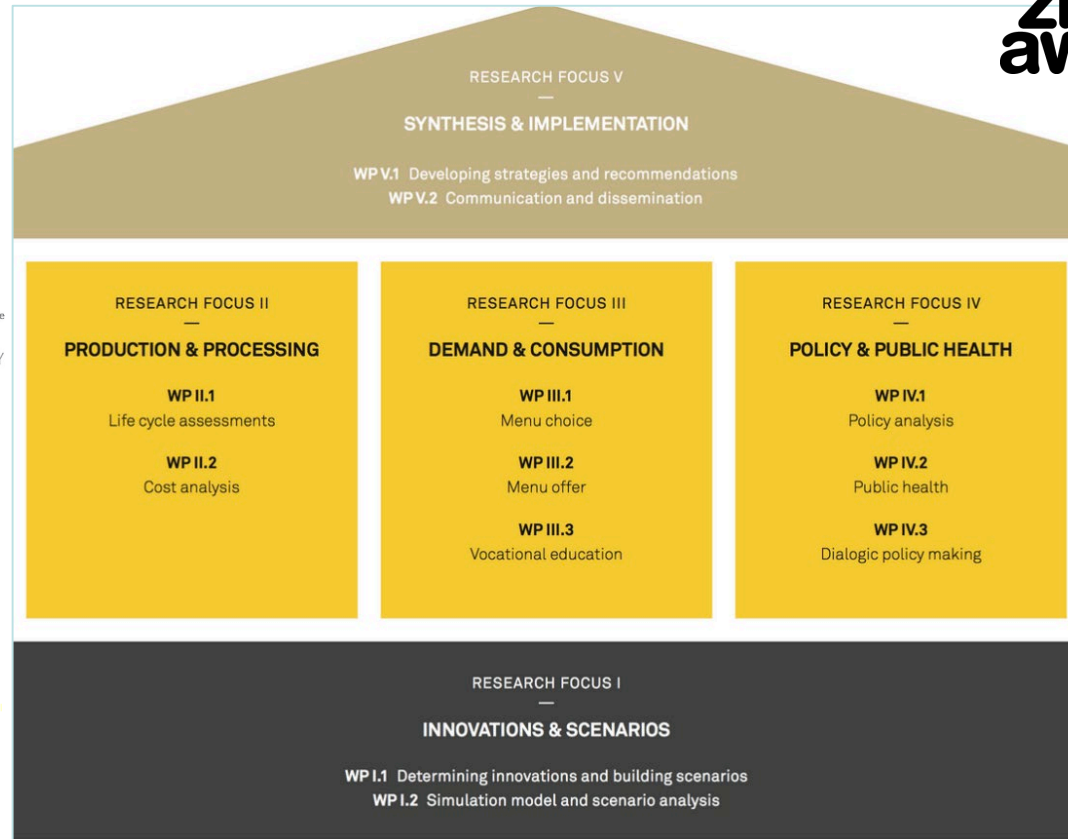
Reported by Priska Baur, 10th April 2019

FNSNF
SWISS NATIONAL SCIENCE FOUNDATION

**Healthy Nutrition and
Sustainable Food Production**
National Research Programme NRP 69

«Chesa NOVANIMAL»

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1. Problems

High annual use of meat and dairy per capita in Switzerland
(FAO, 2017; CH: +shopping abroad)

➢ Meat: CH ca. **80 kg** – World ca. 40 kg

➢ Dairy: CH ca. **340 kg** – World ca. 90 kg

High livestock in Switzerland with harmful emissions

➢ water, air and climate (nitrate, phosphate, ammoniac, methane, …)

➢ ecosystems and biodiversity (nitrogen, …)

Swiss food cultures center around meat and dairy products

➢ Low consumption of fruit, vegetables, pulses, nuts, etc.

➢ No attractive offer of plant based meals in gastronomy

2. Objectives

Finding innovations that contribute to

➢ an animal production adapted to local ecosystem boundaries

➢ an efficient use of energy, water and raw materials in food processing

➢ a lower use and consumption of meat and dairy in gastronomy

Identifying constraints hindering innovations in

➢ agriculture

➢ food processing

➢ gastronomy

Developing approaches to promote resource-lighter eating habits

➢ that are more plant based

➢ with more creativity and variety on our dinner plates

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3. Methods (I)

Field experiment in two university canteens during 12 weeks

➢ Transdisciplinary approach: with SV Schweiz and Facility Management ZHAW

➢ Datasets: 26'234 sold meals; choice patterns of 1'560 canteen visitors

Quantitative surveys

➢ Written survey during field-experiment: usable data of 1'176 students/staff

➢ Online survey of chefs, restaurant/hotel owners, managers: 905 respondents

➢ Integrating questions in 2 GastroSuisse online surveys: 834 & 1'883 respondents

Qualitative surveys (interviews)

➢ 20 chefs, restaurant/hotel owners, managers: fully transcribed protocols

➢ 6 vocational teachers (chefs & hospitality spec.): fully transcribed protocols

➢ 6 classes with 79 apprentices (chefs & hospitality sp.): fully transcribed prot.

➢ 19 senior experts from nutrition relevant policy fields: protocols

3. Methods (II)

Life cycle assessment

- Animal production: beef, veal, milk, pork, broiler, eggs
- Processed foods: milk, cheese, butter, beef
- Gastronomy: 93 meals in field experiment

Nutrition balance assessment (93 meals in field experiment)

- EBP-model ('Ernährungsphysiologische Balancepunkte')
- Plate-model ('Tellermodell')

Modelling

- Excel-based farm model to simulate animal production in 8 CH zones with different local ecosystem boundaries
- Excel-based model to simulate animal food product processing
- Swiss Beef and Dairy Production and consumption system dynamics model

3. Methods (III)

In-depth literature reviews

➤ Meal choice and meal offering

➤ Public health and meat / dairy consumption

Additional methods

➤ Exploring trends, drivers and constraints in the need-field nutrition

➤ Full cost analyses of milk production, suckler cows, beef, pork, egg

➤ 3 online meal choice experiments with 1054, 923, 151 respondents

➤ Qualitative document analysis of teaching materials of chefs/hospitality spec.

➤ Qualitative document analysis of 27 essays written by apprentices (chefs, hosp.)

➤ Historical analysis of the development of agricultural production, food processing industries, eating habits and food related policies over the last two centuries

➤ Experimental dialogue on innovations with professionals from the supply chains

Transparent research & communication & dissemination

➤ NOVANIMAL website

➤ 12 NOVANIMAL cartoons by Sylvia Vananderoye

➤ NOVANIMAL fact sheets, reports and working papers

3. Methods (IV)

What is an innovation?

In NOVANIMAL, an innovation is defined as

➢ 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.

NOVANIMAL dialogue with professionals

10th September 2018

4. Results: Innovations in agriculture & food processing

Agriculture: 22 innovations, e.g.

– Animal stocking density adapted to local ecosystem boundaries

– «Feed no food-strategy» in cattle feeding

– Regional nutrient cycles in pigs and poultry

> **Cattle: minus 30-40%, milk: minus 40-50%, beef: minus 30-40%**

> **Pig: minus 45-60%, pigmeat: minus 50-70%**

> **Poultry: minus > 80%, eggs: minus 80%, chicken: minus > 90%**

Food processing: 18 innovations, e.g.

– Energy: fossil fuels are replaced by renewable energy sources

– Food losses: making use of by-products in animal production

– Water: recirculation of washing water

> **E.g. global warming potential: potentially minus 90%**

> However: **benefits moderate** compared to production and consumption

4. Results: Innovations in out-of-home consumption (I)

21 (+7) innovations to motivate guests eating more vegetable and fewer animal products, e.g.

➢ **Qualitative offer**: delicious, varied and creative vegetarian and vegan (veg^2) dishes; not only meat substitutes; authentic veg^2 dishes

➢ **Quantitative offer**: increase number and percentage of veg^2 dishes; hot & cold buffet with mainly veg^2 components

➢ **Menu labelling**: not advertise as veg^2; appetizing creative meal descriptions; declare veg^2 dishes discreetly and objectively/factually, together with other ingredients

➢ **Positioning at meal counter**: no special veg^2 menu line; offer veg^2 on all menu lines

➢ **Positioning on the menu**: no separate compartments for meat, fish and veg^2 dishes; distribution of veg^2 dishes throughout the menu

➢ **Use synergies**: combine veg^2 dishes with lactose-/gluten-free; offer of veg^2 dishes for members of different cultures, religions, values

➢ **«Less is more»**: less meat dishes on the menu; remove/reduce «invisible» animal foods from recipes; «from nose to tail»; meat not in the centre, but as a «spice»; animal food from animal-appropriate breeding and husbandry (+7)

4. Results: Innovations in out-of-home consumption (II)

13 innovations to improve the range of attractive veg^2 dishes

➢ **New specialisations**: promote and recruite veg^2 cuisine specialists; encourage specialists for «less is more» meat cuisine

➢ **New needs, new audience**: veg^2 cuisine not for vegetarians/vegans, but for flexitarians; address new target groups: children and adolescents, female guests, international business people and tourists

➢ **Diversity and creativity**: pick up employee knowledge; traditional/origin cuisine as inspiration; «cook in residence»; competitions; invest in training

➢ **Supplier relationships**: ingredients and pre-products for veg^2 cuisine: use and optimize existing supply chains; build up new supply networks

➢ **Technical prerequisites**: invest in infrastructure and equipment for veg^2 cuisine: prepare, store, arrange, present

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4. Results: Innovations in out-of-home consumption (III)

21 innovations to promote motivated and competent chefs and hospitality specialists

➢ **Basic skills vocational education**: place in theory and practice for veg^2 cuisine; minimum requirements for training restaurants with regard to veg^2 offer; sensitisation of trainers in training restaurants

➢ **Background knowledge in basic education**: relations between food production and the environment; animal husbandry, protection and welfare; diversity of eating cultures and international nutrition trends

➢ **Educational plans and teaching materials**: more veg^2 recipes; more knowledge concerning food production and the environment, animal husbandry etc.; final apprenticeship examination: include a veg^2 dish in qualification proceedings

➢ **Specialization in vocational education and training**: teachers specializing in veg^2 cuisine; new apprenticeship: veg^2 chef; higher professional examination: veg^2 «Chefkoch»

➢ **Upgrading education**: from 3- to 4-year apprenticeship; additional apprenticeship as veg^2 chef; additional sustainability module; joint inter-company courses; exchange programs

4. Results: Drivers of innovations

Megatrends relevant to nutrition

➢ **Seven trends motivating a moderate animal products consumption**:
gender shift, health, knowledge culture, neo-ecology & smart new green,
security, silver society & millenials, urbanisation

➢ **Four trends promoting resource-efficient production & processing**:
globalisation, global scarcity of natural resources, neo-ecology & smart
new green, urbanisation

Specific drivers

➢ **Agriculture & food processing**: economic opportunities arising from
changing eating habits and food demand; technological development;
competition; increasing resource prices; resource scarcities; scarcities
animal feed (cereals)

➢ **Consumption, gastronomy and vocational education**: economic
opportunities arising from changing eating habits and attracting a new
clientele, in particular woman; emergence of a global society; competition;
chef's professional ambitions

4. Results: Constraints in agriculture & food processing

Constraints in agriculture

➢ CH agriculture specialised in animal production

➢ Self-image of farmers

➢ Reducing animal production contradicts CH agricultural policy

– Maintain agricultural production on current level (23300 TJ)

– Maintain «self-sufficiency», which is for animal food products 100%

– Manifold measures and subsidies promoting milk and meat production

Constraints in food processing

➢ Investing in cleantech in food processing does not pay off

– Subsidised prices (e.g. water, energy, waste)

– No polluter pays principle

➢ Efficiency gaps not seen or perceived as 'minor problems'

➢ Small-scale production and processing structures

➢ Often large variety of products in small quantities

4. Results: Constraints in consumption, gastronomy, vocational education (I)

Sociocultural and psychological constraints

➢ The 4 Ns: meat is 'natural', 'normal', 'necessary' and 'nice'

➢ Meat is perceived as the most valuable item on the plate

➢ 'Regional' products are preferred, which in CH means meat and dairy

➢ Positive image of animal husbandry and animal 'welfare' in CH

➢ Meat is the rule, vegetarian the exception and vegan a disturbance

➢ Veg^2 is cooked and marketed for minority of guests with veg^2 lifestyles

➢ Kitchen hierarchy: meat chef is highest

➢ 'male chefs cook for male guests'

➢ Beliefs concerning a balanced diet: each day and each meal balanced

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4. Results: Constraints in consumption, gastronomy, vocational education (II)

Economic constraints

➢ Expectation, that veg² dishes should cost less

➢ Veg² cuisine is more demanding and time consuming

➢ Lack of skills and knowledge to prepare attractive veg² dishes

➢ Well-established supply chains for meat and dairy (lock-in-effect)

➢ Promotional meat predominates ('Aktionsfleisch')

5. Propositions/recommendations

(additional to proposed innovations in agriculture, food processing and gastronomy)
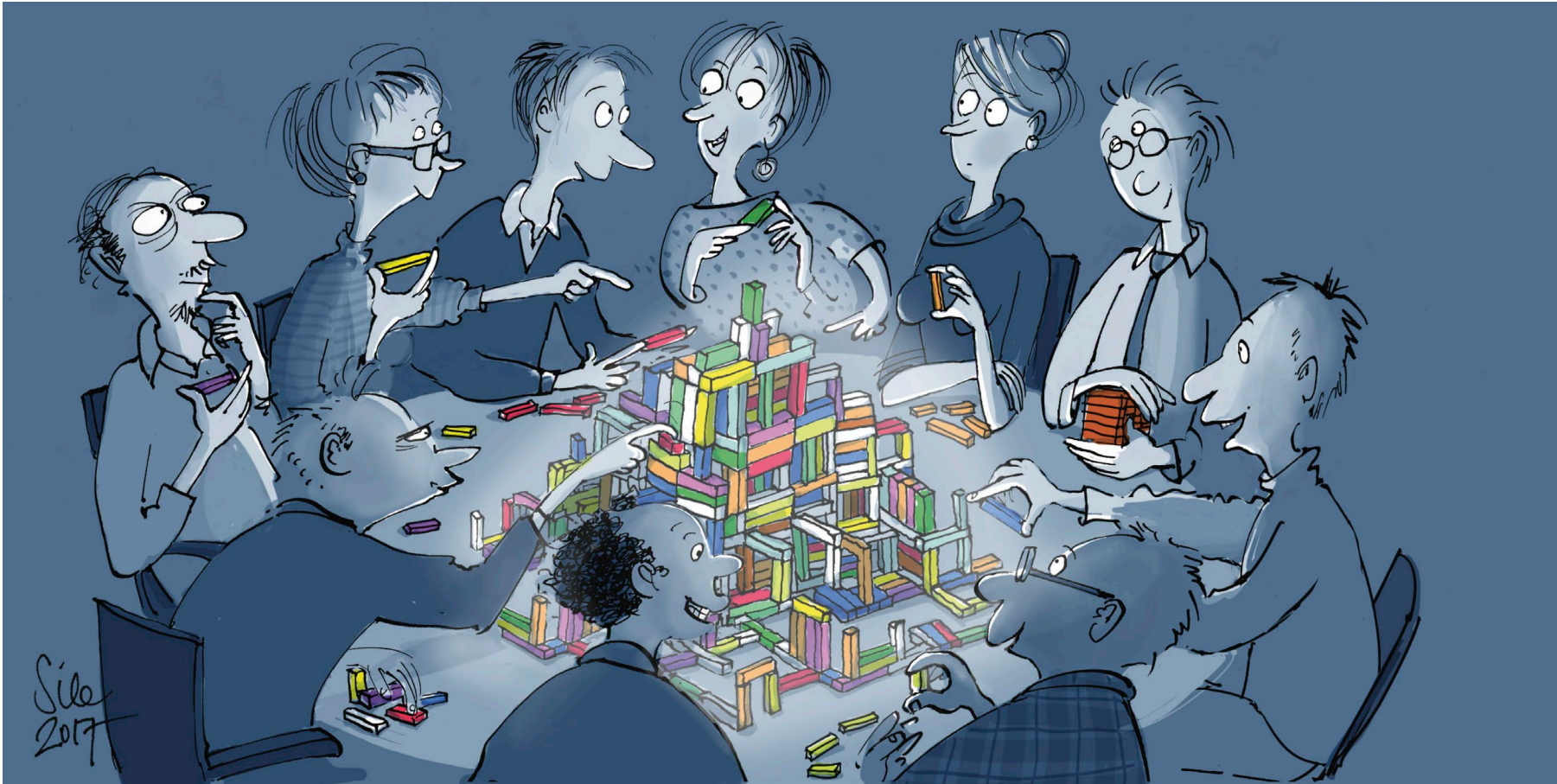
5. Propositions/recommendations (I)

Federal Council, Federal Administration and Parliament

➢ **Conflicting goals**: There are fundamental conflicts between **agricultural, food security, environmental, health, macroeconomic and social interests**. They were not in the focus of the NOVANIMAL project and would have exceeded the possibilities of the project by orders of magnitude, but they were evident throughout the project. These conflicts should be addressed farsightedly and courageously.

➢ **Agricultural research is not independent**: Publicly funded agricultural research in Switzerland is **guided by the Federal Administration** (Federal Office of Agriculture). Research neglects consumer and food industry interests. It should be discussed if a more independent research could contribute to more relevant outcomes concerning food security, food safety, consumer preferences, health and environment.

Farmers

➢ **Doubtful investments in animal production**: Poultry production in CH doubled since 2000. In the short term, production is profitable. But **poultry production in CH is ecologically and economically not sustainable**. It is not resilient to delivery crises ('animal material' and fodder imported). And it may be questioned by ethical reasons.

5. Propositions/recommendations (II)

Food processing

- **Wrong incentives by politics**: **'Perverse' subsidies** (e.g. lower prices for large water or energy consumers or waste producers) should be abolished.

- **Natural resource use**: The **potential to reduce natural resource use** and food waste and to increase resource-efficiency could be more exploited.

- **Responsibility of powerful companies**: In CH, Coop and Migros are the largest meat processors, traders, importers and sellers. Their business strategy is aimed at **maintaining or even increasing per capita animal product consumption**. From an environmental and a health perspective powerful companies should assume more responsibility.

Gastronomy

- **Unsatisfactory veg² offer**: The demand for veg² dishes is greater than perceived by gastronomy (lock-in-effect). However, the offer is quantitatively and qualitatively unsatisfactory. Gastronomy should **invest in the veg² cuisine** or is at risk of missing the development.

- **No marketing for the niche**: Gastronomy still offers veg² dishes for 'vegetarians' and 'vegans'. This is a fundamental misunderstanding and mistake. Veg² dishes should be **cooked for flexitarians and meat-eaters**.

5. Propositions/recommendations (III)

Gastronomy, cont.

➢ **Win new customers**: Today, gastronomy still cooks for a 'male clientele'. If gastronomy wants to profit from women's increasing purchasing power, the offer must become **more creative and more plant-based**. Women are more demanding, they like to choose and more often prefer veg[2].

➢ **Responsibility of large caterers**: 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. In particular large caterers and community gastronomy are 'scout and guide' on the way to more plant-based eating habits.

➢ **The end of generalists in the kitchen**: The idea that a chef is capable of cooking delicious meat, fish and veg[2] menus is outdated. More **professionalization and specialization** is needed. There are chefs specialized in meat cuisine, which includes the competence to cook 'from nose to tail'. And there are chefs who specialize in veg[2] cuisine.

➢ **Role models, inspirations and pioneers**: A more plant-based cuisine can be inspired by a person's **own traditions** ('grandmas' apple pie'), by eating cultures in other parts of the **world**, prominent **celebrity chefs** who are passionate about veg[2] cuisine and successful **pioneers**.

5. Propositions/recommendations (IV)

Products and supply networks

➢ **Unsatisfactory products and purchase options**: A greater variety of **high quality precursors** is needed which make it easier to prepare attractive veg^2 dishes. This also means **new supply networks**.

Vocational education

➢ **Apprenticeship does not prepare for the future**: The prospective chefs need **more background knowledge** about nutrition. They should learn more about a modern, **increasingly plant-based cuisine**. Vocational training and teaching materials need to be adapted.

➢ **Improved education is not enough**: New specialists are needed in the kitchen. A **new apprenticeship for veg² cuisine**, including specialized further training opportunities ('Chefkoch') could make a difference.

Nutrition guidelines

➢ **Swiss dietary guidelines SGE-SSN under criticism**: Current guidelines are only partially in line with scientific evidence. The potential of an increasingly plant-based diet is not sufficiently recognised or translated into recommendations. We encourage to **review and revise guidelines** against the background of new scientific findings, controversies and uncertainties, and considering effective eating habits.

WWW.NOVANIMAL.CH

Ein Forschungsprojekt des Schweizerischen Nationalfonds im NFP 69 «Gesunde Ernährung und nachhaltige Lebensmittelproduktion»

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Annex 1: Selected data & findings

Swiss meat production growing again

Jährliche Fleischproduktion in der Schweiz 1961 - 2016
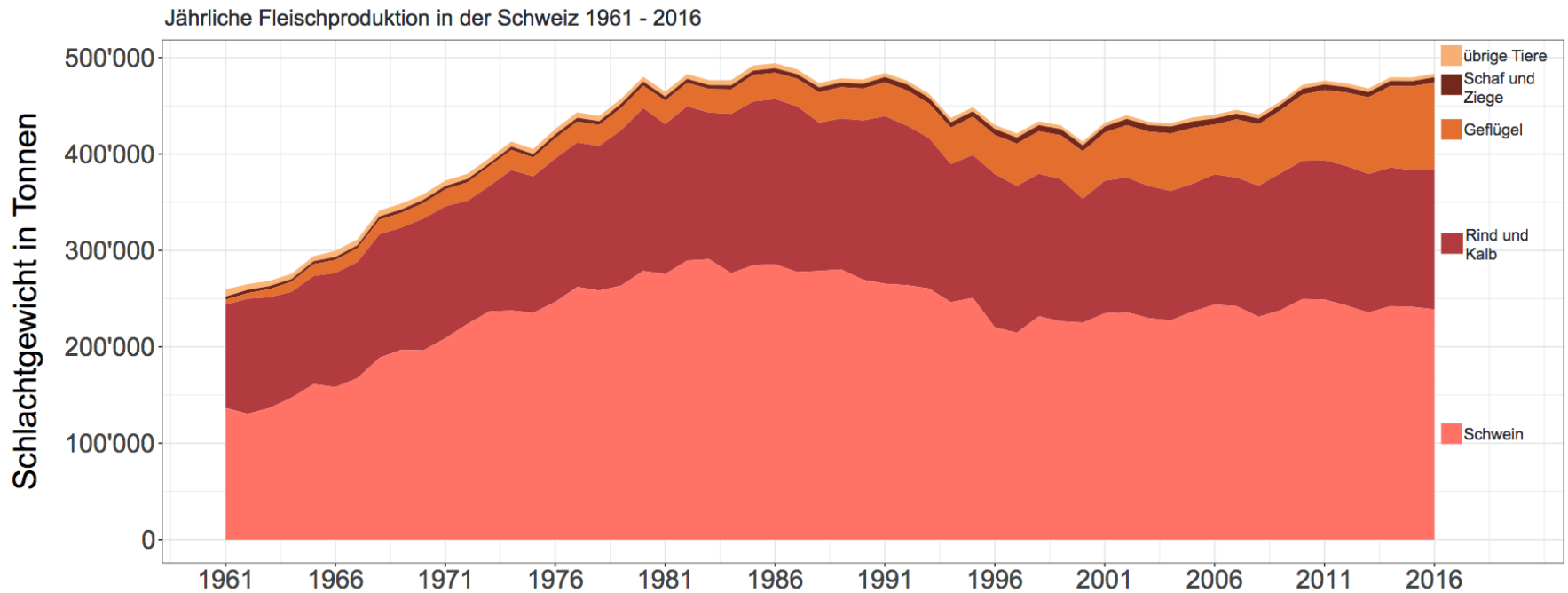
Data: FAO (2018)

After WW II: ‚take-off‘ of pig stock and then poultry

Livestock in Switzerland, 1821–2017

Data: OFS, Historical Statistics (Schluep et al., 2019)
Graphic: Lorenz Rieger, ZHAW
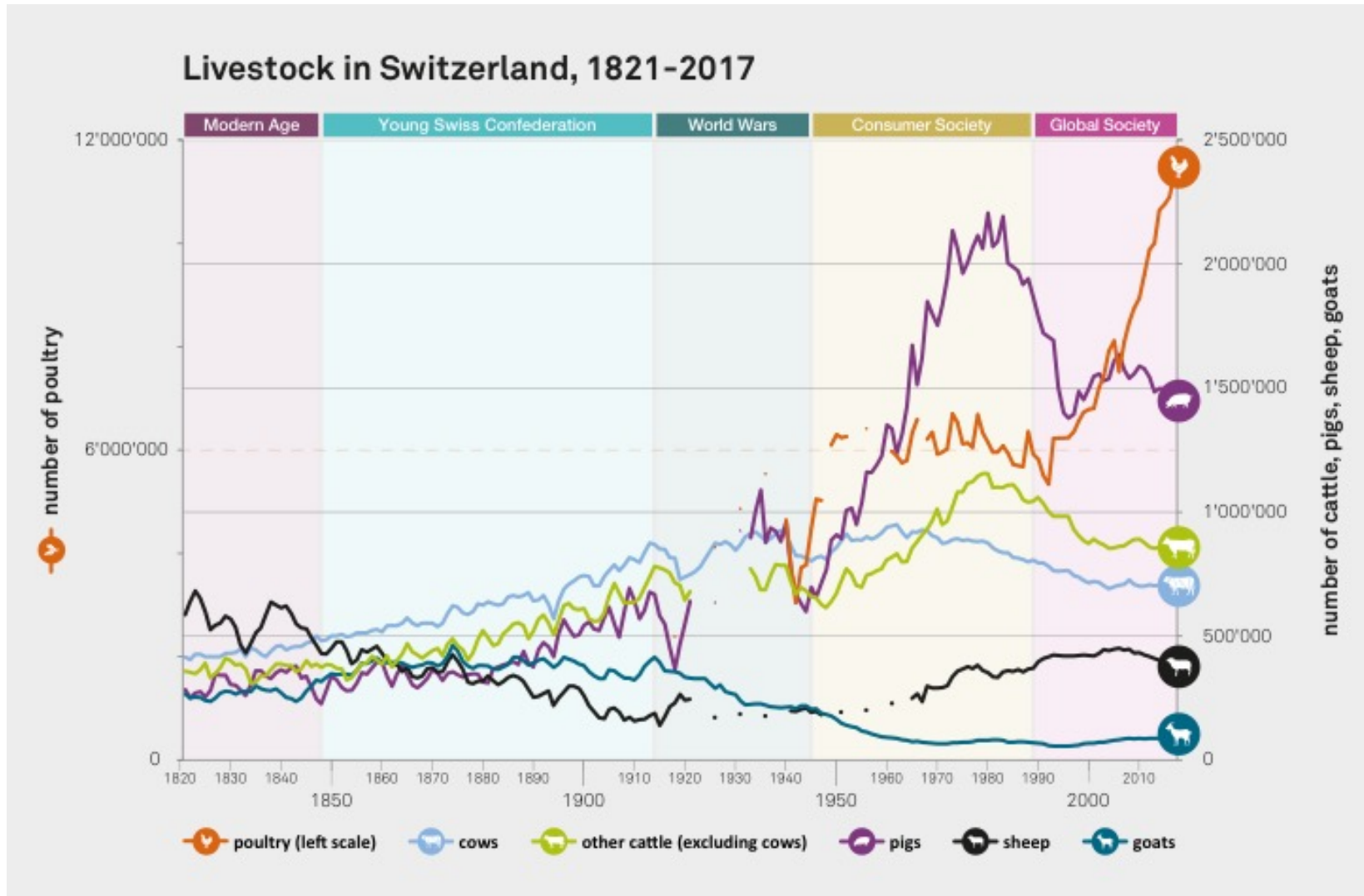
Swiss methane emissions the same as 100 years ago

1910: 5.3 million tons CO_2-eq, 2015: 5.08 million tons CO_2-eq

Total cattle: 1914: 1.65 million, 2015: 1.55

Total methane emissions in Switzerland, CO_2-eq, 1900 - 2015
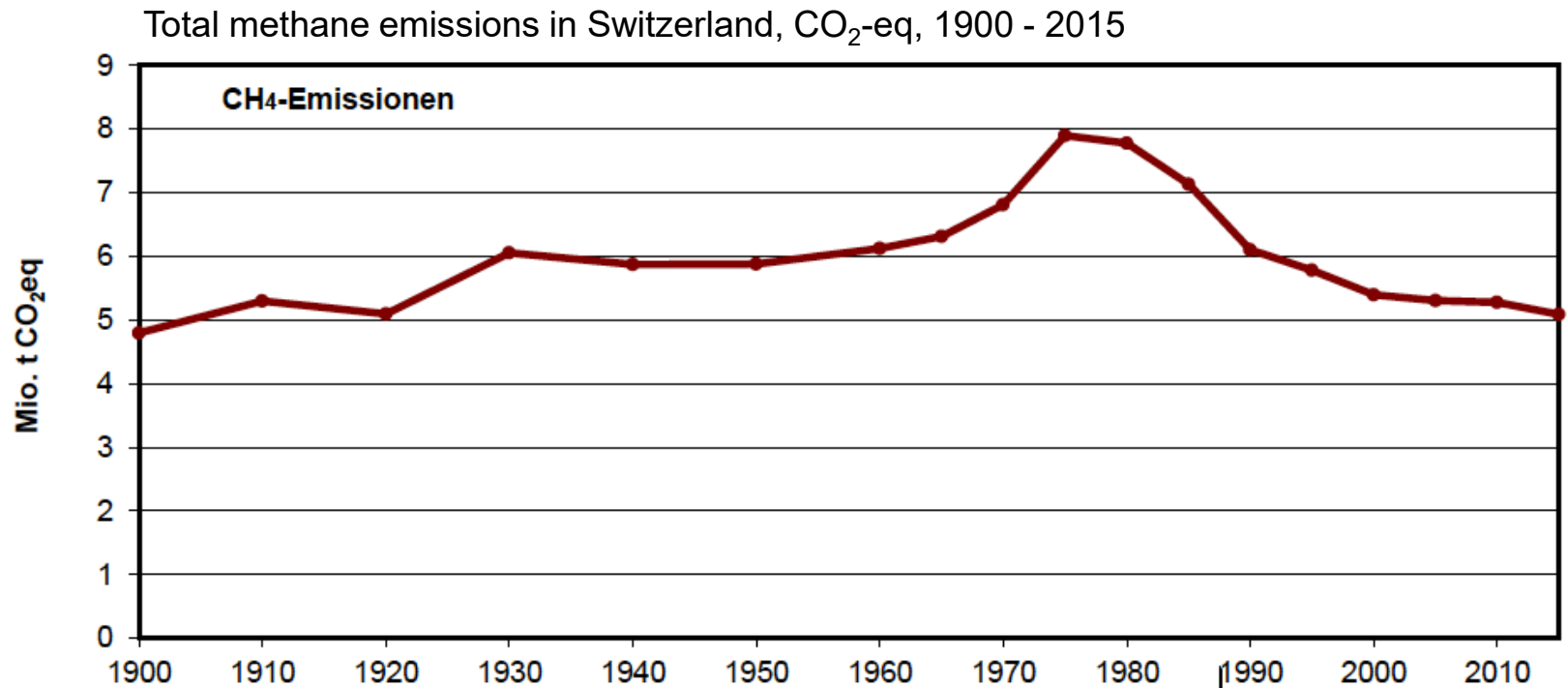
Source: FOEN (2017; pp 57)

Men choose meat more often than women

Meal sales by content and gender in 'basis' and 'intervention' weeks
(687 females & 816 males; 21853 transactions)

Daten: Kassendaten SV Schweiz und ZHAW (2017)

Analysis & graphic: Gian-Andrea Egeler, ZHAW
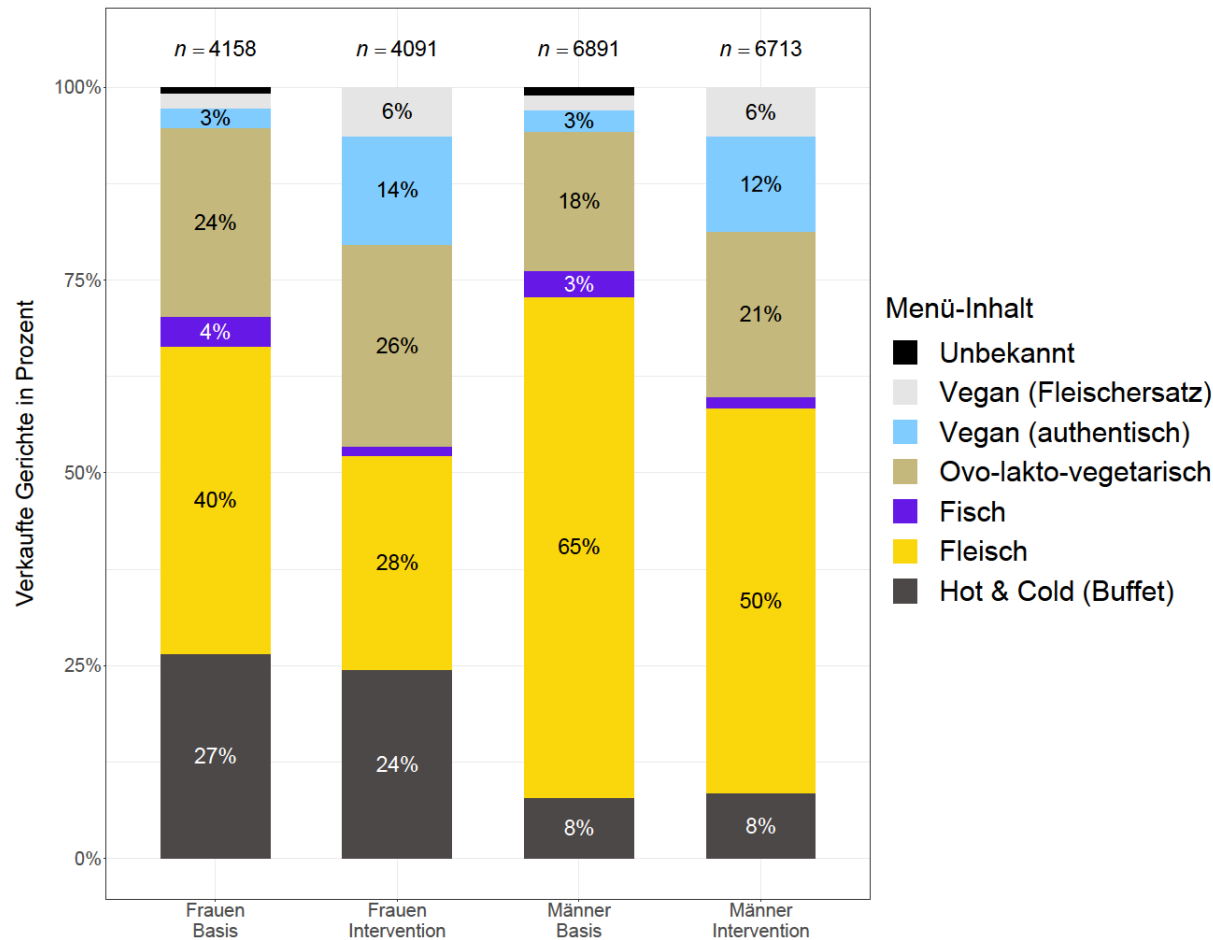
Respondents who ate in the canteen were not less satisfied with the chosen menu in the intervention weeks (874 canteen visitors)

Ich fand das Menü gut.

Analysis & graphic: Flavio von Rickenbach, ZHAW
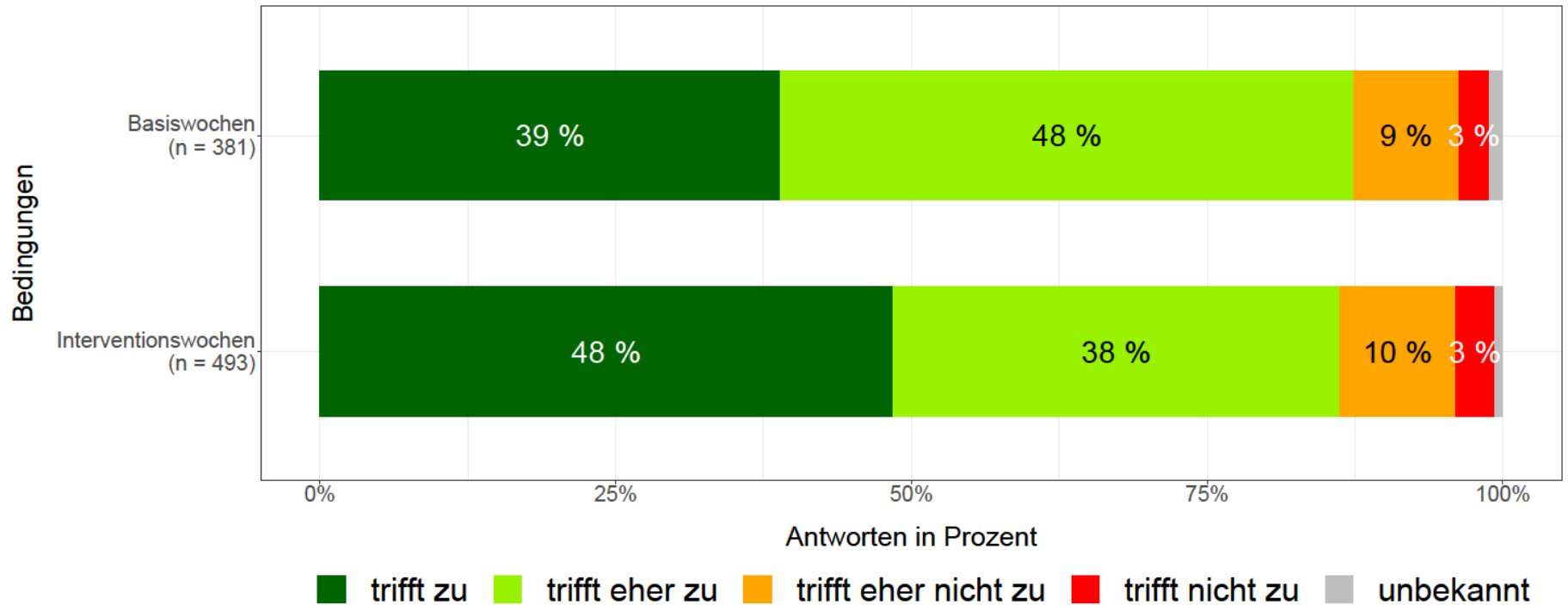
Daten: ZHAW (2017)

>90% of canteen visitors ate both, meat and vegetarian
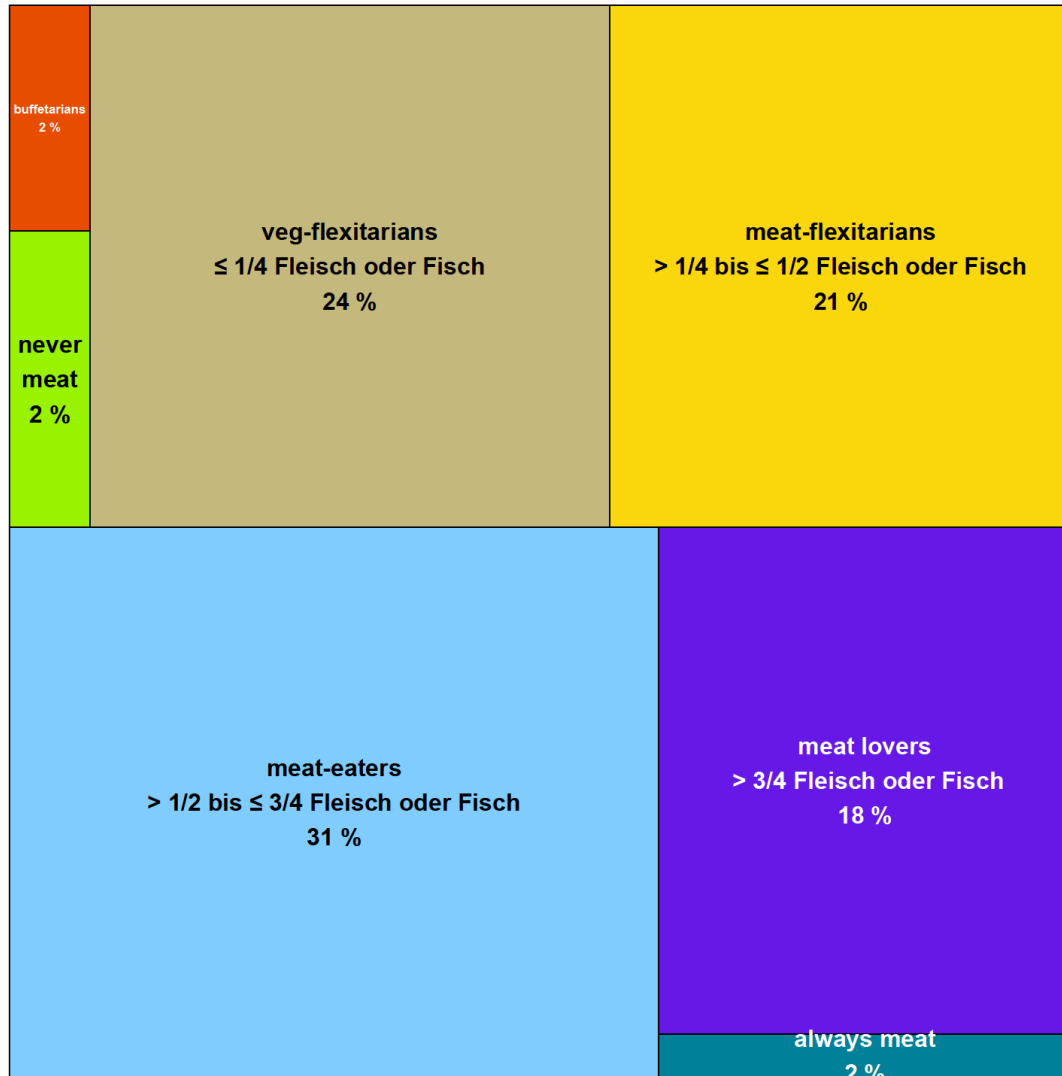
Meal choice patterns of 1'007 regular canteen visitors

buffetarians
2 %

veg-flexitarians
≤ 1/4 Fleisch oder Fisch
24 %

meat-flexitarians
> 1/4 bis ≤ 1/2 Fleisch oder Fisch
21 %

never
meat
2 %

meat-eaters
> 1/2 bis ≤ 3/4 Fleisch oder Fisch
31 %

meat lovers
> 3/4 Fleisch oder Fisch
18 %

always meat
2 %

Daten: Kassendaten SV Schweiz und ZHAW (2017)

Analysis & graphic: Gian-Andrea Egeler, ZHAW

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Female canteen visitors are less often meat-eaters or meat lovers than male (30% vs. 64%)

Meal choice patterns by gender (1007 regular canteen visitors)

Frauen (416)	3% 3% 38% 25% 25% 5%	
Männer (591)	14% 18% 36% 28%	

0% 25% 50% 75% 100%

Anteil Personen mit Ernährungsmuster

Ernährungsmuster:
- buffetarians
- never meat
- veg-flexitarians
- meat-flexitarians
- meat-eaters
- meat lovers
- always meat

Daten: Kassendaten SV Schweiz und ZHAW (2017)

Analysis & graphic: Gian-Andrea Egeler, ZHAW
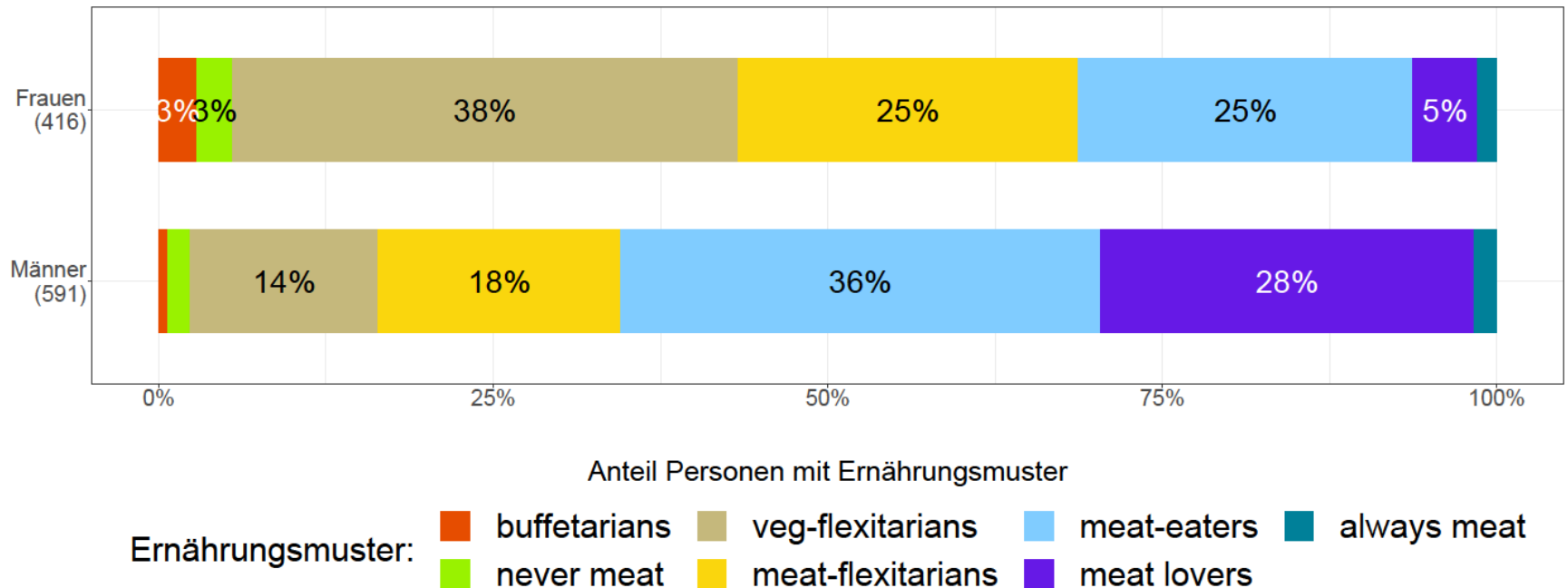
Respondents who had chosen a meat dish worried less frequently about the consequence of their diet for their health, the environment, animals or the workers in the supply chain (799 canteen visitors)

Ich mache mir allgemein Gedanken über die Folgen meiner Ernährungsweise für...

	stimme zu	stimme eher zu	stimme eher nicht zu	stimme nicht zu	unbekannt
Gesundheit (Gericht ohne Fleisch oder Fisch)	55 %	36 %	7 %		
Gesundheit (Gericht mit Fleisch oder Fisch)	33 %	48 %	11 %	7 %	
Umwelt (Gericht ohne Fleisch oder Fisch)	49 %	34 %	12 %	4 %	
Umwelt (Gericht mit Fleisch oder Fisch)	20 %	42 %	26 %	12 %	
Arbeitende in der Wertschöpfungskette (Gericht ohne Fleisch oder Fisch)	32 %	41 %	20 %	6 %	
Arbeitende in der Wertschöpfungskette (Gericht mit Fleisch oder Fisch)	15 %	35 %	34 %	15 %	
Tierwohl (Gericht ohne Fleisch oder Fisch)	47 %	34 %	12 %	6 %	
Tierwohl (Gericht mit Fleisch oder Fisch)	19 %	43 %	21 %	16 %	

Antworten in Prozent

Legende: ■ stimme zu ■ stimme eher zu ■ stimme eher nicht zu ■ stimme nicht zu ■ unbekannt

Daten: ZHAW (2017)

Analysis & graphic: Flavio von Rickenbach, ZHAW

SGE-SSN's 'plate-model' rates meat meals better than vegetarian and vegan meals.

Nutritional balance assessment of 93 meals with the EBP- and the 'plate model'
The 'Ernährungsphysiologische Balancepunkte' (EBP)-model is based on the nutrient profiling of the UK Food Standard Agency; the 'plate model' on the 'optimal plate' by the SGE-SSN.

Daten: SV Schweiz (2017),
BLS 3.02 (2017)
Berechnung: Claudia Müller

Graphic: Gian-Andrea Egeler, ZHAW
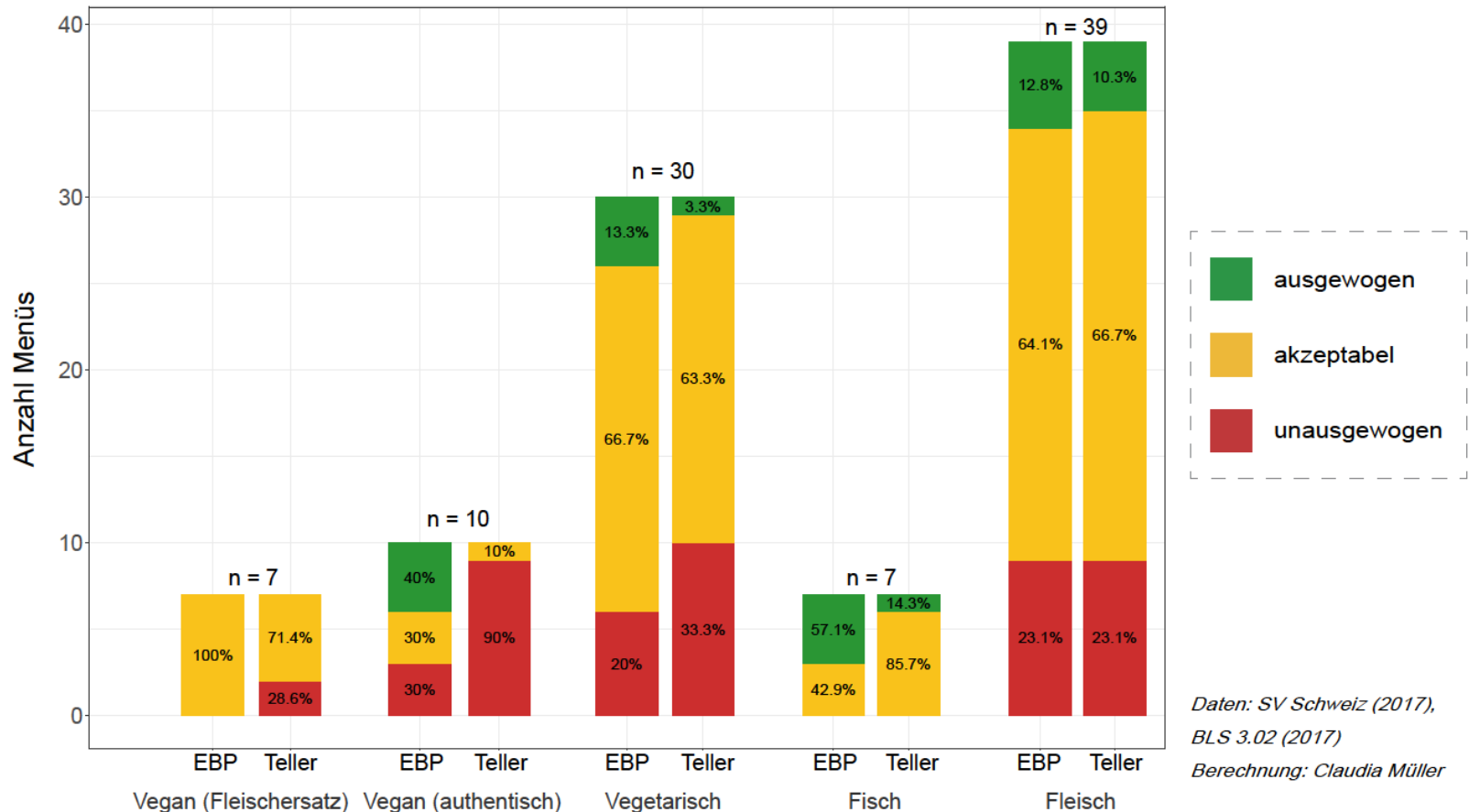
The EBP- and 'plate-model' match for 52% of meals (48 of 93).
Only 3 are rated balanced by both, 2 of them with poultry, 1 with fish.

Matching of the two rating methods EBP and 'optimal plate'.

TELLER-MODELL

EBP-MODELL	Ausgewogen	Akzeptabel	Unausgewogen	Total
Ausgewogen	3	7	7	17
Akzeptabel	2	39	17	58
Unausgewogen	1	11	6	18
Total	6	57	30	93

Daten: SV Schweiz (2017), BLS 3.02 (2017)
Berechnung: Claudia Müller

Average consumption of dairy products in Switzerland is in the 'green' range

Milch/-produkte
Portionen*/Tag

Konsum gemäss Selbstdeklaration
durchschnittlich 2 Portionen*/Tag

Empfehlunge SGE
3-4 Portionen*/Tag

Gesundheitsrisiken

0   1   2   3   4   5   6
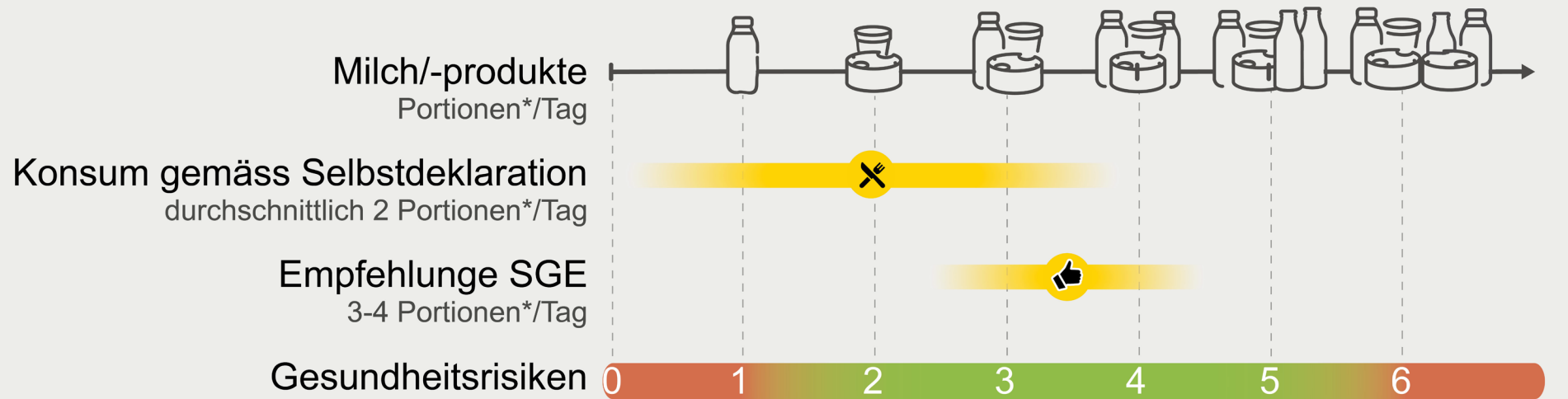
*Eine Portion entspricht 200 ml Milch oder 150-200 g Joghurt/Gewürzkäse/Hüttenkäse/andere Milchprodukte oder 30 g Hart- oder Schnittkäse oder 60 g Weichkäse.

Quellen: BLV (2017a), Krieger (2018), SGE (o. J. a)

durchschnittlicher Konsum CH: 2 Portionen*/Tag (menuCH, 2014/2015)

Empfehlung SGE: 3 - 4 Portionen*/Tag

Gesundheitsrisiken (Epidemiologie): im grünen Bereich eher gesundheitsfördernd, im roten Bereich eher gesundheitsschädigend (Krieger & Fäh, 2018)

Source: https://novanimal.ch/wp-content/uploads/2018/12/2018_krieger_novanimal_faktenblatt.pdf

Average consumption total red meat in acceptable range, processed meat in 'deep red'-range.

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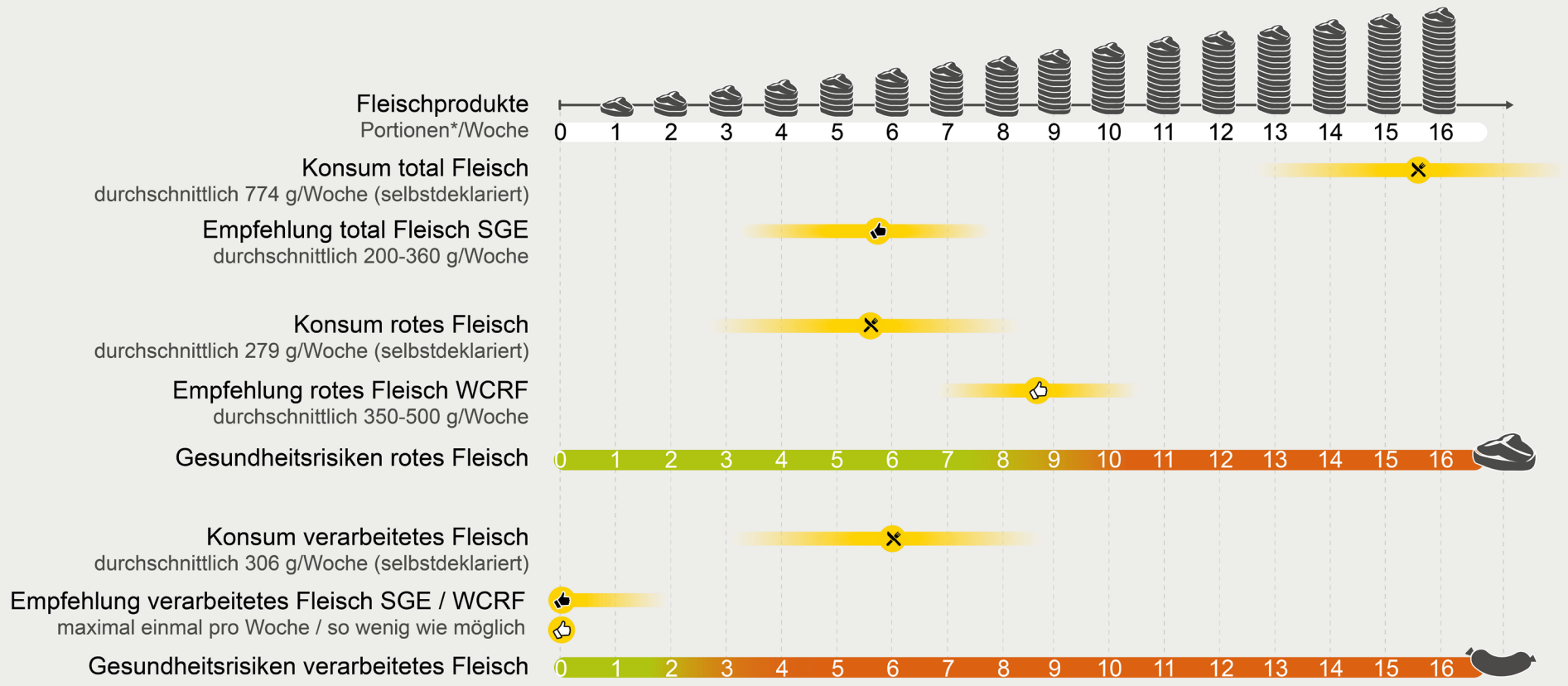Innovations for a future-oriented consumption and animal production

Fleischprodukte
Portionen*/Woche
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Konsum total Fleisch
durchschnittlich 774 g/Woche (selbstdeklariert)

Empfehlung total Fleisch SGE
durchschnittlich 200-360 g/Woche

Konsum rotes Fleisch
durchschnittlich 279 g/Woche (selbstdeklariert)

Empfehlung rotes Fleisch WCRF
durchschnittlich 350-500 g/Woche

Gesundheitsrisiken rotes Fleisch
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Konsum verarbeitetes Fleisch
durchschnittlich 306 g/Woche (selbstdeklariert)

Empfehlung verarbeitetes Fleisch SGE / WCRF
maximal einmal pro Woche / so wenig wie möglich

Gesundheitsrisiken verarbeitetes Fleisch
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

*In dieser Abbildung entspricht eine Portion 50g Fleisch.

Quellen: BLV (2017b), Krieger (2018), SGE (o. J. b), WCRF (2018)

Konsum CH (menuCH, 2014/2015)   Empfehlungen WCRF   Empfehlungen SGE

Gesundheitsrisiken (Epidemiologie): im grünen Bereich eher gesundheitsfördernd, im roten Bereich eher gesundheitsschädigend (Krieger & Fäh, 2018)

Source: https://novanimal.ch/wp-content/uploads/2018/12/2018_krieger_novanimal_faktenblatt.pdf

Annex 2: Differences between NOVANIMAL and widespread views

Differences between NOVANIMAL and common positions in research

➢ **Political postulates and appeals**: Innovation ideas primarily address commercial enterprises along the food supply chains.

➢ '**Action knowledge**': Research often enhances system and target knowledge, NOVANIMAL focuses in particular on action knowledge: the questions are how meat consumption can be reduced and how animal production can be adapted to the location.

➢ **Gastronomy**: Out-of-home consumption/catering seem blind spots in sustainability research although importance is high and will probably increase. Searching for impact, NOVANIMAL research addresses gastronomy in particular.

➢ **Cattle vs. poultry**: General position 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.

Differences between NOVANIMAL and common positions in research, cont.

➢ **Health effects of meat consumption**: Health effects of meat consumption are discussed controversially. We conclude that in Switzerland the average (self-declared) consumption of red meat is not within the health risk range. In contrast, declared processed meat consumption could increase population health risks.

➢ **Health effects of milk and dairy consumption**: We criticise the scientific basis of the general positive image of milk and dairy over a very large range, and the negative image of cream and butter. Criticisms:

– No general differentiation in analyes between very different dairy products, such as milk, yoghurt and cheese, but simple aggregation

– Neglection of invisible milk components which are finely distributed over many processed foods

We conclude that existing data is not sufficient to call for a consumption of 3-4 portions of dairy products per day, as recommended by the SGE-SSN.

NOVANIMAL

Differences between NOVANIMAL and common positions in research, cont.

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.