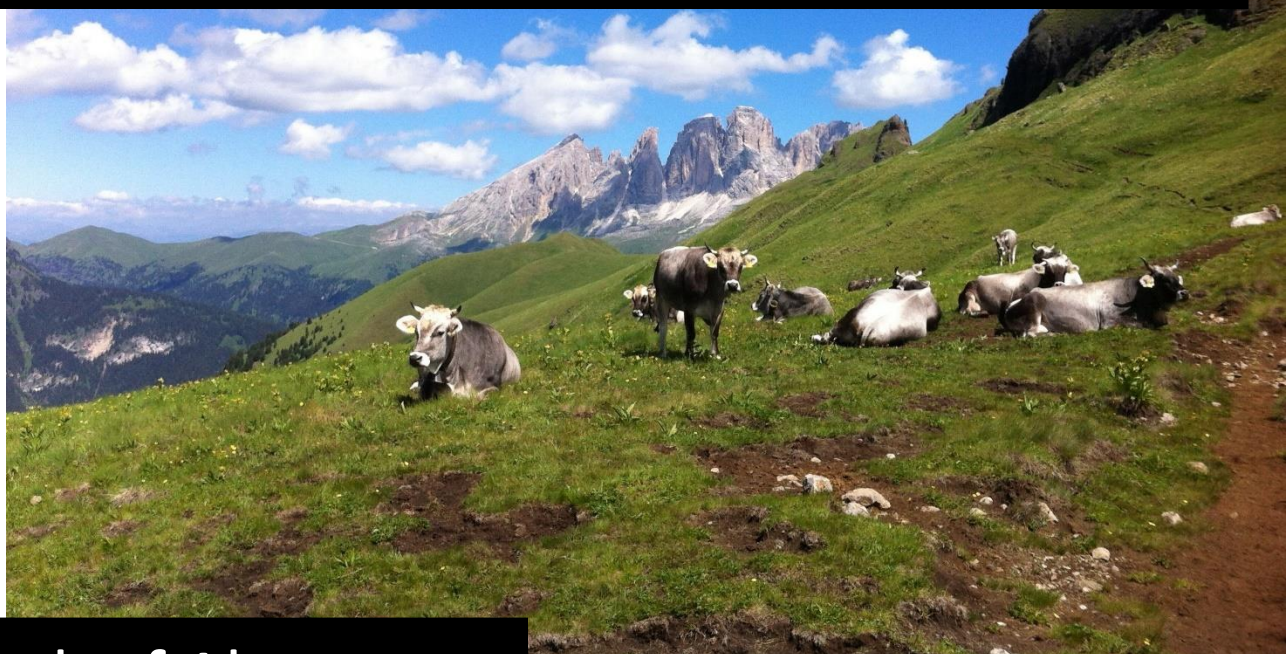


Bozen-Bolzano 2018

# 1<sup>st</sup> European Symposium on Livestock Farming in Mountain Areas



Book of Abstracts

20.-22.06.2018

a cooperation of Freie Universität  
Bozen-Bolzano, EURAC Research,  
EAAP, Università degli studi di  
Padua and FIBL Switzerland

**Welcome to the “1st European Symposium on Livestock Farming in Mountain Areas” 2018!**

Livestock farms located in mountain areas around the globe are very diverse and individual enterprises. They differ for example in size, species, breeds, equipment, mechanization, product processing, social structure and farmers' personality. Moreover, the legal framework that farms are operating in might differ between countries as well. Nonetheless, many mountain farms face similar challenges independent of geographical location. Such challenges include harsh climate, steepness of lands, high altitudes, isolation of farms or wildlife interactions – to name only a few. With our Symposium, we want to introduce a platform where scientists working in various environments and disciplines related to mountain livestock farming can present and discuss their work, interact with a diversified audience and exchange ideas. Discovering similarities as well as differences, and learning from each other are the main aims of our meeting. Therefore, within the three days of the Symposium there are times for scientific talks as well as for personal interactions and exchange of experiences between participants to stimulate discussions.

We are happy to host this Symposium in Bozen-Bolzano. There are many people who have contributed to the organization of this event. Without their help, the organization would not have been feasible – we are grateful for all the support we received.

We further thank all the local sponsors who helped to make this Symposium possible through their generous contributions!

***The organizing committee welcomes you to Bozen-Bolzano and we wish you a stimulating and enjoyable conference in South Tyrol!***

The organizing committee

**We are grateful to the sponsors of our symposium:**



Città di Bolzano  
Stadt Bozen



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Milk  
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## Conference Program Overview

<b>Tuesday 19.06.18</b>	
<b>16.00 – 18.00</b>	<b>Registration opens at EURAC (Drususallee 1/Viale Druso 1, 39100 Bozen-Bolzano)</b>
<b>18.00 – 22.00</b>	<b>Welcome reception at Faculty Club F7 Unibz (Universitätsplatz/Piazza Università 1, 39100 Bozen-Bolzano)</b>

<b>Wednesday 20.06.18</b>	
<b>07.30 – 08.45</b>	<b>Registration and Coffee</b>
<b>08.45 – 09.15</b>	<b>Welcome Session</b>
<b>09.15 – 09.45</b>	<b>Invited Talk 1: “New breeding strategies for local and endangered cattle breeds in the Alps”, Johann Sölkner, University of Natural Resources and Life Sciences (Austria)</b>
<b>10.00 – 10.30</b>	<b>Session 1a: Mountain Dairy Breeding and Husbandry I Session 1b: Mountain Farms in their Social Environment</b>
<b>10.30 – 11.00</b>	<b>Coffee Break</b>
<b>11.00 – 11.30</b>	<b>Invited Talk 2: “Niche Marketing for Premium Food: The example of Mountain Products”, Achim Spiller, Georg-August-University Göttingen (Germany)</b>
<b>11.45 – 12.45</b>	<b>Session 2a: Mountain Sheep and Goat Breeding and Husbandry I Session 2b: Innovation and Marketing of Mountain products</b>
<b>12.45 – 14.00</b>	<b>Lunch Break</b>
<b>14.00 – 14.30</b>	<b>Invited Talk 3: “Socioeconomic valuation of ecosystem services delivered by mountain livestock farming”, Alberto Bernués Jal, Centro de Investigación y Tecnología Agroalimentaria de Aragón (Spain)</b>
<b>14.45 – 16.00</b>	<b>Session 3a: Mountain Livestock and Landscape Biodiversity Session 3b: Mountain Dairy Breeding and Husbandry II</b>
<b>16.00 – 16.30</b>	<b>Coffee break</b>
<b>16.30 – 17.15</b>	<b>Session 4a: Cooperatives in Mountain Farming Session 4b: Poultry and Horses in Mountain Farming</b>
<b>17.15 – 19.30</b>	<b>Poster Session and Aperitivo</b>

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<b>Thursday 21.06.18</b>	
<b>08.30 – 09.00</b>	<b>Invited Talk 4: “Reciprocal relationships between humans and wolves as a way to keep wolves at distance from livestock”, Michel Meuret and Nicolas Lescureux, COADAPHT network animator/INRA and CNRS (France)</b>
<b>09.15 – 10.00</b>	<b>Session 5a: Wildlife management in the mountains Session 5b: Mountain Dairy Breeding and Husbandry III</b>
<b>10.00 – 10.45</b>	<b>Coffee break</b>
<b>10.45 – 12.00</b>	<b>Session 6a: Farm Economics and Succession in Mountain Livestock Farming Session 6b: Grassland Management and Mountain Pasture</b>
<b>12.00 – 13.45</b>	<b>Lunch Break</b>
<b>13.45 – 14.15</b>	<b>Invited Talk 5: “Phenotypic variation of technological and nutritional milk traits in local and cosmopolitan dairy breeds reared in mountain areas”, Massimo De Marchi, Università degli studi di Padova (Italy)</b>
<b>14.30 – 15.00</b>	<b>Session 7a: Mountain livestock product quality Session 7b: Mountain Sheep and Goat Breeding and Husbandry II</b>
<b>15.00 – 15.45</b>	<b>Session 8a: Mountain Dairy Breeding and Husbandry IV Session 8b: Mountain Livestock and Climate Change</b>
<b>15.45 – 16.15</b>	<b>Closing of the conference</b>
<b>16.15 – 17.00</b>	<b>Next conference; Founding an EAAP Working group</b>
<b>18.00 – 19.00</b>	<b>City Walking Tour Bozen Meeting Point: 17.45 EURAC OR 18.00 Waltherplatz in the city centre</b>

<b>Friday 22.06.18</b>	
<b>07.45 – 13.45</b>	<b>Excursion, Meeting Point: EURAC</b>

## Conference Program: Session Details

Wednesday 20.06.18, EURAC, Drususallee 1/Viale Druso 1, 39100 Bozen-Bolzano		
	Conference Hall Ground Floor	Seminar Room Ground Floor 1-2-3
<b>07:30 – 08:45</b> <b>Registration and Coffee</b>	<b>Foyer: Registration, Coffee</b>	
<b>08.45 – 09.15</b> <b>Welcome Session</b> <b><u>Auditorium</u></b>	<b>Greetings and Welcome in the Auditorium:</b> Matthias Gauly, Unibz Arnold Schuler, Regional Minister for Agriculture South Tyrol Ulrike Tappeiner, President Unibz Roberta Bottarin, Vice-President EURAC	/
<b>09.15 – 09.45</b> <b>Invited Talk</b> <b><u>Auditorium</u></b>	Johann Sölkner, University of Natural Resources and Life Sciences (Austria): New breeding strategies for local and endangered cattle breeds in the Alps <i>Chair: Matthias Gauly</i>	/
<b>10.00 – 10:30</b> <b>Session 1a/b</b>	<b><i>Mountain Dairy Breeding and Husbandry I</i></b> <i>Chair: Giulio Cozzi</i>	<b><i>Mountain Farms in their Social Environment</i></b> <i>Chair: Christian Hoffmann</i>
10.00 – 10.15	Fuerst-Waltl, Birgit et al.: Alpine pasturing of young stock positively affects fitness-related traits	Guidobono Cavalchini, Antoniotto et al.: Animal systems in the Apennines and economic and environmental sustainability
10.15 – 10.30	Zupan, Manja et al.: Keeping cows on mountain alpine pasture affects rising and fear towards unfamiliar humans positively	Quendler, Erika: The social inclusion of female farmers in mountain areas
<b>10:30 – 11:00</b> <b>Coffee Break</b>	<b>Foyer and Garden: Coffee break</b>	
<b>11.00 – 11.30</b> <b>Invited Talk</b>	Achim Spiller, Georg-August-University Göttingen (Germany): Niche Marketing for Premium Food: The example of Mountain Products <i>Chair: Gesa Busch</i>	



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<b>11:45 – 12:45</b> <b>Session 2a/b</b>	<b><i>Innovation and Marketing of Mountain products</i></b> <i>Chair: Gesa Busch</i>	<b><i>Mountain Sheep and Goat Breeding and Husbandry I</i></b> <i>Chair: Veronica Maurer</i>
11.45 – 12.00	Gambardella, Annalisa et al.: Innovation and promotion of livestock product systems: a case study of the mountain regions of the Calabrian inland	Weber, H�el�ene: The role of sheep in the transformations of sheep farming and marketing of lambs in Switzerland
12.00 – 12.15	Rainis, Simona et al.: Remarkable value of the dairy products in the mountain of FVG (Italy): role of quality labels and technical assistance	Rose, Ian et al.: Breeding goals for sheep managed on extensive farms need to be adapted to the number of animals managed
12.15 – 12.30	Sturaro, Enrico: The added value of mountain livestock products: an ecosystem services approach	Mendel, Christian et al.: Preserving Alpine Biodiversity with Indigenous Livestock Breeds: the example of the Alpine Steinschaf
12.30 – 12.45	Segato, Severino et al.: The analysis of nutritional profile and communication strategy of intensive and extensive dairy chain products in the North-East of Italy	Milerski, Michal et al.: Milk production and composition in Wallachian sheep
<b>12:45 – 14:00</b> <b>Lunch Break</b>	<b>Foyer and Garden: Lunch break</b>	
<b>14:00 – 14:30</b> <b>Invited Talk</b>	Alberto Bernu�es Jal, Centro de Investigaci�n y Tecnolog�a Agroalimentaria de Arag�n (Spain): Socioeconomic valuation of ecosystem services delivered by mountain livestock farming <i>Chair: Thomas Streifeneder</i>	/
<b>14.45 – 16.00</b> <b>Session 3a/3b</b>	<b><i>Mountain Livestock and Landscape Biodiversity</i></b> <i>Chair: Thomas Streifeneder</i>	<b><i>Mountain Dairy Breeding and Husbandry II</i></b> <i>Chair: Giulio Cozzi</i>
14.45 – 15.00	Silvestri, Silvia et al.: Agro-ecological typization of hay meadows in mountain areas: a tool for the sustainable management of local forage resources	Bieber, Anna et al.: Comparison of production level, fertility and health associated traits of native and commercial dairy cattle breeds on organic farms in Austria and Switzerland
15.00 – 15.15	Schneider, Manuel et al.: Counteracting green alder expansion by extensive grazing: Potential and challenges	Herndl, Markus et al.: Eco-efficient dairy farming – a case study from a mountainous region in Austria
15.15 – 15.30	Pauler, Caren et al.: Does cattle breed prime the composition of grazed vegetation?	Flach, Laura et al.: Effect of low and high concentrate supplementation on health and welfare in mountain dairy farms
15.30 – 15.45	Assandri, Giacomo et al.: The impact of modern dairy farming on avian communities: a case study in the hay meadows of Trentino	Saha, Sudeb et al.: Effects of summer transhumance of dairy cows to alpine pastures on milk composition and cheese yield

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15.45 – 16.00	Monsorno, Roberto et al.: HealthyFarm: providing a Precision Livestock Farming solution within the process of digital transformation in agriculture	Just, Annik et al.: Genotype by environment interactions in low and high altitude farm locations and production systems for milk production traits in Brown Swiss cattle
<b>16.00 – 16.30 Coffee break</b>	<b>Foyer and Garden: Coffee break</b>	
<b>16:30 – 17:15 Session 4a/4b</b>	<b><i>Cooperatives in Mountain Farming</i></b> <i>Chair: Christian Hoffmann</i>	<b><i>Poultry and Horses in Mountain Farming</i></b> <i>Chair: Veronika Maurer</i>
16.30 – 16.45	Miribung, Georg: “Community-barns” as an instrument to foster cooperation between small-scale farmers: legal issues and challenges	Ablondi, Michela et al.: Explore genetic diversity at pedigree level in an Italian native mountain horse breed to develop strategies for breed preservation and management
16.45 – 17.00	Romanzin, Alberto: Dual Breeding Project - Dual-purpose cattle breeds: an alternative model of eco-sustainable animal husbandry	Lambertz, Christian et al.: Potential of two dual-purpose chicken genotypes for egg and meat production for small-scale mountain farmers
17.00 – 17.15	Pachoud, Carine: Relations of proximity between local actors and territorial development dynamics: analysis of the artisanal Serrano cheese value chain in the Campos de Cima da Serra region/RS-Brazil	Wuthijaree, Kunlayaphat et al.: Prevalence and burden of helminths in free-range laying hens under mountain farming conditions in Northern Italy
<b>17.15 – 19:30 Poster Session and Aperitivo</b>	<b>Poster session + Come together (Aperitivo)</b>	

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Thursday 21.06.18, EURAC, Drususallee 1/Viale Druso 1, 39100 Bozen-Bolzano		
	Conference Hall Ground Floor	Seminar Room Ground Floor 1-2-3
<b>08:30 – 09:00</b> <b>Invited Talk</b>	Michel Meuret and Nicolas Lescureux, COADAPHT network animator/INRA and CNRS (France): Reciprocal relationships between humans and wolves as a way to keep wolves at distance from livestock <i>Chair: Thomas Streifeneder</i>	/
<b>09.15 – 10.00</b> <b>Session 5a/5b</b>	<b><i>Wildlife management in the mountains</i></b> <i>Chair: Thomas Streifeneder</i>	<b><i>Mountain Dairy Breeding and Husbandry III</i></b> <i>Chair: Giulio Cozzi</i>
09.15 – 09.30	Trevisan, M. et al.: Analysis of brown bear predation on livestock in the Eastern Alps and technical solutions to reduce the negative interactions and to promote the establishment of bear Alpine-Dinaric-Pindos metapopulation	Seefried, Franz: Reviewing developments in breeding Original Braunvieh
09.30 – 09.45	Yannick, F. et al.: Golden jackal and livestock: new conflicting scenarios?	Zollitsch, Werner et al.: Sustainability of dairy production in mountainous areas of Austria
09.45 – 10.00	Stauder, Julia et al.: Social aspects and management strategies for wolf conflicts in South Tyrol	Zuliani, Anna et al.: Welfare assessment in mountain small scale dairy farms
<b>10:00 – 10:45</b> <b>Coffee break</b>	<b>Foyer and Garden: Coffee break</b>	

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<b>10:45 – 12:00</b> <b>Session 6a/6b</b>	<b><i>Farm Economics and Succession in Mountain Livestock Farming</i></b> <i>Chair: Christian Fischer</i>	<b><i>Grassland Management and Mountain Pasture</i></b> <i>Chair: Matthias Gauly</i>
10.45 – 11.00	Kirner, Leopold: Competitiveness and future strategies of mountain dairy farms in Austria	Speroni, Marisanna et al.: Robustness and resilience of livestock farming systems in the Alps
11.00 – 11.15	Fritz, Christian: Comparison of costs and benefits of field drying, barn drying and ensiling	Maxa, Jan et al.: Livestock monitoring and workload on alpine pastures
11.15 – 11.30	Gramm, Verena et al.: Agriculture 4.0 – Potentials and Perspectives for Farmers and Mechanical Engineers in South Tyrol	Lonati, Michele et al.: Changing from continuous to rotational grazing enhances alpine grassland composition and plant diversity: results of a five-year monitoring
11.30 – 11.45	Sati, Vishwambhar Prasad: Livestock farming in the Uttarakhand Himalaya, India: use pattern and potentiality	Dolek, Matthias et al.: Dos and Don'ts: Key characteristics and recommended actions to improve the conservation of Alpine grasslands and their characteristic invertebrates
11.45 – 12.00	Cozzi, Giulio et al.: SoZooAlp as bridge between research and end-users in the livestock sector of the Italian alpine area	Florian, Claudia et al.: Suitability of seed mixtures containing tall fescue ( <i>Festuca arundinacea</i> Schreb.) for mountain permanent meadows under recurrent drought
<b>12:00 – 13:45</b> <b>Lunch break</b>	<b>Foyer and Garden: Lunch break</b>	
<b>13.45 – 14.15</b> <b>Invited Talk</b>	Massimo De Marchi, Università degli studi di Padova (Italy) Phenotypic variation of technological and nutritional milk traits in local and cosmopolitan dairy breeds reared in mountain areas <i>Chair: Thomas Streifeneder</i>	
<b>14.30 – 15.00</b> <b>Session 7a/7b</b>	<b><i>Mountain livestock product quality</i></b> <i>Chair: Thomas Streifeneder</i>	<b><i>Mountain Sheep and Goat Breeding and Husbandry II</i></b> <i>Chair: Veronika Maurer</i>
14.30 – 14.45	Cozzi, Giulio et al.: Quality and traceability of mountain dairy products	Ravetto, Enri et al.: Is distance from night penning areas an effective proxy to estimate sheep stocking density at grazing? A new methodology experienced in the Western Italian Alps
14.45 – 15.00	Asaduzzaman, Mohammad et al.: Verifying geographical origin of South Tyrol milk by proton transfers reaction mass spectrometry (PTR-MS)	

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<b>15.00 - 15.45</b> <b>Session 8a</b> <b>and 8b</b>	<b><i>Mountain Dairy Breeding and Husbandry IV</i></b> <i>Chair: Giulio Cozzi</i>	<b><i>Mountain Livestock and Climate Change</i></b> <i>Chair: Christian Hoffmann</i>
15.00 – 15.15	Chiumia, Daniel et al.: Alpine pasture affects circulating progesterone and oviduct redox environment in early-pregnant heifers	Mayer, Andreas et al.: From farmers, livestock and mountains – Assessing scenarios of land use and ecosystem impacts under climate change in selected mountainous regions in the Pyrenees
15.15 – 15.30	Poulopoulou, Ioanna et al.: Evaluating working time of mountain dairy farms – A step towards production efficiency	Bona, Daniela et al.: Advanced opportunities to develop a circular economy model for mountain livestock farming
15.30 – 15.45	Costa, Angela et al.: Characterization of electrical conductivity in individual milk of cattle breeds reared in Alpine area	/
<b>15:45 – 16:15</b> <b>Closing</b>	<b>Closing of the conference</b> Matthias Gauly, Unibz	/
<b>16:15 – 17:00</b> <b>EAAP Working Group</b>	<b>Next conference</b> <b>Founding an EAAP Working group</b>	
<b>18.00 – 19.00</b> <b>City Tour</b>	<b>City Walking Tour Bozen</b> <b>Meeting Point: 17.45 EURAC OR 18.00 Waltherplatz in the city centre</b>	

<b>Friday 22.06.2018</b>	
<b>07:45 – 13:45</b> <b>Excursion</b>	<b>Excursion to local farms</b> <b>Meeting Point: EURAC Research</b>

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### Posters:

Poster Nr.	Name of presenter	Title
<b>Session: Mountain Dairy Breeding and Husbandry</b>		
1	Wójcik, Piotr et al.	Characteristics of milk production in a mountain region using the example of the Malopolska Province
2	Wójcik, Piotr et al.	Effect of selected environmental parameters on udder health and cytological quality of milk from cows in a mountain region
3	Wójcik, Piotr et al.	The use of herbal mixtures for mastitis control in cattle raised in mountain areas
4	Segato, Severino et al.	Variation of lipid profile in Asiago PDO cheese during the alpine pasture
<b>Session: Innovation and Marketing of Mountain Products</b>		
5	Morán Lobato, Lara et al.	Effect of plant diversity of mountain pastures and sampling period on terpenoid profile of Idiazabal PDO cheese. A case study
6	Rainis, Simona et al.	Technical Assistance in Alpine Cheesemaker Huts of FVG (IT)
7	Rainis, Simona et al.	The production of Alpine Ricotta Cheese in FVG (Italy)
8	Chaupin, Marie-Thérèse	Mountain sheep farming: quality wool production and sustainable future
<b>Session: Farm economics and succession in Mountain Livestock Farming</b>		
9	Theodoridis, Alexandros et al.	Best observed practices in efficient farms: How Data Envelopment Analysis (DEA) can serve as an innovation identification tool
<b>Session: Mountain farms in their social environment</b>		
10	Krawczyk, Wojciech et al.	Cultural grazing of sheep in Polish part of Tatra Mountains - a case study
11	Ragkos, Athanasios et al.	Transhumance in Greece: Present and future
<b>Session: Wildlife management in the mountains</b>		
12	Miraglia, Nicoletta et al.	Estimation of the wild boar population ( <i>Sus scrofa</i> ) in the Regional Park "Taburno – Camposauro" (Benevento, Southern Italy Apennines) using the Pellet Count Group technic
<b>Session: Mountain livestock product quality</b>		
13	Segato, Severino et al.	Authentication of Asiago PDO cheese by using NIR spectroscopy
<b>Session: Mountain Sheep and Goat Breeding and Husbandry</b>		

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<b>14</b>	Tamburini, Alberto et al.	Milk flow parameters and milk quality in Bionda dell'Adamello dairy goats
<b>15</b>	Signer-Hasler, Heidi et al.	Runs of homozygosity and genomic inbreeding in local Swiss sheep breeds
<b>Session: Other species: Poultry, Pigs, Horses</b>		
<b>16</b>	Bondesan, Valerio et al.	Free-range organic pigs production with agroforestry system in low mountain Alpine valley: implications for environmental sustainability and animal welfare
<b>Session: Grassland management and mountain pasture</b>		
<b>17</b>	Florian, Claudia et al.	A method for a comprehensive analysis of grassland innovations
<b>18</b>	Krawczyk, Wojciech et al.	Effect of organic fertilizers on permanent grasslands in the Low Beskids – the Polish part of the Western Carpathians
<b>19</b>	Florian, Claudia et al.	Inno4Grass - Shared Innovation Space for Sustainable Productivity of Grasslands in Europe
<b>Session: Mountain livestock and landscape biodiversity</b>		
<b>20</b>	Krawczyk, Wojciech et al.	Consequences of the deagrarianization process in the mountain region of Bieszczady
<b>Session: Mountain Livestock and Climate Change</b>		
<b>21</b>	Vitalone, Lorenzo et al.	Changes of yield and forage quality of silage maize over the last 30 years in South Tyrol
<b>22</b>	Satyvaldiyeva, Nazira et al.	Collaborative strategies to integrate the traditional knowledge in pastoral resources conservation and increase the adaptive potential of the local population to climate change
<b>Session: Free communications</b>		
<b>23</b>	Rainis, Simona et al.	“MADE - Malga and Alm Desired Experience” - Interreg project ITA-AU 2014-2020

# Abstracts of the Conference

## Session 1a: Mountain Dairy Breeding and Husbandry I

### **Alpine pasturing of young stock positively affects fitness-related traits**

Fuerst-Waltl Birgit<sup>1</sup>, Aichhorn Tanja<sup>2</sup>, Fuerst Christian<sup>3</sup>

University of Natural Resources and Life Sciences, Vienna (BOKU)<sup>1,2</sup>, ZuchtData EDV-Dienstleistungen GmbH, Vienna, Austria<sup>3</sup>

Alpine pasturing, i.e. seasonally grazing livestock in mountainous areas, is typically practiced in Alpine regions. Access to mountain pastures is often claimed to be beneficial with respect to health and longevity. However, particularly for replacement animals, robust evidence is scarce. Therefore, the effect of juvenile Alpine pasturing was tested by including it in the routine genetic evaluation data set for longevity. Alpine transhumance records from 2004 to 2013 were used. In total, records of 871,287 dual purpose Fleckvieh cows sired by 9,953 bulls and 31,327 Pinzgauer cows sired by 4,808 bulls were available. Data were analysed by means of survival analysis accounting for the time-dependent fixed effects of region-year-season, relative performance within herd (fat plus protein yield, 7 classes), change of herd size (6 classes), and Alpine pasturing of cows, the fixed effects age at first calving (17 classes) and Alpine pasturing of young stock, the random time dependent effect of herd-year following a log-gamma distribution and the random genetic effects of sire and maternal grandsire. Fleckvieh cows that had access to Alpine pasture during their rearing period at least once for a minimum of 60 days had a significantly decreased relative culling risk compared to cows that had always stayed on the home farms as calves or heifers (relative culling risk 0.905 vs. 1.000, respectively;  $P < 0.001$ ). Similar, but less pronounced results were found for Pinzgauer cattle (relative culling risk 0.954 vs. 1.000, respectively;  $P < 0.05$ ). As the Pinzgauer breed is on average kept on higher altitudes, the lack of differentiation between animals that are kept outdoors on the home farm or outdoors on high altitudes may be one reason for this finding. In both breeds, additional analyses of fertility data sets of the Federal country Salzburg were carried out. The time from first to successful insemination was significantly prolonged for first calving Fleckvieh and Pinzgauer cows that never had access to mountain grazing as heifers. Evidence for the beneficial effect of juvenile Alpine pasturing on the animals' later fitness could thus be provided.



## Keeping cows on mountain alpine pasture affects rising and fear towards unfamiliar humans positively

Zupan Manja<sup>1</sup>, Kraševc Maruša<sup>2</sup>, Zuliani, Anna<sup>3</sup>, Bršćic Marta<sup>4</sup>, Winckler Christoph<sup>5</sup>, Leeb Christine<sup>6</sup>

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We evaluated the hypothesis that keeping cows on mountain summer pasture (MSP) for 60-110 days results in easier rising and lower fear responses, but that undesired behaviours such as lying outside the lying area in the valley farm increases 2-6 weeks after MSP compared to 2-4 weeks before MSP. A modified animal-based welfare assessment protocol developed by EFSA for use in small-scale dairy farms was applied on 67 family farms. Farm inclusion criteria were location in the alpine region of Slovenia, Italy or Austria, keeping cows of traditional breeds and the practice of summer pasture farming. Behavioural measures assessed were: avoidance distance towards an unfamiliar person at the feed place (with lower avoidance distance score, ADS, indicating less fear of humans), percentage of cows lying outside the lying area; and rising movement score (the lower the score the easier the rising movement). Statistical analysis were carried out using mixed models (GENMOD or MIXED procedures) considering the main fixed effects of assessment (before and after MSP), housing (tie-stall, loose housing), flooring (concrete/brick, concrete grid, rubber mat, other) and quantity of bedding, with farm nested within country as a repeated or a random effect. Our main results indicated that the percentage of cows lying outside (data included if at least 4 cows/farm were observed) was similar between the assessments (19.9 vs. 16.5 %;  $P=0.97$ ), but that the ADS (0.59 vs.0.54;  $P=0.04$ ) and the rising score (2.07 vs.1.84;  $P=0.002$ ) were lower after compared to before MSP. Even when cows were able to stand up easier after MSP, which could be explained by increased locomotor activities over the summer, the size of cubicles did not change, leading to significantly indifferent number of animals lying outside. The slightly reduced ADS, although in both assessments very low, can be interpreted in a way that cows didn't become more fearful over the summer, but benefit from a potentially improved human-animal contact. In conclusion, our findings suggest that mountain summer pasturing improves behavioural aspects of welfare, especially rising movements, and it decreases the level of fearfulness in dairy cows.

**Session 1b: Mountain Farms in their Social Environment**

**Animal systems in the Apennines and economic and environmental sustainability**

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The Italian mountains show different socio-economic situations as highlighted in the last Montagne Italia Report 2017. If in the Alpine valleys there is evidence of dynamism in society, the opposite occurs in the Appennino ridge, where the process of agriculture and human abandonment is continual. The consequence is a progressive degradation of the environment and barriers to the development of any tourist activity. The cost of the field operations, their randomness and the poor yields involved, make production costs much higher than those of the plains, with a gap that is difficult to overcome even with the processes of transformation and valorisation of typical final products. The present work examines an Apennine valley (Val Borbera) in which measures have been carried out on: the cultivated agricultural land and on those abandoned; farm data, including the part time activities, with particular attention to machinery; mechanical operations for land preparation, seeding and forage harvesting; yields; environmental maintenance work aimed at improving the landscape. The cost of operations and of foraging have been therefore calculated. A simulation was carried out to determine the production costs in the hypothesis of the introduction of an Association under which the small properties (Associazione Fondiaria according to the recent law of Regione Piemonte) could join together and/or, adoption of an associated management of the mechanical operations. The results highlight the economic and ecological sustainability of production systems based on the models of Associazione Fondiaria and of the associated management of the mechanical operations. These models can also sustain environmental maintenance operations exclusively performed for landscape purposes, as well as a number of employees sufficient for the survival of a managed and pleasant territory on which touristic activities could be added.\*formerly full professor of Agricultural Engineering at Milano University\*\* Phd in Agricultural Engineering , agronomist

## **The social inclusion of female farmers in mountain areas**

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Continuous changes in the social and economic environment inherently include changes in the social inclusion of female farmers in mountain areas. There is no universally agreed definition or benchmark for social inclusion. Social exclusion in this contribution describes a state in which female farmers in mountain areas are unable to participate fully in economic, social, political and cultural life, as well as the process leading to and sustaining such a state. This contribution (i) aims to define the multidimensional concept of social inclusion in the context of female farmers in mountain areas and (ii) offers statistically proven insights on ways to secure social inclusion for female farmers in mountain areas. Following some definitive remarks on the classification of mountain areas and social inclusion, the situation in Austria is outlined using official statistics from the representative surveys of female farmers in Austria, 2006 and 2016. We conduct a comparative analysis of Austria and its lowland and mountain areas. For the purpose of reporting results and drawing conclusions we analyze single indicators and calculate a social inclusion index. Social inclusion shows a positive development from 2006 to 2016, despite some single indicators displaying a severely negative trend. The social inclusion index for Austria as a whole has improved by 0.6% from 0.943 in 2006 to 0.949 in 2016. A similar picture appears in lowland areas where the index is 0.969 in 2016 – an increase of nearly 3.8% from its level in 2006. As a trend, this is a welcome development. In mountain areas, however, the social inclusion index has fallen from 0.924 in 2006 to its current level of 0.917 in 2016 – a decline of nearly 0.8%. All in all, the results elucidate the areas of consistency and ambivalence in social inclusion. Clearly, the development shown implies room for improvement especially in mountain areas. This further reinforces the importance of a certain social inclusion especially in sparsely populated mountain areas. Moreover, there is a need to learn more about the social conditions and forms of social inclusion of female farmers in mountain areas.

## **Session 2a: Innovation and Marketing products**

### **Innovation and promotion of Livestock product system: a case study of the mountain regions of the Calabrian Inland**

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One of the issues increasingly at the center of international debate is environment versus strong industrialization of production system. New strategies are needed to enable the livestock sector to respond to the growing demand for animal products. At the same time, the sector also has to contribute to food security, poverty reduction, sustainability and human health in accordance with the Agenda2030 for Sustainable Development Strategy. Livestock farm systems are facing the challenge of how to reshape the Livestock System Model in order to better balance intensification of production but use extensive management methods to guarantee sustainable development. This includes conservation of territory and extensive landscape use. The paper uses an empirical methodology. The research focuses on the development of the livestock farming systems deployed in mountain areas of the Calabrian inland by applying the Strategic Reshaping Model. In doing so, this paper aims to strengthen the potential of the region. This potential stems from the diversity and flexibility that characterize the region and are a source of competitive advantage. The results imply that measures need to be set to generate and promote innovation in both the production processes themselves and in their corresponding up- and downstream sectors. Combining the analysis of the innovative Livestock System Model and product valorization methods used in the area the paper proposes a concrete project for implementation in this region. Keywords: ICT, Livestock Management, Local Food Chain, Territorial Marketing, Sustainable Development Strategy

**Remarkable value of the dairy products in the mountain of FVG (Italy): role of quality labels and technical assistance**

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The high quality of the dairy products in the mountain of FVG (Italy) are recognisable also by the trademarks and the identifications, respectively:1 DOP-Protected Designation of Origin, namely the Malga Montasio Alpine Montasio Cheese;3 SlowFood Presidium “Çuç di Mont” in Losa, Pozof and Costa Cervera huts;1 wording PDM-Prodotta di Montagna (Mountain Product) that identifies the cheese produced in Malga Montasio;26 PPL-Piccole Produzioni Locali, a sanitary authorization appositely designed for typical and local productions. The accession to these brands implies the commitment to follow the related disciplinary. A constant supervisor is assured by the experts to certify the respect of the quality parameters. A further support to the cheesemakers of alpine huts of FVG is guaranteed by the experimental project of technical assistance activated by ERSA – the Regional Agency for the Rural Development. From 2001, every grazing season, usually an average number of 20 farms join, on voluntary compliance, this program and they work together with the technicians, to improve the modality of the milk transformation. In addition, numerous scientific and marketing initiatives are constantly dedicated to this compartment. Interesting evidences of all these huge affords could be observed considering the results of some national and local competitions where cheeses from FVG were presented. Generally, the prizes for their excellence were awarded to the productions that were ultimately characterized by a quality label. This is worth of a deep analysis, in fact, this confirms that there is no quality without control and high hygiene and health conditions throughout the food chain. Moreover, it is evident that the best alpine cheeses of this area present at the bottom of their productive pathway an entrepreneur mentality, which is demonstrated in the choice to adhere to the specification of each quality scheme that implies rigorous strict and tight monitoring. These distinctive features deserve a worldwide appreciation and an effort should be done by all the actors implied to collaborate in the promotion of these dairy “niche” productions that in this way can obtain also a right economical valorization and recognition.

## The added value of mountain livestock products: an ecosystem services approach

Sturaro Enrico

DAFNAE-University of Padova

The added value of mountain livestock products: an ecosystem services approach Berton M.1, Bovolenta S.2, Corazzin M.2, Gallo L.1, Pinterits S.3, Ramanzin M.1, Ressi W.3, Spigarelli C.2, Sturaro E.1, Zuliani A.21 University of Padova, Italy2 University of Udine, Italy3 Umweltbüro GmbH, Klagenfurt, Austria

The socio-economic evolution of mountain areas is challenging local productions, leading to the abandonment of traditional jobs and rural areas. The multifunctionality of mountain livestock systems can be addressed using the ecosystem services (ES) approach, to ascribe values to products and services that contribute to human well-being and the attractiveness of mountain areas. In this study we present the preliminary results of a project (IR VA Italia-Österreich "TOPValue") aiming at: 1) implementing the optional quality term "mountain product" (MP) as defined by EU Reg. 665/2014; 2) empowering the optional MP quality term by identifying and quantifying ES delivered by local food chains, with a particular focus on mountain dairy cattle farming. A multidisciplinary approach has been adopted to identify and quantify ES delivered in eastern Alps: 1 - participatory approaches (questionnaires and focus groups) have been used to identify stakeholders (local communities, tourists and producers) perception of mountain products and associated ES delivered; 2 - on a sample of 80 dairy farms associated to 7 dairy cooperatives the following methodological approaches were applied: analysis of biodiversity in the grasslands managed by each farm; environmental footprint (Life Cycle Assessment); animal welfare (Welfare Quality adapted protocol for small scale farms); landscape aesthetic and cultural value.

The preliminary results evidenced that the dairy cattle systems investigated are able to provide several ecosystem services, particularly when the management of local open areas is considered. Synergies and trade-offs between different indicators are useful to address the "global" sustainability of MP chains. The results will be used in the last part of the project to address effective communication strategies for ES in order to develop labels (e.g. smart labels) that better meet consumers expectations and understanding.

**The analysis of nutritional profile and communication strategy of intensive and extensive dairy chain products in the North-East of Italy**

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The aim of this study was to analyse the nutritional value of dairy products obtained by two dairy chains of North-East Italy and evaluate their market communication. One farm is located in the lowland and the dairy cows are mainly fed by permanent grass and alfalfa hay; the other is located in highland and the dairy cows have a diet based on hay (permanent meadow), except during summer, when they are fed on an alpine seasonal pasture plus a small amount of concentrate. Results about the nutritional value of these products highlight that, during the summer season, the analysis of the lipid fraction of the mountain (grazing pasture) dairy products shows a significant higher amount of fat-soluble vitamins as well as a richer profile in beneficial fatty acids such as conjugated of linoleic acid (CLA) and branched-FA, than the samples from the lowland dairy chain. However, it was observed that, during winter, the dairy lipid nutritional value was comparable between the two productive systems. Considering the quite relevant reduction of milk production of dairy cows during the alpine sojourn and the increase of the cost per milk unit, an adequate communication is necessary to improve the costumers perception regarding the mountain dairy products. For this reason the communication of these products has been analyzed through their brand signaling vehicles, in order to understand the overall messages sent to the market. Results highlight similarities and differences between product brands, and underline that some communication efforts (what is said or promised to the market) are not aligned with the real benefits included in the product (what products are really offering in terms of nutritional value). As such, this study suggests that in some cases there are important untapped marketing opportunities that effective communication strategies may help to cover. Acknowledgements – Research funded by FONDAZIONE CARIVERONA (SAFIL project, call 2016)

## **Session 2b: Mountain Sheep and Goat Breeding and Husbandry I**

### **The role of sheep in the transformations of sheep farming and marketing of lambs in Switzerland**

**Weber H el ene**

**University of Lausanne**

In Switzerland, sheep farming is defined by small-scale structures and a lack of specialization of farms. The preference of Swiss consumers for high-quality cuts results in large imports of lamb cuts to fill the gap induced by Swiss lamb production modes, mountain pasturing. This breeding mode is traditional in Switzerland and promoted since 2014 by the government through dedicated subsidies. However, meat import quotas are dependent on the slaughtering volumes of indigenous animals. In this context, retailers reinforce links with the primary production through the collaboration with producers' organizations, which label meat products according to specific conditions of production and herd's management systems, and propose labelled or branded meat to increase the sales of indigenous lambs. Currently, only one quarter of the lambs farmed in Switzerland are dispensed through retailers. Most sheep farmers sell their lambs through alternative food networks. This PhD research aims at exploring the role of sheep in the persistence of pastoral farming and alternative lamb meat chains. By examining the materiality of sheep, as well as the relations deployed in alternative food chains and in emerging integrated food chains, the framework, grounded in political ecology, aims at exploring the role of sheep in the breeding and marketing systems, as well as in the sheep farming sector governance. Methods used are composed of: 1) a survey questionnaire of breeding, husbandry and marketing practices distributed to sheep farmers, 2) interviews of various actors involved in sheep breeding and lamb meat chains, 3) and my experience working as a shepherd in the Swiss Alps in summer 2017 and during the lambing in March 2018. Preliminary results show that sheep farmers use sheep materiality such as the seasonality of sheep breeds associated with a specific breeding system (based on herb) to assert their autonomy and turn it into a collective form of power, as well as to stress meat production sustainability.



## **Breeding goals for sheep managed on extensive farms need to be adapted to the number of animals managed**

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Breeding sheep for extensive farms is difficult because they mostly rely on pasture as the main energy source. Pasture has uncertain supply making management difficult. Therefore, the number of animals managed (stocking rate) varies depending on attitudes to risk and subsidy payments. As the stocking rate increases, farms become more dependent on concentrates which increase costs. Additionally, breeding for production increases energy requirements which needs to be matched by feeding more or reducing the stocking rate. Therefore, breeding objectives for extensive farms may change depending on the stocking rate. We used profit equations to estimate the economic values for breeding goals for an extensive meat and wool farm in Australia. Economic values were estimated when stocking rate ranged from 0 to 5. The sensitivity of economic values to meat, wool and concentrate prices was tested using monthly data across 11 years (132 observations). We tested 2 scenarios for how farmers match increased energy requirements when traits are improved; first farmers reduce stocking rate (flexible) or second farmers keep the same stocking rate and use extra pasture if available or feed more concentrate (fixed). Number of lambs weaned had the highest energy requirement followed by wool and live weight and wool quality required no extra energy. When stocking rate is low the economic value for traits that require more energy were higher for fixed stocking rate because they could match extra energy with pasture. As the stocking rate increased, there was a threshold where flexible stocking rate became more valuable. This threshold was because concentrate fed cost more than the loss of production from reducing stocking rate. This threshold moves towards lower stocking rates when energy requirements of traits increase. Additionally, fixed stocking rate was more sensitive to varying meat and concentrate prices than flexible. Finally, estimating economic values using the average of prices compared to using the average of the economic values estimated using prices across 11 years produced different breeding goals. Therefore, sheep farmers should consider their stocking rate and variation in prices when deciding how to breed their sheep.

## **Preserving Alpine Biodiversity with Indigenous Livestock Breeds: the example of the Alpine Steinschaf**

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New Ways to Preserve Biodiversity”, a concerted effort to counteract the overgrowth of alpine pastures by shrubs and trees has been made. Different methods for the sustainable management of pastures located on marginal lands, which are valuable from a nature conservation perspective, were developed and practical recommendations are provided. We worked with indigenous livestock breeds that are optimally suited for this purpose. By now, most of them have become rare; many are at risk of extinction. This contribution shows ways and means to preserve and reinforce indigenous livestock breeds at the example of the Alpine Steinschaf: This breed of sheep, indigenous to the border region between the Bavaria and Salzburg provinces, is in highest danger of extinction. As integral part of the project, we restored the Kleinrechenbergalm to a summer pasture for young Alpine Steinschaf rams after laying fallow for nearly 50 years. We studied the development of vegetation, fauna, soil erosion and feed value. A new established breeding program shows the different ram lines very clearly with the goal to prevent inbreeding. An innovative measuring tool testing the adaption on alpine living conditions was developed (Alp Index). As part of the marketing strategy, wool of the Alpine Steinschaf is collected, processed and marketed under the label “Kollektion der Vielfalt”. Meanwhile the Kleinrechenbergalm has become the main hotspot for breeding rams in summer in Bavaria. After three years of grazing the unpalatable grasses and herbs have been replaced to a large part by good, biodiverse pastures rich in herbs. No trampling damage has been observed. The highlight of the summer is the annual ceremonial sheep drive with the subsequent examination for breed certification and auction of the young rams.

## Milk production and composition in Wallachian sheep

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Czech and Slovak Wallachian (W) sheep belongs to Zackel sheep group reared in Carpathian and Balkan mountain regions. During the XX. century the breed was widely crossed with other breeds and today, the original W sheep is considered as genetic resource. Recorded population was 1077 ewes in the Czech Republic and 490 ewes in Slovakia in 2017. The aim of current study was to quantify milk production and composition of W under extensive pasture conditions in the Silesian Beskydy Mountains. Furthermore, to genotype at loci of lipogenic enzymes: acetyl-CoAkarboxyláza (ACACA), fatty acid synthase (FASN) and lipoprotein lipase (LPL) and to establish their relationship to the profile of fatty acids in milk fat. Study was performed on 40 clinically healthy ewes kept at one flock. The milk samples were collected within 4 control days at c. 30 days' intervals. A least squares method (LSM) was used to estimate the fixed effects of the control day, days in milk, ewe age category and genotype at loci for lipogenic enzymes. Average daily milk production was 0.86 kg (S.E.=0.41 kg) with average milk fat content 7.02% (S.E.=1.48%) and proteins content 5.19% (S.E.=0.61 %). Milk yield and composition as well as fatty acids (FAs) contents were changing in the course of grazing period. Content of saturated FAs as well as the proportion of medium chain FAs increased from May to August, while proportion of monounsaturated FAs and long chain FAs showed a downward trend. Compared to literary sources, the milk of W sheep had more desired ratio between saturated and unsaturated FAs and a higher CLA content. The most frequent haplotype: AG/GG/CC/CC at the ACACA locus was associated with higher milk yield, lower fat and proteins contents and favorable dietetic characteristics of the fatty acids profile compared to animals of other haplotypes. The high nutritional and health value of the milk of W ewes grazed on mountain pastures could help to increase the population size of this animal genetic resource and its wider use for milk production.

**Session 3a: Mountain Livestock and Landscapes Biodiversity**

**Agro-ecological typization of hay meadows in mountain areas: a tool for the sustainable management of local forage resources**

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Detailed knowledge about the agro-ecological characteristics of cut meadows represents the basis for any planning and management improvement effort. In the past years, a scientific classification and agro-ecological typization of hay meadows of the Trento Province (Italian Alps) was carried out by Scotton et al. (2012), with a comprehensive characterization of terrain morphology, climatic conditions, geological and biological features, and management practices. This classification, consisting of 44 botanic units and 17 botanic types, had not been spatially implemented yet. In the present study, extensive agro-botanical field surveys were conducted, to produce a detailed cartography of cut meadow types on over 1.000 ha agricultural land. Resulting spatial information was integrated in a GIS environment with available data layers regarding orography, soil types, property structures, biodiversity patterns and landscape elements. Further data about forage productivity, herd size and composition, stabulation type and effluent management were collected when necessary. The informational tools developed were applied at both single and multiple farm scale and regarded the computation of nitrogen balances and effluent spreading plans, the estimation of forage production potentials and forage self-sufficiency, the definition of practices for the maintenance of high biodiversity meadows, the quantification of costs related to non-ordinary management patterns for the protection of endangered plant and animal species. The most important innovation element is represented by the spatial scale, which enables to deliver agro-botanical and management information about hay meadows at the single-plot level. Further developments regard the implementation on a larger geographic level as a tool for the design of best management practices and policy measures in the Rural Development Programme.

## **Counteracting green alder expansion by extensive grazing: Potential and challenges**

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In the past decades, green alder (*Alnus viridis*) has expanded into marginal pastures in the subalpine zone of the Alps. A survey of 24 pasture-shrub gradients showed that encroachment by green alder, in contrast to other shrubs, is associated with a substantial decline in plant species richness, primarily due to N enrichment because of its ability to symbiotically fix N<sub>2</sub> from the atmosphere. However, understory vegetation in alder stands provides an underestimated forage, rich in protein and similar in productivity and digestibility to nearby open pastures. A two-year grazing trial demonstrated that robust grazing animals were able to exploit these resources as they readily penetrated the thickets. Engadine sheep as well as mixed-breed goats, but not Dexter cattle consumed green alder bark and thus were actively counteracting shrub encroachment. However, individual animals strongly differed in their browsing activity highlighting the importance of adaptation and conditioning in extensive grazing systems. Since goats preferred other woody species to green alder and depleted them before the alder, they may impair the regeneration of late-successional forest. Dexter cattle and Engadine sheep performed equally well on pastures with high shrub cover than on open pastures in terms of average daily weight gain, carcass and meat quality, which was facilitated by the comparatively low productivity of these breeds. In this way, extensive grazing systems utilizing robust breeds, especially sheep, can add to conservation goals and sustain a viable organic meat production in marginal areas.

## **Does cattle breed prime the composition of grazed vegetation?**

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The past decades have seen a boom in the diversity of cattle breeds in the Alps. Especially robust cattle breeds, like Scottish Highland Cattle, have spread beyond their countries of origin and have been used for new applications, such as conservation of marginal pastures. They differ from production-oriented breeds in terms of robustness, growth rate and weight. Moreover, they likely have different movement and forage selection behaviours, which could impact vegetation composition. The aim of our study was to identify the level of breed-dependent impact on the composition of pasture vegetation. In mountain areas of Southern Germany and the Swiss Alps, vegetation samples were taken in 50 paired pasture sites grazed by either Scottish Highland Cattle or other cattle breeds. Generalized mixed-effects models and multivariate methods were used for data analysis. Irrespective of site conditions, pastures grazed by Scottish Highland Cattle generally had higher plant species richness and less shrub cover than their respective counterparts. Besides, breed-specific effects of species diversity increased with the duration in which the site had been grazed by Scottish Highland Cattle. Therefore, we conclude that robust cattle breeds have the potential to sustain biodiversity and ecosystem services of mountain pastures.

## **The impact of modern dairy farming on avian communities: a case study in the hay meadows of Trentino**

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Permanent grasslands decreased by 6.4% in the EU between 1993 and 2011, due to conversion to other land-uses or abandonment. Furthermore, the remaining grasslands have been subject to marked intensification with severe impacts on biodiversity harboured in formerly low-intensity semi-natural grasslands. Even the measures included in the CAP 2014-2020 to halt grassland biodiversity depletion resulted to allow further grassland reduction and intensification. We investigated the effect of the modernisation of the dairy farming system on bird communities along gradients of hay meadow intensification in Trentino (NE Italy). During spring 2017 we surveyed birds and collected variables related to landcover, landscape structural traits, hay meadow intensification (inferred based on meadow plant communities found at 882 parcels), mowing regime and topography at 63 landscapes units (7.15 ha each). We evaluated the effect of these variables on community composition, species richness, and richness of meadow specialist species by mean of RDAs and GLMs and considering the spatial structure of our design by means of the Moran's Eigenvector Maps. Overall, we censused 65 breeding avian species in the study area. Species richness was positively affected by wood cover, length of tree lines and woody hedgerows, altitude and slope, and marginally but negatively by the meadow intensification. Community composition was influenced by the cover of eroded land-use (meadows recently converted into other crops), woods, traditional orchards, by length of hedgerows and number of shrubs, slope and altitude. Meadow specialists were negatively impacted by meadow surface reduction and by the percentage cover of meadows mown before the fourth week of June, and positively by altitude. In conclusion, we showed how multiple environmental and management traits of hay meadows affect an animal group found at the top of the trophic web within this environment; conservation implications derived from bird ecology in meadows could inform adequate and sound conservation actions to halt further biodiversity depletion in this emblematic Alpine agroecosystem.

**HealthyFarm: providing a Precision Livestock Farming solution within the process of digital transformation in agriculture**

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Digital technologies can support farmers in providing safe, sustainable and quality food and improving their working conditions. The Healthy Farm project foresees the creation of an animal welfare assessment methodology that includes both measurements on animals and on the farm environment by means of innovative IoT – Internet of Things - devices. In South-Tyrol the welfare control of animals is a significant problem, especially in inaccessible areas. The project provides for a close and active collaboration between three actors, ORMA Solutions, Eurac Research and Padua University, collaborating in the development of an advanced precision livestock farming (PLF) solution, which considers to (i) optimize an existing algorithm to infer wellness of animals from their behavior and rumen motility, (ii) identify the sensing technologies and the solutions that will need to be developed in order to (iii) have the final PLF solution applicable to the most common types of dairy cow and cattle farming (e.g. loose housing, pasture, etc). Unbalanced diets fed to ruminants, with particular reference to cattle, frequently cause metabolic disorders, characterized by altered rumen motility and digestive system dysfunction, which lead to a drop in productions and sometimes even to death. The continuous detection of some physiological parameters will allow the prevention or therapeutic intervention in the early stages of disease, thus improving the healing rate and reducing health care costs. The solution that is created during the project will be sized on the specific case of dairy and beef cattle farms, and can then be extended at the end of the project to other types of farms. Collection and analysis of data is essential to allow the further development of the PLF system and, at the end of the project, it will allow to identify the benefits of this solution and to extend its applicability to other farming systems. In addition, the platform created (based on open source standards) will be made available to other SMEs initiatives to allow the development of further applications for precision farming (or Smart farming) and to implement the strategy of European policy context regarding the process of digitization in agriculture.



## **Session 3b Mountain Dairy Breeding and Husbandry II**

### **Comparison of production level, fertility and health associated traits of native and commercial dairy cattle breeds on organic farms in Austria and Switzerland**

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Local/native breeds are indirectly or explicitly recommended in organic standards but little knowledge is available regarding the suitability of native breeds under organic conditions. Our aim was to map the performance of local breeds on organic farms by comparing native/ local and commercial dairy breeds on Austrian and Swiss organic dairy farms with regard to health associated traits, fertility and production traits. Records from the period 01.07.2011 to 30.06.2014 of the local breeds Grey Cattle (AL) and Original Braunvieh (OB) and of the commercial dairy breed Braunvieh (BV) with at least 50% US Brown Swiss blood were compared. We applied generalized linear mixed models in R and performed Tukey tests using the lsmeans package in order to detect breed differences. We found lower milk yields for local breeds, but in most outcome variables better fertility (shorter calving intervals, lower number of inseminations). We also detected lower proportions of milk records with somatic cell counts above 100.000 cells/ ml milk for AL in Austria and OB in Switzerland and a lower proportion of test day records with a fat: protein ratio above 1.5 in the first 100 days in milk for local breeds hinting at a lower risk of subclinical ketosis. We could not find breed differences regarding overall occurrence of veterinary treatments or those due to fertility or leg/ claw problems in Austrian data, but found that AL had less treatments due to udder problems than BV. Breed comparison in Austrian and Swiss data from culled cows on productive life span revealed a superiority of local breeds for this trait, but lifetime production (kg ECM) was higher in the commercial breed. We conclude that the potential of local breeds under organic production conditions should be better exploited in future.

**Eco-efficient dairy farming – a case study from a mountainous region in Austria**

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In the project „Life cycle assessment of Austrian farms” a farm-management-tool has been generated on the basis of the concept for life cycle assessment. By means of this tool it is possible to evaluate the farmer’s handling and efficiency concerning the management of resources, nutrients and pollutants as well as economy. The project “Eco-efficient dairy cattle farming in the model region Liezen” deals with the practical use of this tool. The overarching aim is, to deliver concrete recommendations for farmers concerning a reduction of environmental impacts. 32 dairy farms could be gained for the utilization of the tool and the evaluation of their farm management in terms of economy and ecology (eco-efficiency). The farm selection was tested as representative and results are therefore valid for the whole model region of Liezen. An average farm in the pool of farms had an area of 31.7 ha with a percentage of 8 % in terms of forage from mountain pastures and 18 dairy cows. Milk production per cow (ECM) was 6,470 kg at an average stocking rate of 1.3 LU (livestock unit) per ha agricultural area. The environmental impacts associated with the production of milk were investigated and the following average key data per kg of ECM were obtained: Energy requirement 3.9 MJeq; global warming potential 1.37 kg CO<sub>2</sub>eq; aquatic eutrophication N and P 2.0 g and 0.16 g, respectively. The results of the environmental analysis confirm the assumption of extensive management, whereby an evaluation according to the spatial reference is clearer. Overlooking the parameters of the farms and their environmental impacts, the following fields of action and starting points for the region arise: (i) Resource management – enhancement of the valuable animals’ longevity and of the exploitation of own forage; (ii) Nutrient management - increasing the efficiency of grassland utilization in terms of yield and nutrient density; (iii) Pollutant management – increase in performance by means of the best quality forage and the skill at the feed alley. The economic performance of the farms under investigation can clearly be linked to the farm size.

## Effect of low and high concentrate supplementation on health and welfare in mountain dairy farms

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The optimal level of concentrate supplementation in dairy production in general and in particular under mountain farming conditions, where concentrates largely have to be imported, is critically discussed. Therefore, the objective was to identify relationships between concentrate supplementation and breed with health and fertility traits, animal welfare and husbandry conditions. A total of 49 farms ( $\phi$  12.5 dairy cows/farm) raising either Brown Swiss (BS) or Tyrolean grey (TG) were classified based on concentrate supplementation into low-input (LI; n=5 BS farms; n=11 TG farms) and high-input (HI; n=21 BS farms; n=12 TG farms). Farms were visited during the barn period and 614 animals were assessed for body condition score (BCS), cleanliness, injuries and hairless patches. Milk yield per cow differed significantly between breeds (BS 7151kg, TG 5533kg;  $P < 0.05$ ) and level of intensification (HI 7366kg, LI 5317kg,  $P < 0.05$ ). The breed had an effect on the number of lactations ( $P < 0.05$ ), which ranged between 3.42 in TG-LI and 2.44 in BS-HI. Number of lactations were positively correlated with grazing days ( $r = 0.307$ ;  $P < 0.05$ ), which differed between breeds and intensity levels ( $P < 0.05$ ) and were highest for TG-LI (84.54) and lowest for BS-HI (16.4). Number of grazing days were negatively correlated with milk yield ( $r = -0.492$ ;  $P < 0.05$ ) emphasizing that cows in intensive farms less often have access to pasture. Breed and system had an effect ( $P < 0.05$ ) on the insemination index, which was lower in TG-LI (1.69) than in TG-HI (2.24), BS-LI (2.1) and BS-HI (2.2). The highest incidence of mastitis treatments, which was affected by breed and level of intensification ( $P < 0.05$ ), was found in BS-HI, while the lowest was found in TG-LI (0.86 and 0.29 treatments/cow). Cleanliness was better in TG than in BS ( $P < 0.05$ ). On average, cows showed 0.18 injuries and 1.55 hairless patches, which were correlated with one another ( $r = 0.41$ ;  $P < 0.05$ ). The high variation within the groups already shows that results should be interpreted with caution.

## Effects of summer transhumance of dairy cows to alpine pastures on milk composition and cheese yield

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This study aimed to investigate the effects of summer pasture transhumance of dairy cows on milk composition and cheese yield. The study involved 12 multiparous Brown Swiss cows kept in a mountain herd (permanent farm, PF) allotted in two groups of 6 cows each. Cows of a group remained in the PF, the others were moved (July to September) to a temporary summer farm (TF, 1860 m asl). Daily milk yield (MY), BCS and individual milk sample (2000 mL per cow) were collected monthly from June to October. Milk samples were assessed for fat and protein (PRT) content, milk coagulation properties (rennet coagulation time, curd firming rate and firmness) and cheese yield through individual model cheese-making. Model of analysis included the month x group combination as fixed and the animal as random effect, to examine the pattern of traits across months in PF group and the difference of TF vs PF group by month. Cows kept in PF evidenced from June to October a decrease in MY, an increase of fat and PRT content of milk, an improvement of milk coagulation properties and an increase of cheese yield traits, mostly according to a curvilinear (quadratic or cubic) pattern of change consistent with that expected considering the advancement of the stage of lactation. When compared to cows kept in PF, those moved to TF evidenced a greater depression of MY ( $P < 0.01$ ) and BCS, retained also at the return to PF in October, a greater fat and a smaller PRT content in the first two months of summer pasture ( $P < 0.05$ ). Conversely, neither milk coagulation properties nor cheese yield and milk nutrient recovery in curd were affected by temporary summer transhumance, and their pattern of change during the study was very similar for both groups of cows. In conclusion, summer transhumance affected milk yield and composition, but not the cheese making efficiency of milk produced.

**Genotype by environment interactions in low and high altitude farm locations and production systems for milk production traits in Brown Swiss cattle**

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The dairy dual-purpose breed Brown Swiss is used in a wide range of different production environments in the state of Baden-Wuerttemberg (Germany). Besides their usage in high intensity conventional production systems, mostly located in low altitudes, they also play a role in more extensive production systems, like organic farming or high altitude locations, e.g. the Swabian Alb and Black Forest regions. Especially the feeding regime, depending on pasture grazing and grassland (high altitudes, > 800 m above sea level) or crop cultivation (lower altitudes, <800 m above sea level), makes a difference in the intensity of farming and productivity of the breed. Possible genotype by environment interactions (GxE), depending on the production system and altitudes of the farms, might exist and lead to a re-ranking of animals in terms of breeding values. Genotype by environment interactions were estimated between the milk production traits milk yield, fat yield and protein yield in Brown Swiss cows, milked in four different production environments (conventional or organic systems, low and high altitude locations). Genetic correlations between systems and locations were estimated using a bivariate sire model applied to trait yield deviations, extrapolated from yield deviations using the best prediction method. The genetic correlations between the different production systems ranged from 0.93 (protein yield) to 0.95 (milk and fat yield). The lowest genetic correlation of 0.87 was found for protein yield between the locations at different altitude levels. Genetic correlations for milk and fat yield were 0.91 and 0.93, respectively. To summarize, no severe GxE were found, supporting the hypothesis that the German Brown Swiss is a robust breed. Further studies with regard to functional traits and reaction norm models are in progress.

## **Session 4a Cooperatives in Mountain Farming**

### **“Community-barns” as an instrument to foster cooperation between small-scale farmers: legal issues and challenges**

**Miribung Georg**

**University of Bozen**

A community-barn is a cooperation-tool, that enables small-scale farmers to pool parts of their production processes. From an economic perspective, this helps to reduce administrative and productions costs. Moreover, specific investments can be shouldered by more parties. From a legal perspective, community-barns can be considered as contract-based tools normally organized as partnerships or companies that determine specific rights and obligations. This specific bunch of rules shall make the cooperation stable and durable. The results presented at the Symposium in Bozen are the outcome of a project conducted at the University of Bozen that aims to analyze – from a legal perspective - the potentials of the formation of community barns. This project has been initiated because South Tyrolean farming, which is characterized by relatively small structures, faces major challenges due to changed economic circumstances. They foster industrialized production systems rather than small-scale farming. In fact, in recent years an increasing number of South Tyrolean farmers left the production; this also has major impacts on landscape and tourism. Community-barns, which provide new processing opportunities for milk producers, shall help to stop this development. Interestingly, whereas in neighboring regions (i.e. Bavaria, Graubünden) the concept of community-barn has been successfully implemented, in South Tyrol similar initiatives failed. The aim of the project is to reconsider community-barns from a specific South Tyrolean legal perspective. This required considering national and, due to the specific legislative powers of South Tyrol, also specific provincial laws. In addition it proved helpful to analyze best practice developed in other jurisdictions and compare these solutions with the solutions offered by the applicable (provincial) legal framework. Whereas from an economic perspective community barns offer an adequate response to the necessities of small-scale farmers, the research shows that putting the concept into practice is far from easy - but possible. This aspect is important, because the economic success can only be guaranteed if the cooperation tool is placed on a solid legal foundation.

## **Dual Breeding Project - Dual-purpose cattle breeds: an alternative model of eco-sustainable animal husbandry**

**Romanzin Alberto**

**ANAPRI**

In many mountain areas, breeders have wisely preserved the rusticity and adaptability characteristics in their bovine populations. It is not by chance that in these territories there are many dual-purpose breeds well adapted to environment over the centuries. Sustainable production of milk and meat was a priority for farmers and their associations in the past as well as in the future. In fact, sustainable production is synonymous with environmental protection, biodiversity conservation, landscape defense, but also production efficiency. The dual-purpose breeding associations have maintained the selection objectives always oriented not only for dual-purpose but also for resistance to diseases, maintenance of rusticity and longevity. In order to continue on the path taken the national breed associations met to develop for the first time a collective project called "DUAL BREEDING" mainly aimed to the environmental sustainability, animal health and management of inbreeding. "Dual Breeding project - Dual-purpose cattle breeds: an alternative model of eco-sustainable animal husbandry" is funded by the European Agricultural Fund for Rural Development (EAFRD) through the National Rural Development Programme (NRDP) 2014/2020 - Sub-measure 10.2 "Support for conservation and sustainable use and development of genetic resources in agriculture", and will last for three years. The project involves a total of 16 Italian dual-purpose breeds, from Val d'Aosta to Sicily, with selective stories, consistencies and production attitudes quite different. Among these, many are those closely linked to the Alpine environment (Italian Simmental, Valdostana Pezzata Rossa and Pezzata Nera/Castana, Grey Alpine, Rendena, Pinzgauer, Pezzata Rossa d'Oropa, Pustertaler Sprinzen/Barà, Burlina) and all are however linked to mountain or hilly territories.

**Relations of proximity between local actors and territorial development dynamics: analysis of the artisanal Serrano cheese value chain in the Campos de Cima da Serra region/RS-Brazil**

**Pachoud Carine**

**UIBK**

In the face of an increasing withdrawal of public authorities, the concept of territorial development is becoming important. A growing involvement of local actors in these development dynamics is visible. Here they increase their capacity to mobilize resources and create their own projects. Cooperative relations among local actors in short value chains seem to be a key element of their resilience, in which trust relationships are central. In this sense, we analyze the relationships of beef cattle production in native pastures associated with the production of artisanal Serrano Cheese in the Campos de Cima da Serra region, a mountain area in Southern Brazil. This activity of historical importance disagrees with sanitary norms of production. In fact, the Brazilian laws do not deal with the specificities of artisanal production and are subject to the same sanitary standards and facilities as industrial dairies. Nowadays, the interest of consumers in artisanal and local products, and the growth of tourism allow an increase in the demand for artisanal cheese. Seven years ago, the Aprocampos producers' association was created with the objective to seek legal ways to continue producing, preserving historical characteristics of the artisanal Serrano cheese. However, this association is fragile, with little interest and initiative from the producers; being the Emater-RS (the extension services), the central actor in the incentive of Aprocampos. In this context, we seek to understand the role of proximity and trust in actor cooperations, through semi-structured interviews with local actors, as well as to elaborate the importance of them for the territorial development process. This paper has been written in the framework of my PhD called "Territorial governance in traditional food value chains: collective organization and innovation capacity for territorial development. Comparative analysis of two models of development of mountain cheese value chains. Case studies: Serrano cheese - RS / Brazil and Tyrolean Graukäse - Tyrol / Austria".



## **Session 4b: Poultry and Horses in Mountain Farming**

### **Explore genetic diversity at pedigree level in an Italian native mountain horse breed to develop strategies for breed preservation and management**

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Genetic diversity is a key factor for both adaptation and response to selection. The loss of genetic diversity not only causes a decrease in individual fitness, but it also has a dramatic negative effect on the population survivability in the long term. Bottlenecks, limited introgression and limited number of individuals that build the population can radically affect the rate of genetic diversity. This study aimed to explore the genetic diversity at pedigree level of the Bardigiano horse breed, which is a native breed from the Province of Parma, shaped for living in the mountain areas. The Bardigiano has excellent resilience, being well adapted to roughage diet, harsh climate and pasture conditions. In the 1977 the Bardigiano studbook was founded with the goal of improving the use of the Bardigiano for riding and draft purposes. Pedigree data contained 9,469 horses (3,416 alive) which were used to estimate population parameters using the software Endog 4.8. The completeness of pedigree information was investigated by using the complete generation equivalent (CGE) which was equal to 4.0 when considering all the animals in the pedigree and 5.2 when analysing only alive horses. Eight ancestors explained 50% of the genetic variability observed in the Bardigiano population, and the most influent one had an inbreeding coefficient of 0.25. The average inbreeding coefficient in the living population was 0.08. When considering only the last generation, the coefficient rose to 0.102. The effective population size ( $N_e$ ) of the current population was 2,535. By contrast, when  $N_e$  was calculated including only animals that produced offspring, it decreased considerably to more than three times less than previously calculated. The Bardigiano still shows the pool of genetic diversity necessary to respond to selective pressures in the coming years. However, due to the observed increase in the inbreeding and the reduction of  $N_e$  when considering only breeding animals, we believe that breeding strategies to monitor genetic diversity are required. We thus suggest the use of Optimal Contribution Selection to control the rate of inbreeding while allowing response to selection.

## Potential of two dual-purpose chicken genotypes for egg and meat production for small-scale mountain farmers

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Production systems for dual-purpose chicken where both sexes are raised together during the first weeks, before males are separated during their final fattening stage, while females are kept for an entire laying period, might be an economic alternative for small-scale mountain farmers. However, systems (husbandry, feeding, slaughter) have to be adjusted. The aim was to compare two genotypes in such a system, namely purebred (P) Les Bleues (n=300) and crossbred (C) New Hampshire x Les Bleues (n=300). One-day-old mixed-sex chicken were raised for 12 weeks in a floor husbandry and fed a standard broiler diet. Thereafter, males were moved to a mobile chicken house with free-range access. Males were slaughtered at weekly intervals from 12th to 16th week of age. Hens were kept for one laying period in the mobile house. Live weight development, feed consumption, carcass and meat quality was measured in males and laying performance, egg quality, feed consumption, slaughter traits, health and behaviour in females. At 12 weeks of age, P reached a live weight of 2,075 g and C of 1,865 g ( $P < 0.05$ ), while at 16 weeks both had more than 2,500 g ( $P > 0.05$ ). Dressing percentage was about 1% higher in C than P ( $P > 0.05$ ). Proportion of legs, breast and wings was 34.3, 16.0 and 11.0% in P and 34.7, 15.5 and 12.1% in C ( $P > 0.05$ ). Laying performance was 54.5% in P and 54.2% in C ( $P > 0.05$ ). Egg breaking strength decreased during the laying period, but remained above 30 N. Feed conversion was 3.4 kg feed/kg egg. On average, 25% of the animals stayed outdoors ( $P > 0.05$ ). Keel bone deformations were observed in 10% and breast blisters in 20% of the hens at the end of laying. Slaughter weight of hens was 1,850 g with a leg proportion of 31% ( $P > 0.05$ ). Under the specific conditions of marketing products as high-value, performances resulted in an overall economic benefit, which was higher for P than C. The use of dual-purpose chicken to avoid the killing of one-day-old chicken and mobile housing may be ways to substantiate premium prices.

## Prevalence and burden of helminths in free-range laying hens under mountain farming conditions in Northern Italy

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Free-range egg production is a suitable farming activity for small-scale mountain farmers. However, it is questionable whether under these specific environmental conditions infections with endoparasites are as severe as in lowlands. Therefore, this study aimed to investigate the prevalence and burden of helminths in free-range laying hens kept under mountain conditions in South Tyrol, Northern Italy. A total of 280 hens were collected at the end of laying period from 10 conventional and 4 organic free-range farms. After slaughter, gastrointestinal tracts were removed and examined for the presence of helminths. Individual faecal samples were taken to estimate faecal egg counts (FEC) and oocyst counts (FOC). Prevalence rates and mean worm burden of each helminth species were analysed with the software SPSS. In addition, correlations between different worm species and total worm burden were calculated. In total, 99.3% of all examined hens were parasite-positive with an average worm burden of 171 (SD±261) worms per hen. *H. gallinarum* (95.7%), *Capillaria* spp. (66.8%) and *A. galli* (63.6%) were the most prevalent species, whereas the overall prevalence of cestodes was 30.7%. The percentage of FEC- and FOC-positive samples was 55.5 and 14.4%, respectively. On average, 258±553 nematode eggs and 80±421 coccidia oocysts were excreted with the faeces. The vast majority of the eggs quantified in the faecal samples were ascarids eggs. Correlations between worm counts of different parasite species were highly positive ( $P < 0.01$ ). Total worm burden was significantly higher in organic than in conventional farms (319±396 vs 112±144;  $P < 0.001$ ). The dominating helminth species was *H. gallinarum* with on average 212 worms per hen in organic and 71 in conventional farms ( $P < 0.001$ ). In conclusion, free-range laying hens in the studied mountain region were at high risk of nematode infections, especially in organic systems. Generally, mixed infections were observed, which suggests that the prevailing environmental conditions and free-range management systems provide favourable conditions for helminths. This emphasizes the need for management practices that counteract parasitic infections, in particular from an animal welfare point of view.

## **Session 5a: Wildlife Management in the Mountains**

### **Analysis of brown bear predation on livestock in the eastern Alps and technical solutions to reduce the negative interactions and to promote the establishment of bear Alpine-Dinaric-Pindos metapopulation**

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To promote the coexistence between large carnivores and livestock activities it is necessary to understand the interactions, and apply innovative technical solutions, that can reduce the risk of predation, and in the same time, are economical and technically sustainable. The establishment of a Dinaric-Pindos and Alpine brown bear metapopulation will occur only if the presence of the bear will be accepted by the local populations, also thanks to the reduction of the risks of damage. From 2009 to 2017 we have sampled, through hair traps and opportunistic monitoring, in Friuli Venezia Giulia region, and in particular in the Alpine and Prealpine areas, 23 different genotypes of bears, of these 6 coming from the Trentino population and 17 from the Dinaric population. We have captured and equipped with a GPS/GSM collar six male bears, aged between 3 and 10 years, one of which was from Trentino population. The data of damages, from 2009 has been analysed and interviews were carried out with a sample of 31 farmers. Since 2009, FVG region has refunded over 56800 euros for damages, of 136 claims, of which, 61 referring to beehives. The farms most attacked by the bear, were sheep flocks and mixed with goats (49 attacks); in particular the small flocks, generally with a fixed fence, present in small villages or near scattered houses, having part of the enclosure along the wood. Another important type attacked were the flocks roaming and unattended in summer pastures, only periodically controlled by the owners. The transhumant flocks, with night presence of dogs and with night containment, seemed not vulnerable, as well as the alpine farms, with the constant presence of the breeders; low was the number of predations against cattle (n = 3). In the face of these damages, the attitude of breeders is not negative also thanks to the long period of recolonization (the bear has started to recolonise from 1970) and they considered the bear like a natural component of mountain system. Of the 6 collared bears, only one, showed a predatory behaviour towards sheep, goat and even deer, while in one case, an individual from the Trentino population and known for the strong predatory activity in Trentino and Veneto, settling in the north eastern Alps has changed feeding behaviour. Three out of six showed strong aptitude for attacking the beehives. The distribution of damages and habitat use data by bears has allowed to build a risk maps. The presence of night containment fences and the presence of dogs, also as a shepherd breeds, allows a strong reduction of bear damage as well as the predisposition of electric fences for the beehives or even the use of colored tapes. The negative interactions

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between brown bear and livestock activities depend from the behaviour of individual, the environmental characteristics and the night management of the animals. The adoption of systems that allow the presence of dogs in mountain pastures, of suitable breeds, and automated night containment system must be implemented and some operational proposals are presented

### **Golden jackal and livestock: new conflicting scenarios?**

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The golden jackal (*Canis aureus*), listed in annex V of Habitat Directive, represents a new species for Italy and for the Alpine areas: feeding behaviour and the impact on livestock activities are controversial and the conservation status are different in European countries. The first individuals from the Dalmatian and Pannonian populations arrived in Italy in the 80s. From 2010 to 2017 we have monitored the species using the jackal howling to determine its distribution and in some areas, even the density, and with phototrapping, to verify the responsible of predation or the first consumer. In respect to impact of jackal, we have interviewed 20 farmers in order to determine the perception about the species and the impact on livestock systems. The results of monitoring show as the jackal is concentrated in some alpine areas, even on high altitude pastures, along large water courses rich in riparian vegetation and in the karstland, characterized by Mediterranean scrub and dry meadows. The estimated minimum number of individuals in Friuli Venezia Giulia region is 50 and the minimum number of packs is 12-15, with some areas (Karstland) where the density reach 1,1 head/100 ha, in respect to only a couple of wolves detected in all region. The presence of the jackal has not affected the livestock activities until the beginning of the 2000s, but in the last 5 years, correlated to the increasing of density, in specific areas, the number of predations has raising. Recent data show that the jackal can actively preys, in high-density areas. not only lambs but also older sheep and can strongly affects the structure of flocks. Three free ranging flocks, without dog and with fixed fences or two electric strips, have seemed more vulnerable and have suffered an average predation of 10-20 % per year (135 sheep and lambs preyed in the last 5 years on 200 ha with a total of 150 adult sheep, as declared by farmers);the phototrapping and carcass inspections, on 18 carcasses, mainly on adult sheep, have confirmed the golden jackal as predator. The predations were concentrated from May to October; in the same area the calves born in rangeland did not seem vulnerable thanks to the active defense from cows as well as donkeys. The predisposition of electric fencing and the night presence of dogs, seem to allow the significant reduction of damages. Faced with this situation, the Friuli-Venezia Giulia Region has decided to extend the prevention and compensation

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measures provided for large carnivores (bear, lynx and wolf) also to the jackal. The extension of the species' range and the increase of density in specific areas implies the modification of farming systems and the adoption of prevention measures. In Alpine and Prealpine areas the interaction between jackal and wolf should be evaluated.

## **Social aspects and management strategies for wolf conflicts in South Tyrol**

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For over 100 years, wolves were absent in large part of the European landscape, due to eradication activities which drastically reduced their numbers. Thanks to increased protection status and to the abandonment of mountainous territories, the European wolf population is recently recovering and recolonizing its former territories. Also in South Tyrol, an alpine province in the northeastern Italian Alps, the wolf is naturally returning. This has caused conflicts with human economic activities and the raise of ancestral fears. The province is characterized by a traditional land use, where livestock farming on alpine pastures is a key activity to maintain the typical landscape image. Livestock losses due to wolf predation is a new conflict in this area and it is causing emotional responses and strong discussions on the need for management measures to protect human health and activities. The Province administration of Bolzano and Eurac Research started a collaboration in 2017 working on technical and social aspects of wolf return based on empiric and statistical data. Experts of the Bolzano Province are studying the best way for the implementation of different prevention systems on selected alpine pastures in the provincial territory, including fences and the merging of herds to reduce the risk of predation. In addition, the applied monitoring system guarantees a reliable overview of current wolf presence on the territory. Eurac Research will point to the collection and analysis of social aspects related to the presence of this predator in South Tyrol, providing, at the same time, the scientific background to sustain the strategic management choices developed at provincial level. The methodology foresees quantitative questionnaires for the large public and qualitative interviews for local stakeholder and representatives of interest groups. This shared study wants to fill the lack of information about the general knowledge on this species. It will analyze the concrete problems related to the return of the wolf trying to satisfy the management expectations, demonstrate the potentials for a positive coexistence and reply to the personal consternation of the economic operators and of the large public of South Tyrol.

## **Session 5b: Mountain Dairy Breeding and Husbandry III**

### **Reviewing developments in breeding Original Braunvieh**

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Original Braunvieh (OB) is a local Swiss dual-purpose breed. Conventional genetic evaluation is carried out for 56 traits. Breeding OB is without any introgression of alleles from foreign breeds. However, level of inbreeding in OB is much lower than known from other breeds. Effects on genetic gain and inbreeding are evaluated regularly and show appreciable genetic trends anyhow. Due to the fact that OB is kept under a wide range of environments, we addressed the question whether significant GxE interactions can be observed. Yield traits for milk, fat and protein in lowland or mountain area were coded as different traits. Estimates of genetic correlations between traits in opposite environments were observed between 0.98 and 1, indicating that GxE interaction is unlikely to be relevant. Under the umbrella of modern genetic tools like genomic selection where large datasets are required, OB is clearly seen as a small population. In 2014 however, a female based two step genomic evaluation model was successfully implemented. Evaluations have shown a relevant increase in reliability compared to the existing conventional genetic evaluation system. In addition, investment in large-scale SNP genotype data enabled the identification of specific haplotypes. Genome-wide scans for missing homozygosity were applied and detected a 2 Mb segment on BTA11 at significant level. Seven genome regions were identified slightly below significance threshold. Based on further analyses, co-segregation of the growth-related and recessive FH2-disorder originally reported in Simmental was found behind the observations made for the haplotype region at the telomeric end of BTA1 in OB. In summary, results from all projects together contribute significantly to the positive development of the OB population, which was observed within last years.



## **Sustainability of dairy production in mountainous areas of Austria**

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The objective of this paper is an integrated assessment of selected sustainability criteria of milk production systems located in mountainous regions of Austria. A total of 9 conventional and 6 organic dairy farms were identified and assigned to three different production systems. Detailed information on farm elements, production technology, economics and work management were collected and were utilized for the estimation of ecological, economical and social sustainability indicators. Similarities between farms are due to similar specific factors and farm elements rather than the allocation to the same production system. Productivity has a major impact on the results for ecological indicators: farms producing greater amounts of milk per ha of agricultural land perform better in terms of nutrient balance and life cycle assessment traits. Farms assigned to the Alpine or the Upland-pasture production system show good results for potential farm biodiversity. An intensification of production will have a different impact on different sustainability criteria. In terms of their contribution to global food security, the overall asset of mountain dairy producers lies in the transformation of grass into milk and beef, resulting in a human edible feed conversion efficiency of clearly above 1, particularly for protein. In economic terms, small-structured alpine farms only achieve a marginal remuneration for the production factors utilized. The high work input particularly reduces the economic performance of these farms which depend on subsidies if they shall not achieve a negative income. Despite the greater work load, alpine farmers and their families perceive a greater degree of time prosperity and relatively less psychological stress. In conclusion, dairy farms in mountainous regions of Austria differ in sustainability traits, mainly due to farm-specific factor combinations. Nevertheless, milk production in these regions may be attributed to distinct sustainability aspects.

## **Welfare assessment in mountain small scale dairy farms**

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Given that animal welfare is a topic of growing interest among all members of society, assessment methods on farm and communication strategies to consumers represent two key aspects in the journey towards welfare improvement. Assessment methods that focus on resource or management-based indicators present several shortfalls if applied as such in mountain farming systems, that are often represented by SSDF. For example, the presence of tie-stalls (even though it may be alternated to access to pasture for a period of time) or the coexistence of multiple species are considered a priori a risk for animal health and welfare, without taking into account that local breeds adapt better than more specialised breeds to constrained environments or that lower animal densities and higher biodiversity play an important role in disease regulation. Therefore, an animal-based approach seems more suitable to evaluate animal welfare. The application on-farm of this assessment method highlights a number of welfare-related strengths in mountain SSDF such as longevity and a usually low prevalence of lameness problems. Additionally, a good human-animal relationship can usually be observed in mountain SSDF, possibly due to the farming system and the limited herd size. Moreover, local breeds in mountain SSDF usually present a more regular body condition, both indoors and on pasture, due to a lower production level and a better adaptation. On the other hand, animal cleanliness and somatic cell count may be worst in mountain SSDF, for example due to the more difficult hygienic conditions in tie-stalls; however, these two indicators can show a considerable variation among farms, suggesting that good management practices may help controlling these problems.

**Session 6a: Farm Economics and Successions in Mountain Livestock Farming**

**Competitiveness and future strategies of mountain dairy farms in Austria**

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Mountain dairy farms in Austria play an important role for viable rural areas. However, as a result of tougher site conditions competitiveness of mountain dairy farms may be possible lower than for those in favoured regions. To answer this question we analysed 102 dairy farms within the Austrian working groups for full-cost accounting for 2016. Additionally, future strategies of mountain farmers were realised by using a survey that includes 400 Austrian dairy farms in 2018. Overall, mountain farmers produce with statistically significant higher costs than non-mountain farms. In contrast, the entrepreneurial profit only differ marginal according to site conditions because mountain farmers achieve higher milk prices (higher amount of organic farmers and/or premium products) and higher subsidies. An applied cluster analysis confirmed a high potential for consequent implemented strategies for different production systems in mountain areas. Organic milk production accompanied with premium products (hay milk) or low input strategies prove a very high economic viability. The intended strategies of mountain dairy farmers in Austria are diverse. Around ten percent of them want to increase their dairy herd, seven percent intend to reduce the cows or cancel dairy farming. Hence, it might be assumed that the huge majority remains stable. Also the increase of milk yield per cow is only an option for a minority among mountain dairy farms. On the other hand, around three out of four intend to increase the lifetime of dairy cows and two out of three having in mind raising their forage milk performance. Depending on the degree of disadvantage, 30 to 50 percent of them consider taking part in animal welfare programmes. All in all, mountain dairy farms in Austria can compete with non-mountain farmers under current market and politic conditions, but only with the assumption of higher price premiums for special premium products, sophisticated implemented strategies and higher subsidies for disadvantaged areas.

## **Comparison of costs and benefits of field drying, barn drying and ensiling**

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The objective of the study is to compare the costs and benefits of different types of hay and grass silage. Project background is the significant role of hay-milk as an alternative concept for production and marketing in many mountain areas. Whereas often benefits in weather independent harvesting and feeding are discussed, on the other hand the costs for investments and energy input need to be considered. To evaluate the economic effects altogether, the differences between field-dried hay, ventilated hay, dehumidifier-dried hay and grass silage are examined in a systematic model calculation. The data is provided by a three-year preservation and feeding study which was carried out at the Agricultural research and education centre Raumberg-Gumpenstein in Austria. The comparison starts from the identical meadow and date of mowing. It covers the entire production process from harvesting to conservation losses and milk yield based on the effects per area and year. The evaluation of the costs and revenues takes all relevant fields into account: grassland management, preservation technique, investment costs, energy input, feed quality and intake, milk yield, work management, market situation, and ecological effects. The results show a higher milk yield per area for the more advanced preservation technologies (ensiling and barn drying), but no substantial financial benefit for the individual farm. The key economic advantage results from the reduction of the weather and harvest risks. Decisions at farm level need both, strategic anticipation and a close look at the technology range, since both investment costs and variable costs of hay ventilation differ significantly.

## **Agriculture 4.0 – Potentials and Perspectives for Farmers and Mechanical Engineers in South Tyrol**

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The increasing awareness for sustainable food production and the demand for low food prices push economic pressure on small-scaled farm holdings, mainly in less favored mountain areas. Furthermore, agriculture has to take concern of its impact on public health, environmental pollution and CO<sub>2</sub> emissions. In favor of the European bio-economy strategy, the sector is requested to apply innovative production and management approaches. Particular South Tyrol's small-scaled family farms are on transition to become resilient in coping with crises but also in perceiving new opportunities. This requires new business models, appropriate to cope with the substitution of the manual workload, work safety, ergonomic aspects and particularly with raising efficiency under considering the ecological criteria of integrated or organic production. Innovative technological but also digital or logistical solutions in agro-technical engineering could simplify the situation for geographically disadvantaged mountain farms, which often work under hazardous and physically demanding conditions. Together with the IDM Ecosystem on Alpine Technology and the main farming association and advisory services in South Tyrol, we started the initiative agriculture 4.0 to develop innovative solutions, applicable for steep and unfavorable grassland sites in South Tyrol. Through quantitative and qualitative interviews with experts and farmers from grassland farming, we identified along the single production steps urging technological problems. Based on those priorities we seek for mechatronic, automation, radio-controlled or digitalization solutions or for alternative materials to substitute wear parts in grassland management. Besides, we put also effort on alternatives to change from diesel to electric drive or on irrigation or fertilization techniques to reduce CO<sub>2</sub> emissions. Due to high acquisition costs of agricultural machinery, logistical possibilities for joint purchase and usage are discussed. The findings may provide valuable inputs for South Tyrolean mechanical engineers to produce innovative technical solutions for the European market.

## **Livestock farming in the Uttarakhand Himalaya, India: use pattern and potentiality**

**Sati Vishwambhar Prasad**

**Mizoram University (A Central University)**

This study examines use pattern, changes in livestock population and production, and potential of livestock farming in the Uttarakhand Himalaya. It analyses economic valuation of livestock farming, suitability of its rearing in different agro-climatic zones and questions how livestock farming can contribute in livelihood sustainability of the marginal farmers in particular; and the whole region in general. We used both qualitative and quantitative approaches to conduct this study. Data was collected from secondary sources, mainly from the State's Statistical Report, 2015. Time series data from 2001–02 to 2013–14 on livestock population and production pattern were collected and changes in livestock number, production and economic valuation of livestock, livestock density and per capita livestock were analysed. We calculated different variables and their share at the state and national level. Economic valuation of milk-producing animals, viz. milching cow and buffalo – both indigenous and crossbreed, hens – indigenous and improved, and goat, sheep and lamb used both for wool and meat was made. Correlation of livestock farming, practiced in both mountainous and plain areas, and human and livestock ratio were found. Participatory approach was also used through rapid field visits to the study area. We observed that livestock farming has high potential in terms of economic sustainability. Our study shows that the Uttarakhand Himalaya has feasible climatic conditions and large forests (59.7%) and pasturelands (3.4%) – subtropical, temperate and alpine. However, arable land is limited (12.4%), which supports promotion of livestock farming, mainly of dairy animals. We need a holistic approach for sustainable livestock farming in the Uttarakhand Himalaya. Keywords: Livestock farming, livelihood, socio-economy, sustainability.

## **SoZooAlp as bridge between research and end-users in the livestock sector of the Italian alpine area**

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The Italian mountain has a long tradition in livestock breeding and cattle production in particular and it is worldwide known for the excellence of its dairy products. However, over the last 3 decades, the Italian livestock sector in the mountain area has faced a deep crisis. Official data report the closure of 60% of cattle farms with a loss of 30% of animals. Moreover, in many mountain areas, the traditional extensive cattle farming system based on the use of local roughage as feed source has been replaced by more intensive husbandry systems leading to the abandon of 300.000 hectares of pastures and meadows. Several causes explain this negative trend, but certainly alpine farmers suffered, among others, the lack of a dedicated knowledge transfer system, capable to support their professional growth with the development of management solutions tailored for the alpine environment. The Italian society for study and improvement of Alpine livestock systems "SoZooAlp" was founded in the year 2000 as think tank to welcome all users who are interested in the conservation of an alpine livestock sector rich in productive and cultural expressions, as well as environmentally conscious. The Society promotes the exchange of knowledge and the teamwork among researchers, producers and local authorities of the livestock sector through the organization of thematic meetings. The core tool for dissemination purpose is the Society website [www.SoZooAlp.it](http://www.SoZooAlp.it) where users can freely download all the published documents of the Society. So far, SoZooAlp has organized 11 official Symposiums across different locations of the Italian alpine regions, addressed to specific topics of mountain farming, from farm (cattle and small ruminants feeding, welfare ...) to fork (nutritive quality and traceability of mountain food products).

## **Session 6b: Grassland Management and Mountain Pasture**

### **Robustness and resilience of livestock farming systems in the Alps**

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The concepts of robustness and resilience can be applied at animal, farm and system level to understand the capacity of livestock farming systems (LFS) to resist, recover or adapt to variations of environmental, social or economic conditions. Robustness includes three main components regarding the exposure to disturbance: avoidance, resistance and resilience that is the capacity of a system to recover after being disturbed. Strategies for robustness include diversity and heterogeneity, functional redundancy and modularity. Alpine livestock farming systems (ALFS) have intrinsic attributes of robustness, but they are also exposed to specific perturbations that can make them more vulnerable than other LFS. Different types of perturbations challenging ALFS can be analysed by considering three interrelated domains: agro-ecosystem, livestock, and human dimension. Alpine agro-ecosystems are meadows and pastures. Their resilience is closely related to floristic biodiversity; climatic changes, too low or too high management intensity and mechanical damage interfere with the floristic richness and threaten grassland ecosystems. Other perturbations are economic constraints that push alpine farmers to manage livestock to compete with systems that are more productive. The recognition of a functional dimension of the ALFS drives other farmers to present their activities in a different way. Society in large can have a crucial role in fostering resilience of ALFS by recognizing and valuing ecosystem services and re-defining the role of farmers and shepherds in relation to environmental and landscape effects of their activities. Within this approach, the floristic composition of meadows and pastures, the nutritional and organoleptic characteristics of animal origin products, the rusticity and resilience of a breed are the result of a long process of interactions between human dimension and nature driven by the local environmental conditions and the culture of the alpine communities.



## **Livestock monitoring and workload on alpine pasture**

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A decreasing number of livestock units on alpine pastures during the last decades resulted in succession processes in many regions of the Alps. One of the reasons is high labour workload per livestock unit on alpine pastures compared to lowlands. Even though, modern techniques for tracking of animals have been applied already in the late 1950s, firstly with a broad use of GPS for civilian purposes, this became applied for animal monitoring, especially with wild animals. Nevertheless, such techniques can help to reduce daily workload and to improve pasture management and in combination with other sensors to monitor behaviour of animals grazing on alpine pastures. Therefore, the aims of this study were to (i) investigate the workload on selected alpine farms and (ii) to analyse pasture use and behaviour of grazing cattle based on data from GPS tracking collars. The workload of herdsmen was registered for 34 activities divided into four categories and conducted on a total of 13 alpine farms located in Bavaria, Germany. Furthermore, every herdsman carried a GPS data-logger in order to estimate walked distances needed to search the animals on the pasture. Pasture use and grazing behaviour were analysed based on sensor data from tracking collars (GPS, accelerometer and magnetometer) fitted to heifers. The first results of the workload analysis showed that 70% of the total workload was spent by the herdsmen to control the animals on the pasture. Though, approximately 30% of the time spent for this activity can be reduced by usage of a livestock monitoring system. Based on the data derived from tracking collars it was possible to identify pasture areas with different activity levels of animals as well as to distinguish among heifers' grazing, ruminating and lying behaviour with classification's algorithm total accuracy of 82%. Application of modern techniques for livestock monitoring on pastures reveal beside workload reduction the opportunity to monitor behaviour and in the near future possibly health status of the grazing animals.

## Changing from continuous to rotational grazing enhances alpine grassland composition and plant diversity: results of a five-year monitoring

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The paper reports the result of a five-year monitoring on botanical composition, plant diversity, Pastoral Value (PV) and soil nutrient content in an alpine pasture where Pastoral Plans (PP) were implemented after several years of continuous grazing (CGS). The PP are a policy and management tool aimed at enhancing farm productivity, while preserving plant diversity, soil and landscape. In the western Italian Alps, they are based on rotational grazing systems (RGS) with animal stocking rate adjustments, to keep it balanced with grassland carrying capacity. A total of 199 vegetation transects was carried out in summer 2011 and 2016. Vegetation ecological groups were identified by means of a Hierarchical Cluster Analysis and species richness and Shannon diversity ( $H'$  index) were computed. The mean soil nutrient content was estimated through Landolt N indicator values (N index) for each transect. Paired-sample statistical tests and PERMANOVA were performed on the whole vegetation dataset, on vegetation ecological groups and considering functional pools of species. Considering the whole dataset, species richness,  $H'$  index and N index significantly increased between 2011 and 2016. Species richness increased in almost all the ecological groups, with a peak in the mesotrophic one. A significant change in the botanical composition was measured in oligotrophic, mesotrophic and thermic groups. The number and cover of nitrogen-poor high-elevation species raised in all groups, likely boosted by livestock seed transportation and improved connectivity among different communities. The meso-eutrophic species number and cover increased in thermic, mesotrophic and pre-forest groups, suggesting a greater use of such areas by livestock under RGS than CGS. In addition, an increase of PV was detected in the pre-forest group. In conclusion, the PP implementation was an effective and a sustainable management tool to enhance botanical composition and plant diversity of alpine grasslands over five-year, and to improve their pastoral value as well.

**Dos and Don'ts: Key characteristics and recommended actions to improve the conservation of Alpine grasslands and their characteristic invertebrates**

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As most European grasslands are semi natural habitats, including those in the Alpine Biogeographical Region below the tree line, their genesis, management and species-richness are linked to human intervention, in particular extensive agricultural use as pastures or meadows. We summarized experiences of the Interreg IV A project “Alpine Pasture Action – New Ways to Preserve Biodiversity” as well as conclusions of an expert workshop to help improve existing grassland management in the Alpine Biogeographical Region in the context of the Natura 2000 Biogeographical Process. Alpine pastures can be extraordinarily rich in animal species. Their conservation is intimately linked to particular agricultural practices, often representing centuries-old traditions. Consequently, changes in agricultural use are among the primary causes of semi-natural grassland degradation and disappearance. Even small changes in agricultural land-use, such as slight changes in grazing mode and intensity, introduction of additional feeding of cattle, spraying of slurry or removal of stones, rocks, shrubs, ecotones to forests and other habitats, may cause major losses of characteristic plant and animal (esp. invertebrate) species. This negative trend can be reverted by a sustainable management of grasslands. When re-shaping grazing practices in existing pastures or re-introducing them on abandoned sites it is essential to consider many factors diligently, especially site conditions and microclimate forming special sites such as fens, ponds, forest ecotones, nutrient-poor and rocky areas that are crucial for habitat diversity and many endangered species. Grazing practices must follow very sensitive to maintain this diversity. Nature responsible management does respect these interrelations strictly.

## **Suitability of seed mixtures containing tall fescue (*Festuca arundinacea* Schreb.) for mountain permanent meadows under recurrent drought**

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Recurrent drought periods in the southern side of the Alps require suitable strategies to prevent damage to grassland. Tall fescue (*Festuca arundinacea* Schreb.) is targeted as a component of seed mixtures for mountain permanent meadows because of its tolerance against drought. Four seed mixtures (two seed mixtures already in use in practice and two seed mixtures containing respectively 40% and 60% seed weight of tall fescue), combined with three cutting frequencies (2, 3 and 4 cuts year<sup>-1</sup>) coupled with increasing fertilisation rates (1, 1.4 and 2 livestock units ha<sup>-1</sup>), were investigated over four years in South Tyrol at two drought-endangered sites at altitudes of 835 and 1200 m a.s.l. Dry matter yield and forage quality, including in vitro digestibility, were assessed for the trial's duration. A data analysis across the whole observation period showed only minor differences due to the seed mixtures. The seed mixtures containing tall fescue exhibited a slight reduction of the in vitro digestibility at higher management intensity and an increased content in Mg and Mn. It can be concluded that the seed mixtures including tall fescue are similarly suited like those already in use.

## **Session 7a: Mountain Livestock Product Quality**

### **Quality and traceability of mountain dairy products**

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In the globalization age, the impressive mass of food available to the western society, is featured by a loss of identity and a "standardized" quality. In this scenario, the preservation and enhancement of mountain cheeses typicality must be grounded in the specific and unique terroir provided by their area of origin. For centuries, the mountain environment has been the original nest of a large variety of excellent dairy products. In Italy, 27 out the 50 domestic cheeses granted Protected Geographical Status under European Union law through the Protected Designation of Origin (PDO) come exclusively or partially from a mountain area. The peculiar organoleptic characteristics of mountain cheese and dairy products are closely linked to the feeding regimen of dairy cows through a trophic relationship between animal and land primarily based on the consumption of local roughage. This feeding system transfers to the dairy products unique lipid biomarkers and nutraceutical substances that can be used to trace the location of their production site. Mountain dairy products are often made from milk from local dual purpose breeds and therefore their production is a way to prevent from the loss of these animal genetics sources. Moreover, if based on the consumption of local roughage, mountain dairy chains become an important tool for maintenance and environmental protection by providing through the exploitation of bottom valley meadows and highland pastures, an irreplaceable piece to the extraordinary chromatic mosaic of our Alps. Nowadays, the integrity of this picture, so crucial also for the tourism sector, is however jeopardized by both the progressive abandonment of the alpine farming and the increasing development of farm management schemes that have weakened the trophic relationship with the alpine territory. This drift towards intensive production systems has an intrinsic risk to direct the mountain dairy chain towards anonymous nutritional and sensory connotations making it similar to lowland dairy products.

## Verifying geographical origin of South Tyrol milk by proton transfers reaction mass spectrometry (PTR-MS)

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A rapid and non-invasive method for the control of milk was developed by using proton transfer reaction mass spectrometry. The approach has the potential to verify the geographic origin and altitude of dairy farms. The production of milk from three distinct milk producers located respectively in Merano, Brunico and Bolzano (South Tyrol, Italy) was monitored over a month period. Provided that the cows were extensively grazed with forage that reflects the botanical composition of the local environment. A total of 116 samples (86 for geographical location farms and 30 for different altitude farms) were analysed. A multivariate control chart based on the Hotelling T<sup>2</sup> statistic was built with proton transfer reaction mass spectrometry data. The headspace analysis of the samples led to characteristic mass fragment profiles. A set of 39 m/z were selected for further statistical analysis. From the data set mass fragment showing a rsd% lower than 15% were selected. The most representative mass fragments were m/z 45, 59, 73 & 89 for geographical location farms and m/z 45, 59, 73, 75 & 81 for different altitude farms respectively. A multivariate control chart was developed on the basis of the these mas fragments. Such control charts was then used to identify those milk that were deviated from control (model sample) and assigned the samples to their (1) geographical origin and (2) altitude. Overall, this work exemplifies the suitability PTRMS for the routinely quality control of milk.

## **Session 7b Mountain Sheep and Goat Breeding and Husbandry II**

### **Is distance from night penning areas an effective proxy to estimate sheep stocking density at grazing? A new methodology experienced in the Western Italian Alps**

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Grazing livestock is a useful tool for the implementation of management strategies addressed to the restoration, improvement, or maintenance of grassland vegetation. Many studies aiming at assessing the effectiveness of such strategies were based on indirect measures (proxies) of stocking density exerted by livestock, such as distance from congregation areas (e.g. sheds, water sources). However, the suitability of these proxies has been rarely validated. In the Alps, sheep flocks are usually managed through lenient supervision by shepherds during day and sheltered in temporary night penning areas (TNPA) periodically moved over the grazing area. The aim of our study was to implement a method using a GPS/GIS assessment to determine whether the distance from TNPA can be used as a reliable predictor of sheep stocking density at grazing. In 2015, a flock of 250 sheep grazed for one month over 45 ha of nutrient-poor dry grasslands in the Western Italian Alps and was fenced in TNPA for 2-3 nights each. Ten sheep were tracked at 15-minute intervals with GPS collars. We assessed sheep stocking density as the number of GPS fixes within a 30 m-buffered zone around 65 randomly-generated points. We performed a linear regression analysis using stocking density within each buffered zone as response variable and the sum of inverse distances of each point from all the TNPA as explanatory. Our results highlighted a strong inverse correlation ( $P < 0.001$ ,  $R^2 = 0.83$ ) between the stocking density and the distance from TNPA. This short-term experiment supported the use of the distance from congregation areas as an easy-measurable and effective proxy to predict sheep stocking density in mountain environments.

**Session 8a: Mountain Dairy Breeding and Husbandry IV**

**Alpine pasture affects circulating progesterone and oviduct redox environment in early-pregnant heifers**

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The objective of this study was to compare the effects of alpine versus lowland feeding systems on reproductive parameters in cattle. Specifically, plasma progesterone and gene expression of key antioxidant enzymes in the oviduct were investigated. Dexter heifers grazed shrub-rich pastures at 1,940 meters above sea level (m a.s.l.) (SHRUB; alpine: n=5) while Holstein Friesian fed on herb-rich pastures (POLY; alpine: n=15; m a.s.l.=1,900). The lowland controls were fed pastures without shrubs and herbs at 400 m a.s.l. (SHRUB: n=6; POLY: n=12). Heifers were cycle synchronised after 2.5 months of grazing and slaughtered on day 4 after artificial insemination. Plasma and oviduct tissue were collected. Plasma progesterone concentration was determined and RNA isolated from the isthmus and ampulla regions of the oviduct for gene expression analyses using real-time qPCR. T-tests showed that the plasma progesterone concentration was low in SHRUB ( $1.7 \pm 0.5$  vs  $4.9 \pm 1.3$  ng/ml;  $p=0.033$ ) but not in POLY ( $4.1 \pm 0.5$  vs  $5.7 \pm 0.9$  ng/ml;  $p=0.33$ ) heifers on the alps versus the respective controls. In SHRUB, genes of antioxidant enzymes NADPH quinone oxidoreductase-1 (percentage change: isthmus: -66%; ampulla: -54%;  $p<0.05$ ), catalase (isthmus: -16%;  $p<0.05$ ) and cyclooxygenase-2 (isthmus: -60%; ampulla: -61%;  $p<0.05$ ) were down-regulated in the alpine heifers compared to the control. In POLY, alpine pastures up-regulated glutathione S-transferase A2 (ampulla: +53%;  $p<0.05$ ) and glutathione synthetase (isthmus: +12%;  $p<0.05$ ). Therefore, alpine system in comparison to lowland system differentially affected the embryonic environment in the oviduct during early-pregnancy through altered plasma progesterone and oviduct redox system in heifers.



## **Evaluating working time of mountain dairy farms – A step towards production efficiency**

**Poulopoulou Ioanna<sup>1</sup>, Nock Christian Martin<sup>2</sup>, Steinmayer Silvia<sup>3</sup>, Lambertz Christian<sup>4</sup>, Gaily Matthias<sup>5</sup>**

**Free University of Bolzano, Bolzano, Italy<sup>1,2,3,4,5</sup>**

The aim of the present study was to estimate the labour input on dairy farms with loose and tie stall housing in South Tyrol as a basis to improve production efficiency. The study was performed on 102 dairy farms, half with tie stall and half with loose housing barns. A standardized questionnaire was used to survey all daily and non-daily working activities, management practices and facilities applied on farm level. To determine the exact working time of each single activity and validate questionnaire data, 9 tie stall and 10 loose housing farms were selected for on-site measurements. Average herd size was estimated at 16.3 and 23.2 cows for tie stall and loose housing. Total working time requirement was 177 manpower hours per cow and year (MPh/cow/year) for tie stall and 113 MPh/cow/year for loose housing. Time for milking was estimated at 74 and 56 MPh/cow/year and feeding followed with 34 and 27 MPh/cow/year, respectively. Labour costs per kg of milk were estimated at 32.6 and 16.9 Euro cents, while the production per working hour was determined at 41.4 and 79.7 kg/MPh for tie stall and loose housing accordingly. In both housing systems, the working time decreased with increasing herd size. The comparison between questionnaire and on-site measurements showed that farmers could precisely estimate total daily workload however, they faced difficulties to estimate single activities. Moreover, the results reveal a limited use of facilities that improve productivity and cost efficiency such as milking systems. A clear understanding of their working efficiency will allow farmers to better understand the requirements for dairy farming and encourage them to modify working procedures in a way so that sustainability of mountain dairy farming is improved.

## Characterization of electrical conductivity in individual milk of cattle breeds reared in Alpine area

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Mastitis is one of the most relevant sources of economic loss in dairy farms. Since direct information on udder health traits is generally difficult and expensive to collect, indirect indicators are often considered at individual level to check udder health status. Milk electrical conductivity (EC, mS) is positively correlated with mastitis, due to the increase of Na<sup>+</sup> and Cl<sup>-</sup> concentrations when an intramammary infection occurs. This trait has been recently introduced in the routine analyses of the South Tyrol Dairy Association laboratory (Bolzano, Italy) for individual milk samples. In order to conduct a preliminary characterization of milk EC in Bolzano province, 96,722 test-day records from 2,209 single-breed herds of Brown Swiss, Holstein Friesian, Simmental, Alpine Grey and Pinzgauer cows for the period from March to December 2017 were retrieved from the database of the South Tyrol Dairy Association. The analysis of variance included the fixed effects of stage of lactation (12 classes), parity (6 classes), breed and their interactions; random factors were animal and herd-test-date nested within breed. All fixed effects included in the model were significant in explaining EC variation, with least squares means for breed effect ranging from  $5.43 \pm 0.02$  mS (Pinzgauer) to  $5.58 \pm 0.01$  mS (Holstein Friesian). Contrast estimates between breeds were significant, except for the comparison between Brown Swiss and Alpine Grey. Breed-specific EC lactation curves exhibited similar shapes, even if with different intercept values. The trends of EC among parities were similar between the five breeds, with a progressive increase of EC in subsequent lactations. Pearson's correlations computed for each subset of breed highlighted that EC correlated with SCS in all breeds, with values that ranged from 0.22 (Holstein Friesian) to 0.35 (Pinzgauer). Moreover, EC strongly negatively associated with lactose percentage, with an average value of -0.75. These findings will be useful to better address future investigations and to understand how to exploit this milk feature.

## **Session 8b: Mountain Livestock and Climate Change**

### **From farmers, livestock and mountains – Assessing scenarios of land use and ecosystem impacts under climate change in selected mountainous regions in the Pyrenees**

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Land-use and climate change are pervasive drivers of global environmental change, posing major threats to global ecosystems and biodiversity. Research to date has mostly focused either on land-use change or on climate change, but rarely on the interactions between both drivers, even though systemic feedbacks between changes in climate and land use will have important effects on livestock, ecosystems and biodiversity. Climate change will not only alter patterns of temperature, precipitation or species pools, it will also motivate land owners to reconsider their land use decisions. In an ongoing project (MoLUP), we collaborate in an interdisciplinary research effort with the ongoing Belmont project (P3). There, we explore anticipated systemic feedbacks between (1) climate change, (2) land owner's decisions on land use, (3) land-use change, and (4) changes in ecosystems and hydrological regimes in the coming decades in selected mountain areas in the French Pyrenees. We explicitly focus on the role of alpine livestock systems and livestock grazing in mountain regions. We expand and refine an Agent-based model which we have developed for the Eisenwurzen Region in Austria, that simulates decisions of important actors, and develop a spatially explicit GIS model that translates these decisions into maps of changes in land cover and land use patterns, which we will implement for selected transects in the French Pyrenees. For MoLUP, the most relevant agents are land managers (e.g. farms) that make land-use decisions dependent on framework conditions (e.g. agricultural prices and subsidies) as well as intrinsic preferences and societal norms that may change over time. Expert interviews and interviews during field trips will allow incorporating regional specifics of the respective sites into the ABM. In addition, hydrological data as well as data on pollution and pathogens will be integrated into the model. This integrated socioecological model will allow to explore the option space for future land use under climate change and to assess both the direct and indirect land-use mediated effects of a warming climate on mountain ecosystems.

## Advanced opportunities to develop a circular economy model for mountain livestock farming

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Fondazione E. Mach, San Michele a/A, Italy<sup>1,2,3</sup>

The studies conducted in the last years at FEM Biomass Lab have deeply investigated the analytical quality of cattle manure aimed at a better exploitation of their energy and agronomical potential value. Cattle livestock waste have a good content of lignocellulosic fibre, mainly cellulose and hemicellulose, not completely degraded by rumen digestion, overall ranged between 43–62% DM, depending on both animal feed and husbandry. The studies exploited lignocellulosic fraction of manure by (i) bioethanol production, (ii) biomethane production and (iii) the integration of both (Bona et al., 2017). Bioethanol production were obtained by pretreatment of the manure, hydrolysis of cellulose and hemicellulose and the fermentation of pentose and hexose sugars obtained. Biomethane production were assessed by BMP (BioMethane Potential) tests. A final assessment of the agronomical properties was carried out on processes residue. Data were analysed using ANOVA and multiple pairwise comparison with Tukey's tests (HSD) at  $\alpha=0.05$  level of significance, using STATISTICA software (Statsoft Inc., Tulsa, OK, USA). The bioethanol production was 68 mg/g DM, obtained after saccharification of 292.69 mg/g DM of cellulose content and 219.49 mg/g DM of hemicellulose (saccharification yield 41.22%) and fermentation of sugar. The integration of bioethanol process and biomethane from distillation waste leads to 72.95 mg/g DM of CH<sub>4</sub> production too, generating a net energy balance of 1.28 MJ/kg. The preliminary comparison of wet and dry anaerobic digestion technologies highlighted no significant differences on CH<sub>4</sub> yield, by exploiting about 42% of cellulose content and 45% of hemicellulose residual. The proper exploitation of livestock waste could play a crucial role in the development of a circular economy system in mountain areas, achieving energy and biofertilizers production on one side and the reduction of greenhouse gas emissions on the other one.

## Poster Presentations

### Session: Mountain Dairy Breeding and Husbandry

#### **Characteristics of milk production in a mountain region using the example of the Malopolska Province**

Szewczyk Agata<sup>1</sup>, Prof. Piotr Wójcik<sup>2</sup>, Radkowska Iwona<sup>3</sup>, Walczak Jacek<sup>4</sup>

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Milk production in the Malopolska region is less intensive compared to other regions of Poland. The farms are fragmented with over 97% of cattle maintained in individual farms. Cattle stocking density per 100 ha of agricultural land is slightly over 31 animals, including 15.5 cows. In the studied region, permanent grassland accounts for 26.3% of the total area of land (compared to the national average of 16.3%), whereas pastures form 3.3% of total farm area; the farms were located 519 m above sea-level on average. The Malopolska and the Foothills region are an important site of organic milk production, with over 50% of the domestic organic milk production originating from this region. The aim of the study was to evaluate production results in organic dairy cows from the Malopolska region. Analysis was made of the data from 141 organic farm with a total of around 1,000 dairy cows. Basic chemical composition of milk, milk yield, and basic reproductive parameters were analysed. The yield of the dairy cows raised in the organic farms was lower, forming 84% of the average yield of dairy cows in conventional farms. In the analysed region, the mean yield was 4016 kg milk. Chemical composition of the milk was as follows: mean solids 12.67%, fat 4.04%, protein 3.25%, lactose 4.68%. Urea concentration fell within the normal range and amounted to 194.52 mg/l milk. In some farms, mean SCC exceeded the acceptable limit several times during the study period. The collected data show that the lactation period averaged 301 days, calving interval 470.1 days, pregnancy 283.2 days, postpartum interval 87.77 days, and services per conception 1.52. It is concluded from the results obtained that the milk from organic farms is characterized by favourable chemical composition, and although the milk yield of the cows is lower than in the conventional system, the higher price of milk levels out these differences. The study was conducted as part of the Core Organic project.

**Effect of selected environmental parameters on udder health and cytological quality of milk from cows in a mountain region**

**Radkowska Iwona<sup>1</sup>, Prof. Piotr Wójcik<sup>2</sup>, Szewczyk Agata<sup>3</sup>, Walczak Jacek<sup>4</sup>**

**National Research Institute of Animal Production, Department of Cattle Breeding<sup>1,2,3</sup>, National Research Institute of Animal Production, Department of Production Systems and Environment<sup>4</sup>**

Somatic cell count (SCC) is one of the most important determinants of the quality and technological suitability of milk, reflecting udder health. This parameter is influenced by the living environment of animals in its broad sense. The aim of the study was to analyse the effect of selected environmental factors on udder health of cows in mountain regions. The study analysed 100 cows in 7 farms that differed in housing system (free-stall vs. tie-stall) and milking system (direct-to-can milking vs. milking parlour). Animals were fed according to the same standards (IZ INRA) with consideration of milk yield and organic husbandry principles. Udder health was determined based on SCC in three categories: healthy milk <200 000 SCC, subclinical mastitis 200 000 – 400 000 SCC, clinical mastitis >400 000 SCC. During the summer season, the proportion of cows with SCC above 400 000 was around 30% in the farms with free-stall housing and more than 40% in the tie-stall system. In all the farms, the mean monthly SCC levels ranged from 190 000 to 900 000/ml. Elevated SCC (>400 000) was observed in May and August in the free-stall system with deep litter, and in April and August in the free-stall system with medium litter. In the farms with cows housed in the tie-stall system, elevated SCC was found in July and August. The most critical period in all the systems under study was August. In terms of the milking system, considerably higher SCC levels occurred in the farms with the direct-to-can system. Udder health and thus quality of the obtained milk were found to be significantly affected by both the housing system and the milk system; the best milk quality parameters and udder health were noted in the free-stall system with medium litter, in which the cows were milked in a parlour.

## **The use of herbal mixtures for mastitis control in cattle raised in mountain areas**

**Wójcik Piotr<sup>1</sup>, Walczak Jacek<sup>2</sup>, Radkowska Iwona<sup>3</sup>, Szewczyk Agata<sup>4</sup>**

**National Research Institute of Animal Production, Department of Cattle Breeding<sup>1,3,4</sup>, National Research Institute of Animal Production, Department of Production Systems and Environment<sup>2</sup>**

In Poland, organic dairy farming is carried out on 3087 farms maintaining a total of 19,149 cows. The aim of the study was to develop recommendations for organic dairy farms concerning the prevention and treatment of subclinical and clinical mastitis based on herbal preparations. The study was performed in farms with Polish Red (pc) and Polish Red-and-White (zr) cattle. All the animals were pastured during the plant vegetative season, from 15 April (7:00 am to 5:00 pm) in the Low Beskid. The herbal mixture contained a blend of herbs and extracts of pasture plants as well as essential oils with anti-inflammatory, bacteria-, mould- and yeast-inhibiting effects. Active ingredients of the preparation are phytosterols, flavonoids, juglone, aescin, vitamins A1, D3, E, K and C, beta-carotene, biotin, pantothenic acid, rutin, alpha-lipoic acid, linoleic acid,  $\gamma$ -linoleic acid, and oleic acid esters. The mixture was fed to cattle at 200 g/animal/day during the morning feeding. It was comprised of lucerne meal, algae extract, cumin, astragalus, fenugreek, barberry, chestnut, agrimony, meadowsweet, chamomile, curcuma, cinnamon bark, cloves, ginger, horsetail, oregano, marigold. Quantitative and qualitative cytological examination of milk was performed using the Prescott-Breed method. It was concluded from the analyses that somatic cell count (SCC) decreased considerably in all the farms after the application of herbs. In three farms, it decreased to below 400,000 SCC. In one farm, the milk still did not meet the standards although SCC decreased by 2 million. The total SCC is generally influenced by the level of epithelial cells as well as granulocytes. After application of the herbs, the proportion of both these components decreased. A very good response to the herbs was noted in the pc breed, in which SCC decreased by 1.3 million. Zr breed was characterized by the lowest SCC before and after herbal supplementation. The study showed that in the pc breed, front quarters were most often affected before, and rear quarters after the use of herbs. Herbal supplementation caused a significant decrease in incidence of udder diseases and in most cases it can influence udder health for at least 10 days after the end of application.

## Variation of lipid profile in Asiago PDO cheese during the alpine pasture

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The purpose of this study was to evaluate how the early and late alpine pasture could affect the fatty acid profile and vitamin content of the Asiago d'Allevo PDO cheese. The trial was carried out in two highland dairy farms (1150 m a.s.l., Veneto Region, Italy). Samples (n = 24) of Asiago PDO cheese manufactured in situ with milk obtained from grazing dairy cows in July and September were analysed to assess the lipid fraction. The fatty acid composition was determined by gas-chromatography while vitamins A and E were evaluated by HPLC. Data were submitted to a one-way ANOVA by using a general linear model. At the end of the alpine grazing, there was a significant ( $P < 0.05$ ) decrease of short and medium FA and, as a consequence, an increase in long chain FA. Moreover, it was observed a slightly ( $P < 0.10$ ) decrease of saturated FA (SFA) along the season that increased the proportion of monounsaturated FA (MUFA). Cheese from late alpine grazing was also characterized by a significant amount of CLA (conjugated of linoleic acid) while the incidence of PUFA and PUFA n-3 remained comparable between the two seasonal periods. The pasture-grazing period thesis did not affect the amount of vitamin A (retinol) that, on average, was equal to 9.8 mg per g of fat. The content of the vitamin E (α-tocopherol) tended to increase in Sept.-pasture cheese reaching 36.1 mg per g of fat from the 30.5 mg per g of fat detected in earlier manufactured cheese. However, what is certainly noticeable is the great amount of these two fat-soluble vitamins in both experimental thesis that, acting as antioxidant, could play a positive role in protecting the double bonds of unsaturated fatty acid during cheese ripening. Acknowledgements – This research was funded by FONDAZIONE CARIVERONA (SAFIL project - call 2016)



**Session: Innovation and Marketing of Mountain Products**

**Effect of plant diversity of mountain pastures and sampling period on terpenoid profile of Idiazabal PDO cheese. A case study**

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Idiazabal PDO cheese is produced in the Basque Country and Navarre regions (northern Spain) in a traditional way. In the present study, three Latxa (autochthonous breed) dairy ewe flocks reared in the Aralar Natural Park were studied. Despite the small area of production, mountain pastures are botanically diverse and this may lead to differences on cheese characteristics but, at the same time, the lack of homogeneity in high-value ruminant products may lead to consumer distrust. Therefore, the aim of the study was to evaluate the terpenoid composition of Idiazabal PDO cheese as a marker of dietary differences. For that, first plant relative abundance (i.e. availability) was recorded on the grazing areas of three experimental flocks. Also, plant species, faeces and cheese samples from the selected flocks were collected in two sampling periods (May and June). The terpenoid profile of plant species and cheese samples was determined by SPME-GC-MS, while flock diet composition was estimated using microhistological analysis of faeces. The diet terpenoid composition was estimated by weighting the averaged content of terpenoids in each botanical family to their proportion in the flock diet. Results indicated significant ( $P = 0.05$ ) effects of flock and sampling period on cheese terpenoid profile. Briefly, most terpenoids increased in cheese samples from May to June leading to higher total content in June, which is consistent with the increase in dietary terpenoids in this month. Moreover, despite the plant availability was similar in the three grazing areas, the cheese terpenoid profile varied markedly among flocks. In conclusion, cheese terpenoid composition was clearly related to the plant availability of grazing areas, however, the grazing behavior and diet selection by ewes exerted a significant effect on the terpenoid profile of cheese.

## **Technical Assistance in Alpine Cheesemaker Huts of FVG (IT)**

**Rainis Simona<sup>1</sup>, Pittino Ennio<sup>2</sup>, Chiopris Giordano<sup>3</sup>**

**ERSA - Agenzia Regionale per lo sviluppo rurale, Gorizia, Italy<sup>1,2,3</sup>**

Since 2001, Ersa has activated an experimental program of technical assistance. Every grazing season, alpine farms of FVG (Italy) are visited, in order to follow the processing pathway of dairy production. Some suggestions and advices, addressed mainly to guarantee milk quality and to improve the productive technology, are given. The main productive and technological parameters are registered to create a database that shows the trend of the season. During summer 2016, 33 traditional dairy productions were followed. The 64% of cheesemakers still employ wood as combustible to confer typicality to the taste of the products. This choice is important because it keeps the essential role of multi-functionality of the alpine farms that contribute to manage the forest trees in the surroundings. The ancient tradition to employ caprine milk, that imparts an inimitable flavour to the product, is gradually reducing year by year. From the sanitary point of view, the Californian mastitis test highlights that the 70% of the cattle doesn't show the preliminary evidences for mastitis, a good result that confirm a particular attention for the health of the herd. Quantitative data show that mainly these farms are of medium size. A good level of milk acidity indicates a correct way to storage the raw material. The average total duration of the dairy transformation is adequate for this type of products. It is evident the role of the employed starters that contribute to the milk acidification during the fermentative process. The storage conditions of cheese and the parameters of brine were suitable for an excellent final result. These surveys confirm the improvement of all the productive parameters. The dedications of the cheesemakers together with the technical assistance of ERSA permitted to ameliorate the quality of these typical productions. Further efforts have to be afforded to preserve the unique features of these 'inimitable treasures', fruit of both the tradition that assures specificity, originality and authenticity and both the ability to conjugate the ancient knowledge with technology and innovation.

## **The production of Alpine Ricotta Cheese in FVG (Italy)**

**Rainis Simona<sup>1</sup>, Chiopris Giordano<sup>2</sup>, Pittino Ennio<sup>3</sup>**

**ERSA - Agenzia regionale per lo sviluppo rurale, Gorizia, Italy<sup>1,2,3</sup>**

The experimental technical assistance of ERSA since 2001 is addressed to follow the dairy production in alpine cheesemaker huts. In the present poster, the Alpine Ricotta Cheese production is analyzed. This milk derivative is the result of centuries of old traditions and methods and it has inimitable tastes and smells. For this reason, it is widespread used in the typical friulian dishes. 31 productions of Alpine Ricotta Cheese in 12 cheesemaker huts of FVG (Italy) were monitored, during season 2016. The main parameters were recorded and all the steps analyzed, together with the dairyman, in order to stress out any criticisms and to overcome them. The experts gave recommendations about the correct way of employing the acidifier. Another meaningful feature is the new trend to add milk, cream or butter milk to the whey for the production of alpine ricotta cheese. This is not typical of our Region and in this way there is the risk to distort the original taste of the product. Furthermore, these additions modify the structure of this dairy, making it more tender and moist. In this way, the shelf-life is reduced and some problems can arise during the smoking phase. It can be noticed that the other parameters, as times and temperatures, respect the recommended ranges for obtaining excellent products, so positive conclusions can be expressed about the production of the “Scuete fumade” (Alpine Ricotta Cheese). From 2001, a huge database was created and an “easy-to-use” tool was elaborated that offers the opportunity to analyse the evolution trend, seasons after season, and to examine its development. During these years, working together with Ersa, the cheesemakers improved significantly the quality of this peculiar product. This approach will be very important in the future to maintain the markets or to develop new ones, because it permits to adapt to the market’s needs and demands without losing their specificity, originality and authenticity. It can be stated that the challenge for this type of products, that can be defined of “niche”, is to preserve their peculiarity in a modern and innovative way.

## **Mountain sheep farming: quality wool production and sustainable future**

**Chaupin Marie-Thérèse**

**Association ATELIER-Laines d'Europe**

Mountain sheep farming: quality wool production and sustainable future Marie-Thérèse Chaupin, coordinator and delegate for European relationship of the association ATELIER-Laines d'Europe Mountain sheep farming: quality wool production, joint actions for processing and marketing of finished products, sustainable development of the sector For the last ten years or so, in Europe, young breeders have been interested in promoting one of the products of their breeding, the fleeces of their animals. Wool has long been forgotten by consumers for the benefit of synthetic fibres. It is classified as an animal by-product category 3 by the EU. For the breeder, it generates costs (shearing) but very low income (sale of greasy wool). But today consumers are interested in natural fibres and renewable materials. Mountain sheep farmers are concerned about ecology, they often practice agro-pastoralism and maintain some endangered breeds, they are keen to promote all the resources of their territory and their livestock. Cooperation and mutual aid initiatives between breeders, craftsmen and companies for the valorisation of wool have developed in recent years in several European countries, and particularly in mountain regions. The intervention will present several of these initiatives, in the Pyrenees (France and Spain), the Alps (France, Switzerland, Germany, Austria, Italy), the Massif Central (France), but also in Epirus (Greece) and in Albania. A summary of the difficulties, organization methods and successes of these approaches will help to give new perspectives to sheep farming in European mountain regions.

**Session: Farm Economics and Succession in Mountain Livestock Farming**

**Best observed practices in efficient farms: How Data Envelopment Analysis (DEA) can serve as an innovation identification tool**

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This study aims to connect the concept of efficiency with the best observed practices and by extension to the identification of farm innovations through an empirical application. In this context, the technical efficiency (TE) level of 60 dairy sheep farms which are located in Western Pyrenees and Roquefort areas in France is estimated through the application of Data Envelopment Analysis (DEA) and the fully efficient farms are identified. The data used were collected by the technical organisations, within the French Livestock farms network "INOSYS Réseaux d'élevage". The sample farms are categorized on the basis of the estimated level of TE and their main technical and economic characteristics are compared. Through this approach, the management and production practices observed in the efficient farms are revealed and innovations that could be potentially introduced to other farms of the same or similar production system can be identified. The results indicate that 22 farms (36.7% of the total sample) are efficient, while the mean TE of the 60 farms is 85.7%, indicating that there are substantial inefficiencies among farms and that that given the level of inputs the average extensive dairy sheep farm could increase its production if it was operating efficiently. The descriptive analysis indicates that the efficient farms rear less ewes, who however achieve higher milk yields. Moreover, the efficient farms appear to manage more rationally human labour and depend more on home grown feed compared to the inefficient farms. Another interesting result is that the fixed cost per ewe is much higher in the inefficient farms, indicating that these farms are characterized by irrational investments and/or poor capital management and that they could decrease their fixed cost per animal by using their infrastructure at full capacity. Results also show that a higher level of efficiency is related to a higher value of production.

**Session: Mountain Farms in their Social Environment**

**Cultural grazing of sheep in Polish part of Tatra Mountains - a case study**

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Sheep production is nowadays perceived in Poland as bringing rather small income, hence for many years has been facing continuous recession. However, a tradition of keeping sheep has been strongly rooted in the culture of the region of Tatra Mountains for many centuries. That was favoured by some very specific natural conditions, characterizing of harsher climate, bigger precipitation and short vegetation period, in comparison with the surrounding areas. Cultural grazing is a monitored grazing of sheep or cattle in protected areas, e.g. national parks, which is allowed under numerous restrictions. Currently there are 7 flocks of sheep covered by cultural grazing in the area of the Tatra National Park, with a total number of animals up to 1300 individuals. The aim of the study was a synthetic evaluation of the rules of cultural sheep grazing, presenting as an example a lease agreement between a chief shepherd (baca) and the Directorate of the Tatra National Park, for grazing in the Chochołowska Niznia and Jarzabcza Niznia pasture lands, with the acreage of 20,3 ha, where 150 sheep of polish mountain breed is pastured. The chief shepherd is chosen following a tender procedure, and then a lease agreement is signed, which means that socio-cultural requirements and rules related to the nature conservation must be conform. The first are related to the furnishing of the shepherd's hut, that is located on the oscypek cheese trail. The mandatory equipment includes the traditional hearth, a kettle, equipment for processing milk etc. There is also much focus on other cultural elements, such as regional clothes and using the regional dialect. Grazing can only take place in the pasture lands, without the possibility to lead animals to adjacent forests. The cultural grazing of sheep in the area of the Polish Carpathians, guarantee maintaining the tradition of folk culture, as well as shaping and preserving a cultural landscape with high biodiversity.

## Transhumance in Greece: Present and future

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The purpose of this paper is to present the current dynamics of the Greek transhumance sector in terms of its multifunctionality under a vulnerability/resilience framework. Indeed, transhumance has been proven resilient to the suffocating conditions of the economic crisis and showed low vulnerability to the abrupt changes in the Greek primary production sector in general. This is due to the rational strategies undertaken for the management of available resources, especially of variable capital and family labor. Nonetheless, actually the sector is witnessing a structural reform as cattle transhumance is increasing while sheep and goat populations remain relatively stable. These developments are closely related (a) to the Common Agricultural Policy which threatens the traditional character of the sector and (b) to the rangeland allocation framework in force in Greece, which affects the smooth access of transhumant farms to land. As a multifunctional system, transhumance plays multiple roles affecting the environment, rural livelihoods and food security in the form of ecosystem services. Although actually there is a general mobilization towards the protection of the procurement of such services by transhumance, there is much room for improvements. Some issues that need to be targeted include - apart from land uses - (a) the support of the cultural identities of the system, (b) the promotion of the high quality of its products, (c) cheese production on-farm, (d) capacity building and dissemination of relevant knowledge and information, (e) social recognition and increase of the self-esteem of the producers themselves regarding the services they provide to society. Sheep and goat transhumance was recently acknowledged as intangible cultural heritage in Greece, but still many things remain to be done in order to provide the system with the institutional support required to reach the standards implied by its dynamics. All the above issues are discussed either in terms of initiatives already undertaken or under the light of funding opportunities provided by the policy framework as well as of market and consumption patterns.

**Session: Wildlife Management in the Mountains**

**Estimation of the wild boar population (*Sus scrofa*) in the Regional Park “Taburno – Camposauro” (Benevento, Southern Italy Apennines) using the Pellet Count Group technic**

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Today the development of wild ungulates represents one of the most relevant changes of the Italian wildlife in the last decades. Knowledge of distribution, abundance and population dynamics is essential for their correct management, especially for the Wild boar (*Sus scrofa*) considering its impact on the natural and agricultural ecosystem. This paper proposes an estimate of the wild boar population in a study area, located in the south / south-eastern part of the Italian Regional Park “Taburno – Camposauro” (southern Apennines of Italy, Benevento area). The census technique was planned through field inspections and cartographic elaborations using GIS software and the Pellet Count Group technic. The data of the Pellet Group discovery were marked on special field cards. 7.010 linear meters and 14.020 m<sup>2</sup> were crossed; 12 Pellets Group were found. From this database and knowing the extent of each specific habitat it was detected the presence of about 7/8 animals per 100 ha. These densities, projected by the number of hectares of each analyzed habitat, indicate a presence of animals ranging between 187 and 164. Considering that, the optimal density for the study area would be about 47 animals per 100 ha, this means that the real density exceed considerably these values. Therefore, the population within the Park should be reduced through a set-up of a real census plan. The efforts should be intensified by cross-referencing the databases deriving from different types of census repeated over several years. Key words: Wild boar, *Sus scrofa*, habitat, Pellet Count Group



**Session: Mountain Livestock Product Quality**

**Authentication of Asiago PDO cheese by using NIR spectroscopy**

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This study aimed at evaluating the use of the near infrared spectroscopy (NIRS) to discriminate Asiago PDO produced in three cheese production systems (CPS). The first was an alpine seasonal pasture-based system (P-UL) in which cows graze on natural pastures and received a small amount of concentrates. The second was also located in a mountain area and it was a hay-based production system (H-UL) with dairy cows fed total mixed rations (TMR). The third was located in the surrounding lowland, the dairy cows were kept indoors and fed maize silage based high energy TMR (MS-LL). The Asiago PDO cheese (n = 28 per CPS thesis) were manufactured in two local dairy plants and ripened for 6 months. Ground samples of Asiago were scanned in duplicate using a NIR spectrometer and spectral data (log 1/reflectance) were used to assess the correct classification by a partial least square discriminant analysis (PLS-DA). The accuracy of classification of the CPS based on NIRS spectral data was fairly correct for P-UL samples (hit samples = 0.89) meanwhile it was much more frequent for H-UL (hit samples = 0.68) and MS-LL (hit samples = 0.79). Compare to MS-LL samples, the discrimination of P-UL cheeses was probably due to a significant difference in the lipid profile as highlighted by the wet-chemistry analysis. The outcomes of this study confirm that the use of NIRS spectral data could be a reliable, chemical-free tool to identify Asiago PDO, especially in the case of those from the pasture-based production system. Acknowledgements – This research was funded by Regione Veneto (GREENGRASS DAIRY project) and FONDAZIONE CARIVERONA (SAFIL project - call 2016)

**Session: Mountain Sheep and Goat Breeding and Husbandry**

**Milk flow parameters and milk quality in Bionda dell'Adamello dairy goats**

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The aim was to study the relationship between milk flow parameters in Bionda dairy goats and milk quality characteristics, in relation to number and stage of lactation, and production level. Bionda dell'Adamello is a local dairy goat breed autochthonous of Valle Camonica (northern Italy); its population is estimated in about 4000 heads. A sample of 42 Bionda dairy goats milked twice a day were monitored once a month at the evening milking for 5 months to obtain milk emission parameters through electronic milk flow meters, for a total of 152 milking tests. Official controls of milk yield and quality were performed in other 7 different test days by the Breeder's Association of Lombardy Region for a total of 168 dairy tests. Milk yield was very low ( $1.05 \pm 0.54$  kg/d, from 0.2 to 3 kg/d) and milk composition was scarce and characterized by high variability: fat  $2.69 \pm 0.56$  % w/v, protein  $2.88 \pm 0.34$  % w/v, fat/protein ratio  $0.937 \pm 0.172$ . Somatic Cell Count seems a critical point, with a very high Linear Score ( $7.27 \pm 2.04$ ), particularly for multiparous goats ( $7.73 \pm 1.92$ ). Milk Yield per milking (MYm) and Maximum Milk Flow (MMF) were higher in primiparous goats ( $0.51 \pm 0.24$  kg/milking;  $0.76 \pm 0.34$  kg/min) than in multiparous ones ( $0.45 \pm 0.23$  kg/milking;  $0.64 \pm 0.32$  kg/min). Both MYm and MMF showed a decrease with advancing lactation. Fat/protein ratio was significantly influenced by stage of lactation ( $1.00 \pm 0.18$  in 1-100 d;  $0.93 \pm 0.18$  in 101-150 d;  $0.89 \pm 0.14$  in 151-200 d), while it was not significant the effects of number of lactation. The relationships between milk flow parameters and somatic cell count was significant in a covariance model with number of lactation and stage of lactation as fixed effects, goat as random effect, and milk yield per milking and maximum peak milk conductivity as covariate variables. The estimates of parameters were -1.93 for milk yield ( $P=0.021$ ) and 0.683 for maximum peak conductivity ( $P=0.002$ ). The results underline the close relation between milk flow parameters and somatic cell count as obtained in other dairy species.

## Runs of homozygosity and genomic inbreeding in local Swiss sheep breeds

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Climatic conditions and topography are recognized as sources for the rich variety of livestock breeds created in the mountainous areas such as the Alps in Europe. During the era of breed formation in the 19th century herd-books were created, and breeding organizations started to select animals in closed populations and by focusing on different traits. Today, Switzerland has numerous locally developed sheep breeds with different breeding history and external characteristics. The availability of genome-wide SNP data allowed the characterization of runs of homozygosity (ROH) which can quantify the extent of genomic inbreeding in diploid individuals. The biological interpretation of FROH (e.g. genomic inbreeding coefficients using ROH) is easy, it can conveniently be partitioned into values for individual chromosomes and the length of the observed ROH segments can be used to distinguish between recent and ancient inbreeding. In this study 33,828 SNP of 324 sheep belonging to the seven local Swiss sheep breeds Bundner Oberlander sheep (BOS), Engadine Red sheep (ERS), Swiss Black-Brown Mountain sheep (SBS), Swiss Mirror sheep (SMS), Swiss White Alpine (SWA) sheep (SWA), Valais Blacknose sheep (VBS) and Valais Red sheep (VRS) were used to investigate patterns of genomic inbreeding. In total 7,332 ROH were found using PLINK v1.9 software. The largest fraction of ROH segments larger than 30 Mb (recent inbreeding) were observed for the SBS breed. With around 50% the fraction of ROH segments between 1 and 5 Mb (ancient inbreeding) was largest for the SWA breed. The average FROH ranged from 1.88% (ERS) to 10.12% (VBS), whereas the pedigree inbreeding FPED ranged from 1.58% (ERS) to 13.84% (VBS). The overall correlation between FROH and FPED was 0.55. The high levels of genomic inbreeding in VRS and VBS are explained with the known genetic uniqueness and geographic isolation of these breeds. Overall the results underline the impact of past breeding strategies on actual inbreeding levels in local sheep breeds.

**Session: Other Species: Poultry, Pigs, Horses**

**Free-range organic pigs production with agroforestry system in low mountain Alpine valley: implications for environmental sustainability and animal welfare**

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In the north of Italy pigs production in mountain farming is not common; however, fattening a small number of pigs, for on farm meat processing to obtain traditional products, has recently been increasing especially within organic and local market oriented farms. Free range system offers several benefits: the possibility of using marginal pasture and tree-bush areas, low costs for equipments (sheds, feeding tanks and drinkers); although, specific attention is needed to prevent environmental risks and assure good welfare conditions. A four year experiment was carried out to assess the impact of growing fattening pigs (average of four trials: days 265  $\pm$ 11, from the middle of April to the beginning of December; stocking rate 14 pigs per hectare, piglets live weight 38 $\pm$ 7.6, and final slaughter weight 187  $\pm$ 15.8 ) using a permanent pasture with spontaneous trees-bush fields (n=3, total area 1.8 ha), in alpine low mountain valley (380 m asl). Pigs behaviour, sward conditions and shrubs-trees damages were recorded weekly; soil samples, from different spots in the fields were analysed to measure main nutrient content (N, P, Cu, Zn, SOC-soil organic carbon). Piglets adapt quite easily to free range system, performing natural and social species specific behaviour such as rooting, searching for food, biting, roll over in watery mud etc. Defecation areas were identified both in the pasture and in trees area; rooting, searching for food and resting were mainly performed in the more wet zones of trees and bushes. Damages of grass sward were higher during rainy months (April and October) and could be reduced with proper rotation fields. Pigs damages on trees and shrubs were more evident on young plants; deep rooting and biting bark and thin branches, could provoke the death also in a 5-10 years old plants. Main nutrients content in the soil may vary depending on the different utilisation of zones by pigs; in general, nutrients level are higher in pasturage than in the trees areas, confirming that the large and deep root network of trees is able to absorb a large amount of nutrients from urine and faeces.

**Session: Grassland Management and Mountain Pasture**

**A method for a comprehensive analysis of grassland innovation**

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Farmers often develop own strategies to secure the long-term viability of the farm in response to changing conditions. In order to transfer this knowledge gain into practice for other farms, a suitable method is needed to detect and analyse innovations in a comprehensive approach. Within the Inno4Grass thematic network ([www.inno4grass.eu](http://www.inno4grass.eu)), a framework for such an analysis has been developed. In multi-stakeholder discussion groups with a participatory approach, 5 to 15 stakeholders covering all issues potentially arising during the discussion and representing both science and practice are involved. An on-farm visit as well as a short fact-sheet, describing the innovation and distributed prior to the meeting, ensure baseline knowledge sharing. The analysis of the innovation, led by a facilitator agent, consists of three different phases. Initially, the main strengths and weaknesses of each innovation are listed by means of a brainstorm-like, simplified SWOT analysis. Then a PESTLE-analysis is performed, taking into account the political, economic, social, technological, legal and environmental factors affecting the innovation. Sub-topics, which are expected to be relevant for all innovations in grassland, are predefined for each category. Strengths and weaknesses identified by means of the simplified SWOT analysis are assigned to the respective PESTLE-category. The analysis of the innovation concludes with some final statements of the innovator concerning the willingness to implement again this innovation, suggested changes to the process and an evaluation of the market demand at a local scale. The result is a comprehensive analysis of the innovation which gives an overview of the necessary requirements, strengths and weaknesses regarding the implementation of an innovation.

## Effect of organic fertilizers on permanent grasslands in the Low Beskids – the Polish part of the Western Carpathians

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The aim of the study was to determine the actual dispersal of N and P from cattle slurry on permanent grasslands in the Low Beskid Mountains located in the Polish segment of the Western Carpathians. This has a special impact on environmental conservation and quality of life in rural submontane areas. The study used slurry from Simmental and HF cattle. The experiment was conducted on 120 ha of pastures and mown meadows in a clay loam soil. Data were statistically analysed with Statgraph using Duncan's test. After slurry application, N, P, K content and NH<sub>3</sub> emission were measured, and chemical analysis of the plant material was performed. Initial N and P content in meadows was 15.85 and 34.5 kg/ha; in pastures, N content was about 50% higher and P content about 30% lower. This N to P ratio in permanent grasslands resulted, among others, from N loss through emission and leaching. Over 22% and 27% N were leached in meadow and pasture. P loss from leaching was 5.5 kg. The use of slurry as a fertilizer also led to N loss through emission. Following slurry application, N emission as ammonia was 9.8 kg in meadow and 28.9 kg in pasture. Accumulation of elements in grass yields of meadows and pastures was 70.77 – 78.23 kg for N and 20 – 16.5 kg for P. Several technological factors of dairy farming contribute to periodic variations in the biogenic amines content of natural fertilizers. Before their use as fertilizer, the essential and permissible doses must be calculated based on current chemical analyses. Classical methods of soil slurry application cause large N losses as NH<sub>3</sub> emissions. N loss from leaching is directly proportional to N content in a single fertilizer dose. This observation refers to the permissible level of 170 kg N/ha. P fertilization also involved a high level of leaching, which is directly related to an almost 80% content of mineral P in cattle slurry.

**Inno4Grass - Shared Innovation Space for Sustainable Productivity of Grasslands in Europe**

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Inno4Grass is a Horizon 2020 Thematic Network with the aim to bridge the gap between practice and science to ensure the implementation of innovative systems on productive grasslands and to achieve profitability while providing environmental services. The scope of Inno4Grass is fully in line with the outcomes of the EIP-AGRI Focus Group „Permanent Grasslands“ that identified the need for innovations and the possible contributions of grasslands to economic performance and sustainable production in Europe. Inno4Grass operates on an international and multi-actor level. Over the course of three years, farmers' organisations, extension services, education and research in eight countries (Germany, Italy, Belgium, France, Ireland, the Netherlands, Poland and Sweden) will capture innovation capital from practice combining farmers know-how with research and development results. An innovation is something original which increases the effectiveness or efficiency of the grassland farming management. Practice and science meet in discussion groups, using a participatory approach with the aim to analyse the strengths, prerequisites and weaknesses regarding the discussed innovation. Practice abstracts and video clips describing innovative practices will be provided to interested farmers. New and novel dissemination approaches will be generated, ensuring the transfer of innovation capital and the exchange of grassland information to farmers and the grassland industries within and between member states

**Session: Mountain Livestock and Landscape Biodiversity**

**Consequences of the deagrarianization process in the mountain region of Bieszczady**

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Bieszczady, which is part of the Outer Eastern Carpathians, is an area constrained by economic development problems that have accumulated since the 1950s. Their origin is attributed to displacement of the local population, which led to significant depopulation and thinning of settlement. This is still visible today in Bieszczady County, which has an area of 1138 km<sup>2</sup> and is inhabited by around 22,000 people. This gives around 19 people per km<sup>2</sup>, which is three times lower than the average figure for rural communes in Poland. Today, despite the diversification of agriculture in this region, a significant problem is the abandonment of agricultural activities, known as deagrarianization. The aim of the study was to show the extent of the deagrarianization process in Bieszczady County and its consequences for the population of ruminants. Expert field studies were done in 3 counties: Ustrzyki Dolne, Czarna, and Lutowiska. The available agricultural data were statistically analysed with Statgraph software. As a result, the deagrarianization processes were observed to be highly advanced. Around 58% of the farms hold no ruminants, which, considering the structure of land use, means that they abandoned agricultural production, and around 10% of the farms set aside land from production. In the area of the studied communes, around 10% of the farms are considered suitable for development, 12% showing the signs of development, and around 70% can be classified as stagnant and declining. Quantitative analysis of the ruminant population shows that the stocking rate for cattle and sheep per ha of permanent grasslands is 0,21. This is indicative of livestock shortage and consolidation of the irrational use of the local production potential. Therefore, it seems necessary to support livestock husbandry with new regional policy instruments.



**Session: Mountain Livestock and Climate Change**

**Changes of yield and forage quality of silage maize over the last 30 years in South Tyrol**

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There is evidence of genetic yield improvement for maize. For Northern Europe, further improvements are expected because of the ongoing climate change. We used experimental data gained in variety trials performed in South Tyrol (NE Italy) at the same mountain location (Teodone/Dietenheim, about 900 m a.s.l.) from 1989 to 2017 to assess the contribution of genetic improvement and of the meteorological conditions to yield and forage quality of silage maize. Growing degree days (GDD) from sowing to harvest using a base temperature of 5°C, dry matter content, dry matter yield and energy concentration (NEL) were subjected to a statistical analysis. A set of varieties grown for at least 5 years and at least partially overlapping were used in a regression analysis over time. Data from years with damages due to extreme events (2007 and 2009) were removed from the data set. GDD showed a slight increase over the years, whilst no trend was observed for NEL. Dry matter yield exhibited a steady, large increase over time, which in light of the faint trend of GDD seems to be mainly related to the breeding success. However, further evidence would be needed to draw certain conclusions on this matter.

**Collaborative strategies to integrate the traditional knowledge in pastoral resources conservation and increase the adaptive potential of the local population to climate change**

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The research was conducted to find optimal solutions for the management of natural resources in forecasting, planning and implementing adaptation measures taking into account traditional and scientific knowledge addressing the local territorial and climatic specifics of the region. The findings of the research and experience in conservation of pasture territory contributed to effective pasture management by the local population and practitioners. The research covered Cholpon rural community. The pasture territory makes up 80% out of total area. This is a mountainous area with a very fragile natural environment. The study revealed that a large concentration of livestock during herding led to a disturbance of the grass stand, the replacement of the eaten vegetation with poisonous, harmful one. Lack of climate monitoring system, pasture load and overgrowth of uneaten plants led to fall of productive mass of animals and the forage dignity of pastures, as well as pasture degradation and soil. In addition, the population irrationally use pasture resources due to loss of tradition of nomadism and careful attitude towards nature. The locals ignored traditional methods, culture of using pastures and zootechnical methods, which caused the degradation of pastures. In order to identify how the community cooperatively can address climate change and pasture management issues, the participatory rural appraisal approach was integrated to reveal traditional knowledge and practices reducing the vulnerability of the local community to the effects of climate change. Inventory of the cattle and pastures was done to develop pasture management and conservation strategy and introduce it into practice. The research succeeded to combine modern methods of pasture management and traditional practices. Climate monitoring system was integrated and revised based on the best practices of traditional pastoralism. The approach will help to achieve a balanced distribution of livestock in pastures during grazing seasons and be proactive to address climate change.

**Session: Free Communications**

**“MADE - Malga and Alm Desired Experience” - Interreg project ITA-AU 2014-2020**

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The purpose of the project is to develop a trans-boundary system that involves the alpine huts of Friuli Venezia Giulia (Italy) and Carinzia (Austria) and the excursion and bike routes of the two Regions. The experimental idea is based on the aim to preserve and protect the natural and cultural patrimony, as well as the knowledge of the traditional agriculture in the alpine area, throughout the enforcing of the common identity and the extension seasonal adjustment of the touristic proposal. The intent is to involve and sustain the local productions, in order to increase the employment and to strengthen the sustainable mobility between the neighbour Regions. The enhancement of the alpine huts, the pastures and accommodations will be allowed throughout the promotion of the gastronomic offer, a joint marketing and the improving of the perception of the landscape context. The organization of informative meetings and workshops, with highly qualified experts, will actively involving the operators, in order to increase the added value to the eno-gastronomic peculiarity of the productions. The approach is based on the development of a system for the recovering of the quality of the peculiar products. Thematic pathways that connect the trans-boundary cheesemakers huts will be designed and enriched with info-points, signs and indications. The communicative strategy will be the developing of promotional tools as an internet site and an app. Furthermore, itinerant happenings and a pilot event, with an innovative format, will be organized. PERIOD: 2017-2019. BUDGET 1.176.470,50 €. PARTNER TEAM:- Consorzio di Promozione Turistica del Tarvisiano di Sella Nevea e di Passo Pramollo (IT);- Comune di Hermagor-Presserger See (AT);- ERSA FVG (Agenzia regionale per lo sviluppo rurale) (IT).

## Assessing the Alpine ibex and livestock distribution in Gran Paradiso National Park (GPNP)

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In the last few decades a drastic decrease of GPNP ibex population, linked with a reduction of occupied territories, was occurred. This decline is partially related to recent climate changes but causes are still not completely clear. This work aims:

- 1) to analyse Alpine ibex (1985-2009) and livestock (2000-2009) distribution in GPNP;
- 2) to assess relation between distribution pattern and ibex population trend in 2000-2009.

The composition and spatial configuration of ibex and livestock occupied areas were described through 5 landscape ecology metrics and tested using the Spearman's rank correlation coefficient. The same statistical measure was also used to assess the relationship between distribution patterns and ibex population size. Results showed a reduction of ibex occupied territories from 4587,50 hectares in 1985 to 2331,25 ha in 2009 ( $r_s = -0,818$ ;  $P < 0,001$ ). Number of patches increased from 130 to 224 units ( $r_s = 0,784$ ;  $P < 0,001$ ). Livestock distribution didn't show a particular trend ( $r_s \approx 0$  or  $P > 0,05$ ). The relation between changes in ibex population trend and distribution patterns was not proven (all  $P > 0,005$ ). These results suggest that probably ibex distribution was influenced by different combined factors (landscape changes, climate change, and anthropic activities) and they show how landscape ecology approach may become a useful tool to understand the degree of fragmentation and connectivity of landscape, defined on species distribution.

