

DRAFT FULL PROPOSAL

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Title: Plant biodiversity and high-quality animal products from mountain grassland systems.

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A. ABSTRACT AND KEYWORDS

Abandonment of species-rich grasslands has increased in many mountain regions of Europe, causing biodiversity loss, landscape degradation and negative economic, social and cultural impacts. Livestock grazing is the most sustainable way of preventing these changes. Its profitability should be supported by high prices of products protected by labels of origin. Compared to lowland products, Mountain Dairy and Meat (MDM) products have a distinct flavour and a better nutritional value. They also have a positive impact on human health due to the high content of anti-oxidants, fatty acids and vitamins. This project aims to establish the links between these positive properties, the grazed vegetation, farmers' management practices, product processing and the socio-economical context. Standardised analytical methods will be developed and will provide a scientific background to marketing and policies for quality products. Key social and economic factors for the use of mountain areas will be identified. Consumer and tourist expectations will be analysed. Practical information will be provided to farmers, product processors, marketers and decision makers. COST is the appropriate framework because the objectives of the project require merging data from a high number of mountain regions for establishing broad databases, robust correlations and widely applicable conclusions.

Keywords: grassland management, dairy and meat products, plant secondary metabolites, traceability, regional and rural development.

B. BACKGROUND

B.1 General background

Despite their longstanding tradition, agricultural activities in European mountain areas have been gradually abandoned in the last decades. As a consequence, shrub encroachment has developed and is leading to a loss of grassland productivity, landscape attractiveness and biological diversity. In order to preserve human presence in uplands, farming activities must be economically viable. Mountain farming has many handicaps compared to lowland farming. It can only survive if it is rewarded for the production of public goods (biodiversity, landscape) and if it can get higher prices for its products. Stockbreeding is one of the main sources of revenue for rural communities in these territories. Grazing represents the most viable solution for the conservation and the restoration of the cultural landscape and the associated botanical diversity.

In recent years, there has been considerable growth in consumer interest for high-quality food products. In the mean time, there has been a rapid expansion of labelling and certification mechanisms. Mountain Dairy and Meat (MDM) products must be unequivocally and clearly identified by their high quality. Their promotion, thanks to Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI), needs scientific evidence of the link between their quality and their origin. Species diversified grassland vegetation is particularly rich in Plant

Secondary Metabolites (PSM) which are transferred to herbivores and confer a distinct flavour and a better nutritional value to MDM products. These products also have a positive impact on human health due to the high content of anti-oxidants, fatty acids and vitamins. Knowledge on the dietary and sensory value of animal products issued from species-rich grasslands has to be expanded and published. Scientific evidence and solid data are urgently needed for marketing these products, for developing a sustainable management of the natural resources in mountain regions, for supporting negotiations at the WTO and for the recognition of the EU Food Quality Certification system.

While there is a growing policy interest in grassland biodiversity in Europe, there has been relatively few researches on its integration into the productive function of agriculture. Grassland biodiversity is considered to be a positive externality of agri-environmental programmes. It must be considered as an integral part of the quality of animal products.

Mountain farming systems are various and complex, and although a number of relevant research teams are working on connected topics to this field, there is a critical need for a more interdisciplinary approach. Isolated attempts in individual countries to adequately address the link between biodiversity and product quality cannot be totally efficient due to the high number of interacting factors and underlying mechanisms. COST support for international network is thus required. Only joint forces of the member countries are able to address properly the problem. Duplication of efforts will be avoided when protocols and monitoring will be standardised. Coordinating research and integrating results will rapidly advance our knowledge and increase benefits. Neither the ESF nor the FP7 Calls do have suitable topics for this activity. COST is an obvious choice compared to other research frameworks, because it represents the fastest way to build a platform to coordinate activities and produce clear results. Finally, although the members will provide a significant financial contribution in total manpower and equipment, the crucial network is missing so far. Therefore, COST, which funds networking and capacity-building activities, is an optimal funding tool to support the objectives of this project.

B.2 Current state of knowledge

In order to keep the text concise, it has been chosen not to cite literature references in this section and in most parts of the text. These references are available on request.

Links between mountain grasslands and the quality of the environment

Many previous researches have studied the effect of grassland management on plant diversity, although most of them have been conducted in lowland areas. Mountain grasslands are recognised as ‘hot spots’ for biodiversity. The positive altitudinal gradient of species richness has been described in many countries. The conservation of this natural heritage is closely linked with stockbreeding activities. Herbivore grazing creates disturbance favourable to the coexistence of different plant species and communities. Plant diversity in grassland is the result of environmental characteristics and management practices. Each plant species develops strategies to adapt to its environment and to defoliation intensity. Plant Functional Types (PFT) can be defined on this basis; they include species with similar strategies.

Due to the tough competition with industrial farming in the lowlands and to the marginal conditions for farming in mountain environment, summer grazing of herds in uplands is becoming progressively less common. This process results in an extension of brush encroachment and a standardisation of the vegetation with a concomitant decrease in grassland feeding value for both livestock and wild fauna. Loss of biodiversity has been monitored in the Alps over the last decades, highlighting the risk of species extinction. Other consequences of this trend are the closing of landscape reducing spaces for recreation and an increasing fire risk in dry areas. To face these alarming processes, many research teams are experimenting extensive grazing systems in order to manage wide territories with reduced herd size. The use of different animal types, mainly cattle, sheep and goats, with different feeding strategies is also studied.

Links between mountain grasslands and the quality of the products

PSM are chemical products that are not directly useful for plant metabolism but which possess different biological activities, often protecting plants against predator and parasite attacks. They are much more abundant in dicotyledons compared with grasses and in mountain than in lowland grassland plants. PSM are still commonly viewed as a limit to ingestion and are considered to decrease the value of forage causing sometimes health problems, as in the case of anti-nutritional compounds. Some PSMs are indeed well known for their toxic effects. This project will promote a different and innovative view of these molecules: 1) They can increase animal welfare; 2) They exhibit anti-microbial, immuno-stimulant, anti-tumoral and anti-oxidant properties; 3) Tannin-rich plants are an alternative to control nematode parasites in small ruminants; 4) PSM can provide unique characteristics to animal products by being transferred from grazed plants, to intestine, blood, muscles and milk of domestic herbivores.

Technological and sensorial qualities of dairy products depend on a large range of factors related to animal (breed, genotype), plant (forage type, fresh or conserved, biodiversity of grassland), microbes (strains and diversity) and processing. Meat from sheep and cattle grazing species-rich grasslands can have higher concentrations of antioxidants and different fatty acid profiles. The importance of PSM on cheese and meat taste is being increasingly emphasized. These compounds can also be used for product traceability. Other molecules can provide attractive flavour characteristics or have a positive impact on human health: anti-oxidants, omega-3, Conjugated Linoleic Acid (CLA) and vitamins. Studies on the relation between product quality and biodiversity of grassland are still at an early stage of development. They are carried out at national level, mainly in France, Italy, Norway, Switzerland, Spain, Slovakia and UK. This kind of research is even less developed in other parts of the World because many countries do not have the 'terroir' approach like in the traditional farming regions of Europe.

Links between mountain grasslands, mountain products and socio-economic stakes

The conservation of biodiversity and natural resources can constitute a comparative advantage for mountain producers if they are able to demonstrate and deliver quality attributes that are related to the production system. Though, product quality alone does not seem to be able to stop the decline of mountain agriculture in Europe. Other very important issues related to agricultural policies, economic profitability and productivity, as well as social factors of the households need to be analysed together with environmental issues, leading to a global sustainability analysis.

There is a good market demand for mountain products. Its development is implemented through different strategies: direct sales by producers, public labelling and private brands using the mountain designation. Those strategies face the question of the assessment of the arguments used to differentiate and promote mountain products, first of them being the delimitation of the mountain area. Apart from this question, the use of nutritional, cultural, social and environmental arguments has been studied. But references have to be deepened about their translation into criteria for assessment methodologies and/or certification schemes to be used by public and professional organizations and by private companies. Furthermore, this questions the role of public policies facing the new social demand for food security and sustainability in the context of market globalisation. The social demand for mountain grasslands has also non-food purposes, such as leisure practices, sight-viewing and patrimony conservation. A better understanding of this demand could support new initiatives and policies for mountain tourism and mountain landscape management.

Innovations

The multidisciplinary approach of the whole interaction chain (including biodiversity, forage quality, grassland management, MDM product quality and socio-economic aspects) is totally innovative in this research topic. Description and understanding of processes in this interaction chain will provide an innovative tool for decision-making and food marketing. An innovative definition of food quality based on scientific evidence will be developed.

New analytical methodologies will be developed for vegetation and social surveys.

New techniques will be developed for PSM analysis in plant and food. These spectroscopy techniques will replace the long and expensive chemical methods. That will be extremely important for the researches in these areas because in the future more analysis could be done and more quickly. This progress will really boost the research in this field.

The influence of PSM on the sensorial properties and the dietary value of MDM products is a new research topic. It is situated at the interface of ecology, chemistry, plant and animal physiology, as well as food technology. This combination of several scientific disciplines is a modern approach in science and a fascinating project.

B.3 Reasons for the Action

This COST Action will bring together researchers from natural and social sciences for comparing a wide range of situations in Europe, understanding mechanisms and designing future innovative scenarios. It will use an interdisciplinary approach involving economic, social and environmental considerations within a sustainable development perspective. It aims at scientific/technological advances as well as economic/societal needs.

Participants in this Action are all involved in national programs on at least one aspect of mountain grassland-based systems. However, any of those attempts in individual countries to adequately address the current problem are limited by the high number of interacting factors. Different data acquisition results clearly in not comparable data. There is no common database, which prevents general and consolidated conclusions. In this COST Action, the separated efforts of European countries will be consolidated into one ambitious project. The constitution of a large collection of samples and data from a wide range of areas will allow a better scientific understanding of the mechanisms involved. The inclusion of PSM in the animal nutrition theory is rarely taken into account. The development of suitable analytical methodology and the interpretation of the results will allow a large-scale comparison of animal products according to their origin. Sharing analytical methodologies, databases and analytical results from many parts of Europe will give raise to new investigations. An innovative definition of food quality based on scientific evidence will be developed. Biodiversity conservation will be presented as a tool of socio-economic development. This functional approach will increase scientific innovation. Moreover, the elaboration, application and assessment of this COST Action will be conducted in direct interaction with several stakeholders (*i.a.* farmers, product processors and marketers, decision makers). ‘Typicity’ criteria will be based on a broad range of data will facilitate decision-making using sustainability criteria related with production and product processing. Results will allow a better understanding of the success factors to establish regionally identified food chains which add value to MDM products and support rural development in mountain areas through food industries and tourism development. Citizen expectations for landscape, biodiversity and product quality will be better understood. Description of processes on the whole interaction chain will provide a unique tool for decision making and food marketing.

B.4 Complementarity with other research programmes

The COST action will create synergy and give added value to a rich portfolio of research programmes. It will promote coordination and avoid any potential duplication. Most of the potential members are participating to EU Framework Programmes or other international projects related to defined segments of the whole food/feed chain. In some countries, national projects are conducted with the aim of promoting MDM products, such as: PASTO in Switzerland (preservation of the landscape and bovine meat extensive production in alpine region), PIRINEOVI in Spain (lamb food chain network in the Pyrenees), SCOPES in Bulgaria (sheep milk quality in the Rhodope mountains), EATING BIODIVERSITY in Great Britain (links between quality food production and biodiversity protection), PROALPE in Italy (valorisation of alpine terroir for the promotion and the protection of summer grassland cheese), PDO GRASSLAND in France (trade-off between production, biodiversity and cheese quality in the Massif Central) and ARCTIC LAMB MEAT in

Norway (from grassland plants through animal to consumers and marketing strategies). These investigations are set-up in different pilot sites all around Europe (see section II C) which will be used for the development of common protocols and methods.

The COST Action will connect these efforts through a multidisciplinary approach. It will also facilitate the access of young scientists to international research programmes.

C. OBJECTIVES AND BENEFITS

C.1 Main/primary objectives

The main objective of the Action is to support mountain farming systems by establishing the links between grassland biodiversity, farming management, MDM product processing practices, MDM product quality and socio-economic aspects.

C.2 Secondary objectives

1. Identification and description of mountain grassland use and stockbreeding practices enhancing biodiversity and landscape;
2. Characterisation of environmental factors (soil, climate, vegetation) and feeding properties (PSM) of different grassland types related with high-quality animal productions;
3. Production of knowledge on animal grazing in order to maintain biodiversity and landscapes;
4. Standardisation and new development of analytical methods to describe vegetation and plant diversity;
5. Standardisation and new development of cheap and fast analytical methods to determine PSM content of plants and animal products (spectroscopy);
6. Establishment of the links between grazed vegetation, and chemical parameters of forages and MDM products relevant for organoleptic characterization and human health;
7. Identification of quality parameters that will allow the commercial differentiation of MDM products;
8. Constitution of a database on the characterisation of MDM products in Europe, this database will be used for developing the scientific basis of the traceability of these products;
9. Understanding the effect of processing technologies on the PSM contents and quality of MDM products;
10. Description of farmers'/processors' practices and motivations towards MDM quality products;
11. Dissemination of new knowledge to farmers, agro-food processors and marketers.
12. Characterisation of consumer and tourist expectations towards MDM quality products and landscape conservation for orienting political decisions and marketing strategies;
13. Development of a socio-economic indicator system for the evaluation of the sustainability of high-quality and environmentally friendly livestock production systems;
14. Designing innovative sustainable farming systems;
15. Promotion of local economy through production of high-quality food products;
16. Drafting recommendations for policy makers and other stakeholders of mountain areas including farmers and agro-food producers;
17. Publication of meaningful results.

Concrete outcomes:

- Development of a European research and technical network on mountain grasslands and related high-quality livestock production; Exchanges of researchers including early stage researchers by the organisation of training schools and Short Term Scientific Missions (STSM); Exchanges of experiences and methodologies across the various members of the COST project;

- Development of a large database on the quality (nutritional and sensory aspects) of various dairy and meat products as well as on socio-economic parameters linked to contrasted livestock management systems and geographical production areas in Europe;
- Development of new analytical methods in plant ecology and PSM content in forage and MDM products;
- Definition of a set of common indicators for decision making on sustainable mountain agriculture; this scoreboard of indicators will show the strengths and weaknesses of each European mountain region;
- Definition of common European criteria to describe mountain farming systems and to identify the key factors to develop new sustainable practices including MDM high-quality production;
- Guidelines of best practices for grasslands management and MDM product processing;
- Identification of further research topics and challenges.

C.3 How will the objectives be achieved?

The Action will achieve its aims by concerting the national efforts for: 1) Locally organised standardized monitoring and sampling; 2) Novel, standardized sampling and analysis; 3) Sharing methods, collaborative and coordinated complementary research; 4) R&D link between scientists, SMEs and other stakeholders; 5) Dissemination of results to all stakeholders (section H).

Means needed:

The Action aims will be achieved by concerting the national efforts on the links between mountain farming, plant diversity and feeding quality of forages, animal product quality, sociological aspects and rural development. The networking will result in common protocols, such as: 1) Vegetation monitoring and sampling; 2) Reference material exchanges (ring-tests) between laboratories; 3) Analyses of PSM, fatty acids, terpenoids and antioxidant contents in plant and food products; 4) Inquiries on farmers'/processors' practices and public expectations. All information collected at regional level will be centralised through a web database.

All Action members will actively participate to coordinate the national approaches: pilot sites and regional product choice, field and laboratory work. All leaders of a Working Group (WG) will be responsible to the definition of common protocols, experiments and diagnoses. Working power, study sites and equipment will be provided by each Action member. Five international reference laboratories will analyse the PSM contents in plant and food samples. Inter-laboratory exchanges and know-how development will be organised by WG leaders and other WG members. Validation of results will be organised locally with participation of regional stakeholders.

Workshops, meetings, conferences, training schools and STSMs will be organised facilitating interaction of the different working groups. Dissemination of results will be differentiated according to target audience such as farmers, processors, marketers, scientists, policy makers and general public (section H).

C.4 Benefits of the Action

Applied benefits:

Mountain grassland systems produce many services (public goods) important to human welfare. This project will identify farming systems as well as production and product processing practices preserving these benefits. Results will allow a better understanding of the success factors for establishing local and regional identified food chains which add value to MDM products. These processes will be related to practices with high positive impact in terms of environmental and social expectations. Many positive impacts on MDM product processing and marketing, as well as on stockbreeder and MDM product processor income, are thus expected. All these results will help decision making in order to promote sustainable farming in mountains and should generate new jobs and services.

Scientific benefits:

Interdisciplinary approaches will highlight the effects of grassland management on plant diversity, PSM contents and MDM product quality. A large collection of samples and data from a wide range of areas will be constituted. PSM and MDM products will be analysed by use of standardised methods but also new methods will be defined and their performance verified. Near Infrared Spectroscopy (NIRS) will be developed being faster and cheaper than current chemical analysis. An innovative definition of food quality based on scientific evidence will be developed, including organoleptic aspects and consumer's health. Citizen expectations for landscape, biodiversity and product quality will be better understood. Description of processes on the whole interaction chain will provide an innovative tool for decision making and food marketing.

New analytical methodologies, ecological and social surveys will be designed. Databases on European mountain environments will be developed. These databases will be accessible to all researchers, mountain development stakeholders and policy makers.

Specific benefits regarding grassland and stockbreeding

- Knowledge production on grassland environment, biodiversity and stockbreeding activities for most mountain regions of Europe;
- Definition of guidelines for sustainable livestock systems in mountain areas

Specific benefits regarding mountain product value

- Knowledge production on MDM product processing practices and on the quality of MDM products for most mountain regions of Europe;
- Innovative definition of food quality related with consumer's health, landscape quality and biodiversity;
- Development of a system for tracing the origin of regional products;
- Improvement of the marketing of MDM products;
- Understanding the effect of PSM on animal's health and food quality;

Specific benefits regarding mountain area development

- Stimulation of socio-economic development in mountain areas;
- Development of a public database on grasslands, production systems and products with valuable information to stakeholders and policy makers;
- Evaluation of the sustainability of production systems and recommendations for the development of future sustainable systems in mountain areas;
- Development of knowledge useful for agri-environmental policy design;

Specific benefits regarding research on the topic

- Sharing of methodologies, know-how and data; consolidated relations between research teams and partnership for further researches;
- Publications in scientific journals.

C.5 Target groups/end users

Giving the wide range of topics covered by the Action, the whole food-chain actors and other mountain development stakeholders will be concerned by its results. Five main groups of target groups and end-users can be identified:

- Farmers, MDM product processors and marketers, inter-professional organisations.
- Veterinarians, rural advisors, extension services.
- Scientists and teachers.
- Tourism agencies, regional developers, nature conservationists, policy makers.
- Consumers.

Through the wide range of topics covered by this Action, the whole body of food chains stakeholders will be interested by its results. The technical background assembled on ecology and

chemical composition of plant communities from grasslands will be of high interest for botanists and herbalists. Nutritive values of forages will be better defined allowing efficient and healthy nutrition of ruminants. Extensive management of grasslands will be documented in order to reduce shrub encroachment in less accessible territories. These data will be useful for forest rangers and farmers. The tourism industry will be interested by the means to keep biodiverse open landscapes in order to provide attractive territories for recreation, such as skiing and trekking. People involved in the agro-food industries will learn from data accumulated on MDM products. Regional markets of these products will be reinforced including for their marketing on a wider scale. As end-users, policy makers will have access to scientifically based information for the promotion of rural development in mountain areas.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

The multidisciplinary approach of the project is situated at the interface of ecology, chemistry, plant and animal physiology, as well as food technology and sociology. Interaction between environmental factors, plant diversity, grassland and livestock management, product processing, food quality and social expectations will be studied. The Action is required to coordinate the following research tasks which are essential to describe the whole interaction chain. It will also generate databases on several topics of outstanding importance in the research field.

1) **Identification of pilot sites.** Environmental factors and animal products will be described; each research team has to be connected with local producers and processors; from 20 participating countries, about 40 regions (pilot sites) will be chosen (objective: 1 to 3 pilot sites per country).

2) **Protocols' standardisation.** Samples and data will be collected in each site according to common protocols; environment, vegetation, farming systems, grassland and livestock management, product processing and marketing will be described with standardised approaches (objective: wide and open monitoring frame). New analysis methods will be developed for vegetation surveys and PSM analysis (NIR spectroscopy).

3) **Analytical work.** Plants and MDM products samples collected in each pilot site will be analysed in reference laboratories (objective: 5 laboratories). Material and protocols will be exchanged between these laboratories in order to organise ring-tests and standardise analysis methods. The PSM contents of plant and MDM products will be analysed by traditional chemical analysis; the results will be used for the calibration of NIRS curves in order to develop a cheaper and faster analysis method. The wide range of samples collected during this COST Action will be a unique opportunity for producing robust calibration curves. The most relevant chemical compounds will be set up by specialists (objective: 4 to 6 PSM and other compounds) and related to sensory and nutritional values of MDM products.

4) **Socio-economic surveys.** Success factors for developing local and regional identified food chains which add value to MDM products will be analysed; practices with high positive impact in terms of environmental quality and social expectations will be identified (objective: wide and open monitoring frame). The COST Action will look at how the various criteria of sustainable development articulate with the different initiatives for the promotion of MDM products.

5) **Common database.** Data collected will be assembled and made accessible through a database publicly available on a website. This database on European mountain environment and economic activities will include information on vegetation, PSM in grassland species and forages as well as in MDM products, grassland and livestock management, product processing and quality, tourism and consumer expectations.

D.2 Scientific work plan – methods and means

The research is organised in five Working Groups (WG) dealing with specific themes implemented in each pilot site.

WG 1 Biodiversity, grazing selection and dietary characteristics

Working hypotheses

- Grazing animals prefer heterogeneous plant communities.
- Grazed plants can be characterised by their content in secondary metabolites. These PSM are partly absorbed by grazing animals.

Task 1.1. Relationship between vegetation types and grazing selection

Grassland communities will be characterised by a survey of: environmental factors (soil, climate, orography) and management practices; mapping (aerial photo interpretation); analysis (species identity and abundance, PFT) and statistical treatment (multivariate analysis and clustering). Plant species and functional diversity will be evaluated by means of species number, Shannon Index, proportion of PFT, species pool approaches and turnover rates. Animal diet selection will be identified by sampling plant and fecal material (manual sorting and NIRS analysis, use of plant waxes such as n-alkanes and long chain alcohols) and mapping (GPS studies of animal behaviour combined with the detailed vegetation map on GIS). In some sites, animals' activities (feeding, moving, laying, standing, ruminating) will be determined by using the focal sampling technique.

Task 1.2. Analysis of PSM in grazed forages

Database on the PSM content of the main grassland communities types will be achieved through: analyses of nutrients in selected plants; extraction of PSM important for traceability and sensory properties of MDM products; establishment of sampling and analytical procedures; development of quick and accurate NIRS analysis calibrated on chemical analysis of important plant species and forages. Correlations between environmental factors, vegetation composition, PSM content and management practices will be calculated.

Terpenes and sesquiterpenes will be analysed. Extraction of CLA fatty acids precursors from plants will be carried out. The extracted lipids will then be transesterified to methyl esters by heating with Methanolic-Acetyl Chloride, recovered with hexane and analysed by gas chromatography. Identification and quantification of fatty acids will be done by gas chromatographic method.

Work plan

A standardised diagnosis protocol will be established to guarantee comparability of the selected sites. Grassland specific composition will be monitored according to international recognised methods, such as linear point quadrat and transect methods. Plant functional traits will be selected by mutual consent among the participants in WG1. Samples will be collected at defined periods of the year (objective: twice a year, depending on the phenology of vegetation and on the grazing periods). The condensed tannins of the plants selected by grazing animals will be determined. Laboratory methodologies will be compared and ring-tests will be implemented for chemical and NIRS analysis. Documented results will be formatted and centralised in a common database.

WG 2 Livestock and grasslands characteristics

Working hypotheses

- Animal/plant interaction is influenced by management practices.
- Landscape is conditioned by grazing pressure and animal movements.

Task 2.1. Grassland and grazing management

Grazing management practices will be recorded on the basis of regular inquiries and direct observations about: grazing calendar; movements of animals; stocking rates; presence of

infrastructures; weed and bush control; grassland oversowing; use of burning; manuring and fertilisation. The best practices will be identified.

Task 2.2. Livestock management

Stockbreeding management practices will be analysed on the basis of a survey of: animal breeds and species; body condition scoring; reproductive parameters (fertility, prolificacy), parasite control; use of medicine and medicinal plants; use of concentrated feedstuffs and conserved forage; husbandry and shepherding practices; animal productions level (daily weight gain, dairy production). The best practices will be identified.

Work plan

Historical background of grasslands will be described in order to prevent false interpretation of the current state of the vegetation. Inquiries will be standardised allowing a comparison of practices used in the different sites. Data will be collected by farmers with the help of rural advisors and veterinarians. Documented results will be formatted and centralised in a common database.

WG 3 Characteristics of high quality MDM products

Working hypotheses

- Grazing and downstream processing influence the quality of milk and meat and derived products.
- Grazing influence the quality of milk and meat.
- Milk and meat processing influence the quality of the raw products.
- PSM are traceable in MDM products.

Task 3.1. Milking procedures and milk treatment

Data on hygienic conditions and bacteria control in the stables, milking equipment and treatment of the milk will be collected and compared with the quality-related parameters.

Task 3.2. Dairy products: milk, cheese, yogurt, fermented milks, butter

Technological processes will be described. Samples will be collected. Chemical parameters important for the traceability of mountain dairy products such as PSM, carotenes and terpenes, lipid oxidation products (as markers/derivatives for fatty acid composition, since products are rich in polyunsaturated fatty acids), and other flavour-active compounds as contributors for the unique sensory properties of mountain dairy products will be analysed by Gas Chromatography-Mass Spectrometry (GC-MS) in combination with sensory methods such as Gas Chromatography-Olfactometry (GC-O), stable isotope dilution analysis for labile compounds present at trace levels. Phenols, fatty acids such as CLAs and antioxidants important for human health will also be measured using Mid Infra Red Spectroscopy (MIRS), NIRS and Raman spectroscopy. Correlations between the contents of selected plant species and dairy products characteristics will be calculated and analysed. Objective criteria to describe and improve the quality of animal products for consumers will be defined.

Task 3.3. Meat product processing: fresh meat, sausages, other types of dried and fermented meats

Same procedures as for dairy products.

In addition to the procedures for dairy products, a sensory analysis of the meat will be done to identify the parameters that will allow consumers to recognise these products.

Work plan

Standardised sampling and analysis protocols will be established to guarantee comparability of the studied products. Samples will be collected at defined periods of the year (objective: twice a year). Laboratory methodologies will be compared and ring-tests will be implemented for chemical and physical analysis. Measurements will be made by using Raman spectroscopy on a fat extract of the samples. Documented results will be formatted and centralised in a common database.

WG 4 Sociological analysis of MDM production and marketing

Working hypotheses

- Objective and scientific criteria of differentiation of MDM products have to be appropriated by farmers and other actors of the food chains to be translated into market advantages and regional value added.
- Consumers are sensitive to high-quality food products and to environmentally friendly production systems for which they are willing to pay higher prices.

Task 4.1. Analysis of the different farming systems and food chains

The different types of farming and processing in each region will be defined and linked with social, environmental and economic indicators. Motivations and needs of farmers and processors to maintain their practices and/or develop new ones will be better understood.

Mechanisms for negotiation, articulation and arbitration between the different actors and their knowledge systems in the development of 'quality' production chains and the 'evidence' they use to construct sustainable quality claims will be examined.

Task 4.2. Identification of the actors' networks/governance structure favourable to MDM production and marketing

The producers of mountain products are linked with market and institutions that enable them to sell their products. The identification of the actors' networks and the facilitating or constraining factors affecting their activity will allow to better understand the governance of the mountain food chains and to select successful examples of governance structures.

Task 4.3. Characterisation of the social expectations towards agricultural mountain products

Results of qualitative surveys about consumers' and tourists' expectations towards dairy and meat mountain products and towards landscape and biodiversity conservation, and leisure space will be compared. Links between landscape and products will be highlighted in order to elaborate adapted marketing strategies and to contribute to design a new and better-adapted policy for the support of mountain farming and marketing of MDM products.

Work plan

A standardised methodology will be defined on the basis of inquiries and available statistics. Documented results will be formatted and centralised in a common database. Qualitative surveys about consumers' and tourists' expectations towards landscape preservation, biodiversity and leisure space, will be carried out with 'Questionnaires' and 'Participatory Rural Appraisal' (PRA), a set of techniques aimed at shared learning between local people and outsiders.

WG 5 Transversal analysis and dissemination

Working hypotheses

- Animal production in mountain areas is sustainable but should be better assessed.
- Animal production in mountain areas offers the potential for innovative approaches to sustainable development through the inherent and dynamic linkage of environmental and product quality.
- There is a lack of information concerning the driving forces of mountain food chains.
- There is a lack of articulation between biodiversity management and agricultural production at the local, regional and national scales both at the policy and the scientific levels.
- Sustainable grassland practices are or could become a commercial argument when selling mountain products.
- MDM products and gastronomy are essential parts of agro-tourism development in mountain areas

Task 5.1. Evaluation of the link between sustainable land practices and market attractiveness

Different case studies of local and regional food chains will be selected, using a common grid of analysis of strengths and weaknesses, patterns of organisation and prospective scenarios (objective: 20 case studies).

On one hand, Strategic Environmental Assessment will be applied with emphasis on the historical interaction between the environmental, social and economic factors and players. The attractiveness of mountain grassland areas for farmers and MDM products processors will be evaluated along with naturally embedded nature of 'quality' production systems. Lock-in mechanisms will be identified and the potential for new collective management practices involving varied stakeholders at the territorial level will be assessed. The value of mountain grasslands for MDM product processors will be assessed.

The analysis will allow us to formulate for the case studies a diagnostic on the present sustainability, competitiveness and viability of the MDM products production, and to propose ways of improvement.

Task 5.2. Development of a guidance document

Examples of good practice in the integrated approach of animal husbandry, MDM product processing and ecological management will be identified, along with examples of innovative management structures and configurations. A detailed summary of development objectives and proposed activities for the achievement of sustainable systems will be available.

Task 5.3. Dissemination strategies

Dissemination will be assumed through articles in scientific journals; presentations at national and international conferences; meetings with stakeholders, users and Commission officers. Web site with direct links to organisations involved in the network will be constructed.

Work plan

WG 5, in collaboration with the other WGs, will focus on the maximum dissemination and exploitation of knowledge based on results obtained in the different case studies. The interactions between environmental, social and economic factors will be analysed. A synthesis of all data collected on the pilot sites will be realised using common indicators.

E. ORGANISATION

This COST Action is implemented through a concerted action. All researches are carried out and financed by the participating countries, while COST provides the means to organise and coordinate efforts.

Management Committee

Major organisation and planning will be performed by the Management Committee (MC), which is the supervisory body and decision making body in all relevant project matters. It is composed of two representatives of each country and the Action Chair. The Action Chair involves a Chair and a Vice-Chair. Meetings of the MC are open to all members of the Action but only the nominated MC members have the right to vote. The MC will have as main responsibilities:

- to design a Core Group consisting of the Chair, the Vice-Chair and one representative of each Working Group (5 WG coordinators);
- to establish panels of specialists when requested to deal with special issues within the WGs;
- to plan and coordinate the different meetings: MC meeting, scientific meeting and workshops;
- to support and to foster early stage researchers;
- to assess the evolution of the different activities in order to meet the general objectives of the Action;
- to report the progress made by the different WGs according to their respective objectives;
- to promote collaboration and exchange of knowledge/data among the WGs;
- to promote collaboration with other COST Actions, other programs and end users;
- to report to the Domain Committee (DC).

The MC will be invited by the Chair twice a year, preferably linked with spring workshops and autumn conferences, to evaluate the Action progress and find solutions to potential problems within

the consortium. When necessary, the Core Group will meet previously in order to organise the link between the WGs.

IPR Council is the panel of arbitration with power to decide disputes amongst the Parties concerning Intellectual Property Rights.

The Swiss Research Station ACW will be the formal grant holder and responsible for the management of the project. Mr. Eric Mosimann is the Action Chair and will be assisted by the administrative staff within ACW. Mr Alain Peeters is the Action Vice-Chair, he will assist the Chair and replace him whenever necessary.

Milestones (see also section F for the list of milestones)

Spring workshop and autumn conference

The core of the Action will be biannual meetings which will be organized at different locations throughout Europe, with the logistic support of local partners.

The spring workshops will be used to concert research activities in the forthcoming season. They will enforce cross-cutting discussions among the five working groups. The WG members will present overviews of the ongoing work in a plenary session. In addition, there will be a formal mixing of the subjects at the interface between the WG.

The autumn conference will be dedicated to presenting results to the stakeholders. They will provide for time to establish ad hoc research groups to address potential novel unforeseen developments relevant to the Action. The autumn conferences will attract a larger audience and are seen as a public forum to present results of the Action to the stakeholders.

DC members will be invited to the workshops and conferences. When requested, they will participate to the meetings of the Core Group in order to have a concise overview of the ongoing activities and to give their recommendations.

Website

A public, Action specific website hosted by the Swiss Research Station ACW will provide general information and will also facilitate data collection. A protected part of the web site will be accessible to Action members where they can read contents of working documents and also make changes online by themselves. The website will enable Action members to work together on specific topics, thereby not only ensuring up-to-date information but also avoiding duplication. It will considerably speed up processes by taking advantage of self-organisation, keeping overall Action administration to the necessary minimum (no e-mail avalanches or even postal letters, etc.).

Other means

Training schools will be organized within each WG on selected topics and will be open to Action members and other early stage researchers. They will be provided at no fee to facilitate exchanges between institutes and laboratories. The training schools and STSMs will primarily aim at early-career scientists but also at extension specialists and other stakeholders. **Scientific publications and technical leaflets** will be used to disseminate the results and information as well as the activities of the Action.

E.2 Working Groups

The research tasks outlined in the scientific programme (see D1) will be distributed between five working groups (see D2).

- WG1 Biodiversity, grazing selection and dietary characteristics
 - WG2 Livestock and grassland characteristics
 - WG3 Characteristics of high quality MDM products
 - WG4 Sociological analysis of MDM production and marketing
 - WG5 Transversal analysis and dissemination.

Each WG comprises between 10 and 30 members with two Working Group Organisers coordinating the scientific issues within the thematic group. Each WG nominates one representative to the MC's Core Group with due authorisation to discuss, negotiate and agree decisions or provide recommendations within the Action.

E.3 Liaison and interaction with other research programmes

Some members are participating in ongoing COST and FP6, as well as possibly in future FP7 research activities. This will allow for close collaborations and links on the whole food chain sectors, from grassland to products of designed origin. Contacts will be established with ongoing projects listed in section B4. Representatives of MCs of other COST Actions related to common topics will be invited to the autumn conferences. The COST Action will also be presented during congresses of other scientific Organisations. This will facilitate the integration of recent research results and stimulate further exchanges.

E.4 Gender balance and involvement of early-stage researchers

This COST Action will respect an appropriate gender balance in all its activities. It will also be committed to considerably involve early-stage researchers. These decisions will be placed as standard items on all MC agendas.

At the time of writing, the list of contacted experts contains 120 scientists (45 females and 75 males). This Action respects the European policy of equal opportunities between women and men. All necessary measures will be undertaken not only to eliminate inequalities between genders, but also to promote equality between them. This will be effective according to the Commission's gender mainstreaming strategy by which each policy area, including that of research, must contribute to gender balance.

The Action will also encourage and improve the involvement of young scientists at all levels including their participation in the meetings of the WGs, conferences, symposia and workshops organised in the network. Particular attention will be given to stimulate young scientists to undertake STSMs during the Action. This will further strengthen the co-operation and collaboration with other research teams and will broaden the scientific horizons of young scientists.

F. TIMETABLE

The Action will take place for a period of four years. The Website will be established in the summer of year 1. Spring workshops and Autumn conferences will be held annually. Each working group will conduct one training school every two years in winter. STSMs and small-scale meetings of research groups will be conducted *ad hoc*. The following table gives an overview of the time scale and of the main milestones for the Action:

	Year 1				Year 2				Year 3				Year 4			
	spr	sum	aut	win	spr	sum	aut	win	spr	sum	aut	win	spr	sum	aut	win
Coordination	[shaded]															
Kick-off meeting	[shaded]															
Website	[shaded]															
MC meeting	MC 1		MC 2		MC 3		MC 4		MC 5		MC 6		MC 7		MC 8	
Spring workshop	[shaded]															
Autumn conference			[shaded]				[shaded]				[shaded]				[shaded]	
WG training schools				WG 1-3				WG 4-5					WG 1-3			WG 4-5
Annual reports				[shaded]												
Dissemination activities																
Final report																

MC meetings' milestones

- MC 1: selection of the pilote sites and of the laboratories
choice of methodologies for vegetation and animal behaviour description
determination of common protocols, sampling strategies
- MC 2: choice of methodologies for PSM analyses
common determination of inquiries and questionnaires
construction of the data bases
information to stakeholders
- MC 3: interlaboratory ring test
analysis of the social and econmical parameters
- MC 4: comparison between pilot sites
dissemination strategies and information to stakeholders
- MC 5: standardisation of all approaches
- MC 6: sustainability evaluation
planification of publications
information to stakeholder
- MC 7: leaflets redaction
- MC 8: results pooling
Information to stakeholders
final report and book preparation

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: Austria:AT; Belgium:BE; Bulgaria:BG; Czech Republic:CZ; Former Yugoslav Republic of Macedonia:MK; France:FR; Germany:DE; Greece:GR; Israel:IL; Italy:IT; Norway:NO; Poland:PL; Romania:RO; Serbia:RS; Slovak Republic:SK; Slovenia:SI; Spain:ES; Switzerland:CH; United Kingdom:GB. Partners from Albania, Andorra, Bosnia and Herzegovina and Tunisia have also manifested their interest in the Action.

On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 50 Million € for the total duration of the Action. This estimate is valid under the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

H. DISSEMINATION PLAN

H.1 Who?

The target audiences for the dissemination of the results will be:

- Farmers, dairy and meat processors, MDM product marketers, inter-professional organisations.
- Veterinarians, rural advisors, extension services.
- Scientists and teachers.
- Tourism agencies, regional developers, nature conservationists, policy makers.
- Consumers.

H.2 What?

Within the Action

The dissemination of results and know-how exchanges will be assumed mainly through meetings (training schools, workshops and conferences) and Short Term Scientific Missions. Posters and oral communications will be synthesised in proceedings available on CDs and leaflets. The Action specific Website will allow continuous updating of information and spontaneous communication by use of blogs. Members will be encouraged to participate actively to this process. Public conferences will be organised annually in different geographic regions to allow participation of local stake holders. Press communication will present the main topics to the broader public audience. Intermediary and final reports will be distributed to all participants and the main partners. At the end of the Action, at one science based book and practical manuals for farmers giving an overview of the main results are foreseen.

Outside the Action

Members of the Action will be encouraged to publish joint research results in scientific journals. The publication of common review, articles and book chapters will help to reach a broader, less specialised public. Technical guidelines addressed to different professional stake holders will be produced. Joint activities with other COST Actions and international projects are envisaged. The Action will be linked with other congresses such as those from European Grassland Federation, European Association for Animal Production, International Committee on Food Microbiology and Hygiene, FIL-IDF, European Association for Chemical and Molecular Science (EuCheMS), International Union of Food Science and Technology (IUFoST), NIZO Conference and International Dairy Federation.

H.3 How?

The MC will organise and encourage the dissemination of information to a wide public. The Action specific Website is a modern tool for promoting exchanges and updating results that will constitute the core of the communication process.

Meetings will be organised with local stakeholders including decision makers

Technical leaflets destined to advisors will be published. This material will be usefull for organising field excursion and professional journeys destined to practitioners, farmers, herd keepers, breeders associations, and cheese/meat processors.

Part II – Additional Information NOT PART OF THE MoU

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HISTORY OF THE PROPOSAL

A core number of participants of this COST Action have a long-lasting history of collaboration within an ESCORENA network. ESCORENA (European System of Cooperative Research Networks in Agriculture) was created in 1974 by FAO (Food and Agriculture Organisation of the United Nations) and European research institutions. It aimed to promote the voluntary exchange of information and experimental data, to support joint research projects and to facilitate the sharing of expertise, germplasm and technologies. It also aimed to promote exchanges between scientists from East and West Europe. The cooperative research network on Pastures and Fodder Crops was established in 1978. FAO was the main contributor to the financing of this ESCORENA network. CIHEAM (International Centre for Advanced Mediterranean Agronomic Studies) co-sponsored the network activities that are important for Mediterranean countries. Though, the financial support of FAO decreased dramatically after 1990. The FAO/CIHEAM Inter-Regional Cooperative Research and Development Network on Pastures and Fodder Crops included the Mountain pastures sub-network. This sub-network has been created as soon as 1962, first as an independent working group. Meetings were organised since then every two years. The proceedings were published in the FAO REU Serie and since 2005 in books. In 2007, about 400 members from 27 countries were registered in this sub-network. The first activities dealt with grassland production and management as well as with the role of grazing in the management of agro-pastoral mountain areas. It appeared progressively that the future of livestock rearing activities cannot be separated from the other mountain areas activities (including tourism and recreation) and the expectations of other mountain users (ex.: tourists and tourism industry, nature conservationists and environmentalists, researchers and teachers). That is the reason why the activities of the sub-network included the study of the biodiversity associated to the production system since 1995 and the quality and the promotion of mountain animal products since 2002. In 2007, it was decided to enlarge the group, to include new research disciplines and to integrate the researches on plant ecology and biodiversity, animal production, quality of MDM products and social aspects linked with diverse stakeholders expectations and the needs of decisions makers of mountain areas. This innovative approach appeared to be the only one that can study in a proper way these multiple interactions in the unique European mountain ecosystems. It appeared also to be an appropriate way for solving the many issues linked with mountain areas development in Europe. COST Action was chosen as the most appropriate programme for bringing together the activities and experiences of a high number of European teams dealing with these subjects. This proposal is the result on one hand of this long tradition of research and development network activities and on the other hand of a totally new and integrated approach.

POTENTIAL PILOT SITES

As already mentioned (see Part I, B.4.), many teams are involved with researches on the whole chain process of MDM products at national level. Their investigations are set-up in various mountain regions of Europe and will be used as reference for the COST Action. Following pilot sites are actually proposed:

Country	Site	Livestock	Product
Greece	Lagadas County	Sheep, goats	Milk, feta cheese
Greece	Portaikos-Pertouli	Sheep, dairy cows	Milk, cheese
Israel	Carmel heights	Goats	Milk, yoghurt
Italy	Suviana – Brasimore	Cattle	Meat
Italy	Valle Stura di Demonte	Dairy cows	Cheese, yoghurt
Italy	Valle Sacra	Dairy cows	Cheese, yoghurt
Italy	Sardinia	Sheep	Meat
Italy	Monti Sibillini	Sheep	Milk, meat
Norway	Senja, Troms	Goats	Milk

Norway	Valdres – Hallingdal	Dairy cows	Milk, cheese
Poland	Poronin	Sheep	Milk, cheese
Poland	Czarny Dunajec	Dairy cows / cattle	Milk / meat
Slovakia	Podlavice	Sheep / cattle	Milk / meat
Spain	Sierra de Guara	Sheep	Meat
Spain	Aragón – Ordino's parish	Cattle	Meat
Spain	Basque country	Sheep	Cheese
Belgium	Gaume area	Cattle	Meat
Great Britain	Northumberland	Cattle	Meat
Great Britain	Limestone County	Cattle	Meat
Switzerland	La Frêtaz	Sheep / cattle	Meat
France	Massif Central	Dairy cows / cattle	Milk, cheese / meat
Austria	Styrian Ennsvalley - Salzkammergut	Dairy cows / cattle	Milk / meat

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