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SUSTAINABLE AGRICULTURAL LAND USE IN ALPINE REGIONS (SAGRI-ALP)

FINAL REPORT

MARCH 2001

Entities in charge of synthesis on the Alpine level and editing: SUACI/GIS and FiBL.

Partners:
Service d'Utilité Agricole à Compétence Interdépartementale/ Groupement d'Intérêt Scientifique Alpes du Nord (SUACI/GIS Alpes du Nord) (FRANCE) (Coordinator)
Research Institute of Organic Agriculture (FiBL), (SWITZERLAND)
Istituto Agrario di San Michele all'Adige (IASMA) (ITALY)
RaumUmwelt (ARU), (AUSTRIA)
Alpine Research Institute (AFI), (GERMANY)

The present project benefits from financial support by the Commission of the European Communities, an Agriculture and Fisheries (FAIR) specific RTD programme. It does not necessarily reflects the Commission's views and does not constitute an indication on the Commission's future policy.

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ABSTRACT

SUSTAINABLE AGRICULTURAL LAND USE IN ALPINE REGIONS (SAGRI-ALP) FAIR5 CT97-3798

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INTRODUCTION :

The overriding aim of this project is to develop guidelines for proper land use in agriculture in terms of sustainability. We analyse the bottom-up capacities for sustainable agricultural development in the Alps by specifying the conditions of sustainability in a mountain context on the basis of the points of view of both local people and scientists. The issues of sustainability are defined according to ecological, economic and social criteria, with regional adaptations to the specific conditions of the Alpine mountain regions. Five countries in the Alps are involved in this project, namely Austria, France, Germany, Italy and Switzerland.

The results of SAGRI-ALP are:

- a comparative analysis of the limits of sustainability, its potential and trends in the rural areas of the Alps;
- regional guidelines with concrete indicators, objectives and plans of action to implement sustainable agriculture in the five research areas;
- final recommendations for the European Commission to implement a regionally adapted policy concerning sustainable agricultural land use in the Alps;
- an Alpine guideline to promote and build up local projects involving local people and targeting sustainable agriculture.

METHODOLOGY :

We used different methodologies:

To take into account and involve both scientists and local people. In each research area a team of local actors is established and involved in the project during the whole period. By means of the « future workshop » method, the wishes and objectives of local people for sustainable agriculture are determined and their own sustainability points of view are understood.

To analyse the relationships between environmental states, agriculture and other activities, policy measures and aspirations of the local population. A system approach in an interdisciplinary research including ecology, geography, agronomy and economy is developed.
To imagine and to evaluate scenarios to improve sustainability we combine quantitative assessment (Linear programming) with qualitative approach (assessment of social component of sustainability thanks to the formulation of scenarios by the local teams).
To take into account global and local size of sustainability we combine different levels of investigations: the classification of sustainable agricultural land use objectives is established both at European, national, regional levels (using international and national documents) and at local level (case studies).
To produce scientific results and also practical tools and diagnosis for the farmers, the agricultural services and the decision-makers in rural development the project involves public and private teams oriented towards research/development activities.

The innovative aspect of SAGRI-ALP is to combine these different methodologies into a consistent approach and not to use one after the other, separately.

RESULTS :

Problems of sustainability in alpine agriculture:

The alpine area is one of the most important growth areas of Europe. In spite of this, **the economic situation** of alpine agriculture is in striking contrast to this general positive trend. Alpine agriculture tends to decline**. The agricultural income remains lower to plain agricultural income.** The current specific correctives measures for mountains, in spite of their positive effects in general, are not sufficient to compensate the higher costs of production of the Alpine agriculture. Scientist and local people discuss some ideas to improve the situation: diversification of farm income with tourist offers, improvement of marketing structures and development of local special products with high quality standards are solutions frequently mentioned.

Agricultural environmental problems are clearly related to two trends in the evolution of agricultural land use, namely intensification and land abandonment. The environmental impact of intensification identified is due to: local over-use of organic fertilisers, the occasionally use of pesticides and herbicides, and overgrazing or grazing near water catchments in alpine pasture. All these practices have negative impacts on biodiversity and water quality (bacteriology especially). Excepted some categories of persons (organic farmers, environmental representatives) local actors are less sensitive than scientist to these topics. Land abandonment affects negatively biodiversity, landscapes and soils. This evolution is linked to the diminution of number of little farms, the limiting working load and the capacity of local society to manage a better distribution of farms in the territory.

The social impact of farmers is now low, being closely linked with the decrease of agriculture. Today, farmers long for new way of living (holidays, social life, less workload, etc.) and their **frequent work overload is a major concern.** Farmers are attached to the traditional and original vocation of agriculture that is to say production of food. They refuse to ensure just environmental functions**. Even including environmental functions into the farm corresponds to a change of profession for farmers**. This is not yet realised and shows the necessity to accompany farmers in this mutation.

Three major limits for the implementation of sustainable agriculture are stressed by the rural world:

1 - On the agricultural level, external factors, more than territorial aspects, exert considerable pressure on production management, namely world trade and prices, industrial and marketing strategies, consumer demands, sanitary standards, etc
2 – On the rural-development level, some communities are not able to take into account medium- and long-term considerations for sustainable development. The short term is considered so difficult that it is the single priority.
3 – **The lack of consistency between objectives of political tools targeting sustainable agriculture and their administrative implementation.** Time perspective of subsidies: in general to short according to the context

of long-term planning of farm activities and investments; current increase of the administrational constraints to obtain subsidies ;

CONCLUSION AND PRACTICAL OUTPUTS

Alpine economic growth, the key function of agricultural land in the development of Alpine tourism, the policy of quality, already implemented by Alpine farmers, the good image of products, etc. may put Alpine agriculture in a better situation to implement the new production methods required by the new economic and environmental constraints than many intensive agricultural systems in the lower areas. Thus, we may assume that Alpine areas are good experimental sites to test the capacity of agriculture to change its relationships with society and nature and to meet the challenge of sustainability.

The local level is a major issue for the implementation of sustainability, in that it is the "connection" level between global values and institutional regulations on the one hand, and the wishes, projects and actions of local actors on the other. Consequently, improving sustainability on the local level means collective change in action by all actors and requires that people share a common view on the long-term evolution of the territory. To achieve this, new ways of sharing information and making decisions have to be implemented on the local level, by bringing together local government structures with local economic and social organisations and representatives of actors. To help local people in this evolution, we propose a method **to facilitate local coordination, prospective reflection and scenario analysis**. **This process has been structured and organised in a methodological set of "Guidelines to formulate local plans of action for sustainable agriculture" presented in this final report, including the successive steps in the process, their objectives, as well as the tools, methods and expected results at each step**.

Policy recommendations to strengthen the implementation of sustainable agriculture are also one major practical output. They concern both general policies implemented on a large scale (Rural development regulation, market policies, etc.) and tools to enhance local participation (leader +; Interrge 3, local agenda 21). Targeting a practical use we discuss both possibilities of use of current policies and general strategies.

EXECUTIVE SUMMARY

Introduction :

The overriding aim of this project is to develop guidelines for proper land use in agriculture in terms of sustainability. We analyse the bottom-up capacities for sustainable agricultural development in the Alps by specifying the conditions of sustainability in a mountain context on the basis of the points of view of both local people and scientists. The issues of sustainability are defined according to ecological, economic and social criteria, with regional adaptations to the specific conditions of the Alpine mountain regions. Five countries in the Alps are involved in this project, namely Austria, France, Germany, Italy and Switzerland.

The specific objectives of the study are those indicated below.
Objective 1. Analyse the policy background (Alpine Convention, etc.) and the global context of sustainable agriculture in the Alps, in order to define a set of basic criteria specific to the environmental, social and economic conditions of this area.
Objective 2. Test whether these criteria and their consequences are relevant and acceptable for the local conditions and actors.
Objective 3. Develop a European strategy for sustainable agriculture in the Alps capable of adapting to the diversity of people and conditions in rural areas of the Alps.

The results of SAGRI-ALP are:

- a comparative analysis of the limits of sustainability, its potential and trends in the rural areas of the Alps;
- regional guidelines with concrete indicators, objectives and plans of action to implement sustainable agriculture in the five research areas;
- final recommendations for the European Commission to implement a regionally adapted policy concerning sustainable agricultural land use in the Alps;
- an Alpine guideline to promote and build up local projects involving local people and targeting sustainable agriculture.

Methodology :

THE SAGRI-ALP PROJECT IS PLANNED IN FIVE TASKS AS FOLLOWS :

Task 1 : Definition of sustainable agriculture on basis of legal and political documents. Using the international and national relevant documents, a general model for sustainable land use has been elaborated. This general model represents the political framework and is a basis for a global evaluation of sustainability in different selected research areas in the Alps of the different member states (Austria, France, Germany, Italy), and in Switzerland.

Task 2 : Selection and diagnosis of alpine research areas. To improve this first framework of sustainable land use and adapt it to different contexts of the Alps, case studies in five selected research areas (one per country) have been carried out. A diagnosis of the situation of the rural development and of environmental problems has been realised on each research area, within their economic, social and policy context.

Task 3 : Definition of criteria of sustainable land use from the point of view of scientists and local people. These case studies constitute the data base for a comparative analysis between the research areas, to create a list of regionally adapted sustainability criteria from the point of view of scientists. On the other hand, local people and regional decision makers involved in rural development have been mobilised in each research area. By means of the " future workshop " method, their wishes and objectives for sustainable agriculture have been discussed and analysed.

Task 4 : Scenario analysis and evaluation. The scientific and the local people objectives have been further developed by the means of scenarios to evaluate their concrete expectable economic and ecological effects. Consequently, potentials of development of sustainable agriculture in rural areas have been investigated. Different strategies to implement sustainable agriculture have been examined in parallel with an analysis of the impact of agenda 2000 on sustainability of alpine agriculture.

Task 5 : Synthesis : guidelines for sustainable land use and recommendations for EU policies. The synthesis of the results includes learning on the way the local people draw scenarios about sustainable land use, regional guidelines for a sustainable agricultural development; a guideline to build up local action plan in favour of sustainable agriculture and final recommendations for EU policies.

WE USED DIFFERENT METHODOLOGIES:

To take into account and involve both scientists and local people. In each research area a team of local actors is established and involved in the project during the whole period. By means of the « future workshop » method, the wishes and objectives of local people for sustainable agriculture are determined and their own sustainability points of view are understood.
To analyse the relationships between environmental states, agriculture and other activities, policy measures and aspirations of the local population. A system approach in an interdisciplinary research including ecology, geography, agronomy and economy is developed.
To imagine and to evaluate scenarios to improve sustainability we combine quantitative assessment (Linear programming) with qualitative approach (assessment of social component of sustainability thanks to the formulation of scenarios by the local teams).
To take into account global and local size of sustainability we combine different levels of investigations: the classification of sustainable agricultural land use objectives is established both at European, national, regional levels (using international and national documents) and at local level (case studies).
To produce scientific results and also practical tools and diagnosis for the farmers, the agricultural services and the decision-makers in rural development the project involves public and private teams oriented towards research/development activities.

The innovative aspect of SAGRI-ALP is to combine these different methodologies into a consistent approach and not to use one after the other, separately.

Results :

MAJOR RESULTS OF THE PROJECT ARE:

IN THE ALPS, CONCERNING SUSTAINABLE AGRICULTURE FOR FARMERS AND FOR COMMUNITY LEADERS, WE IDENTIFIED THREE MAJOR PERCEPTIONS:

1 – Economic factors are the primary concern : the maintaining of farms requires sufficient income. Today the major threat is that agricultural income in mountain remains lower than the one in plains regions. Present-day farmers feel more and more like producers of goods and business managers. Such an attitude is common among young farmers, who clearly separate meadows with high agronomic value for production, from poor, difficult fields which could be maintained for landscape reasons with financial support from society.

2 – The quality of rural life is the secondary factor of concern. The social impact of farmers is now low and still declining. Farmers have some difficulties in finding a new social position which could be a problem in founding a family and taking part in the decisions of the community. The frequent work overload on farms is also a major concern. Such an attitude is common both among farmers and representatives of communities.

3 – The environmental topic is rarely mentioned by farmers (except positive landscape impacts of agriculture or locally some problems referring to water quality). We can summarise a common point of view of farmers concerning the relationship between agriculture and the environment in the following sentence. "The landscape and the rural area are the result of our work, environmental quality depends on agriculture, so the balance between the negative and positive impacts of agriculture is always largely positive". Such an attitude, common in the different Alpine countries, is more pronounced in regions with Latin culture than in regions with German culture, where from an historic point of view "wild nature" is more important. However, for NGOs involved in environmental protection, the reduction of negative environmental effects by agriculture and the promotion of environmentally friendly practices are important.

Briefly, we find two reference models concerning sustainable agriculture:

1 - Sustainable agriculture equals traditional agriculture. Maintaining traditional practices and agriculture is a guarantee for the environment and the key element for rural development.
2 - Sustainable agriculture equals new and up-to-date agriculture. To define and manage the multifunctional dimensions of agriculture and agricultural land, there is a need to define a new project with society and to manage it in the new context where countryside is no longer chiefly dependent on farming activity.

Whatever the definition, **three major limits for the implementation of sustainable agriculture are stressed by the rural world:**

1 - On the agricultural level, external factors, more than territorial aspects, exert considerable pressure on production management, namely world trade and prices, industrial and marketing strategies, consumer demands, sanitary standards, etc. Because of the consequences on their income, such topics are the major concern for farmers. National and European policies are interpreted as being increasingly focused on liberalisation of markets and exports, resulting in price decreases and the increased size of farms, and are also often mentioned as a limitation for sustainable agriculture.
2 – On the rural-development level, some communities are not able to take into account medium- and long-term considerations for sustainable development. The short term is considered so difficult that it is the single priority.
3 – **The lack of consistency between objectives of political tools targeting sustainable agriculture and their administrative implementation.** Time perspective of subsidies: in general to short according to the context of long-term planning of farm activities and investments; current increase of the administrational constraints to obtain subsidies ;

PROBLEMS OF SUSTAINABILITY IN ALPINE AGRICULTURE:

The alpine area is one of the most important growth areas of Europe. In spite of this, **the economic situation** of alpine agriculture is in striking contrast to this general positive trend. Alpine agriculture tends to decline**. The agricultural income remains lower to plain agricultural income**. Prices of the products remain weak except in the case of quality production. Alpine agriculture can be in deep concurrence with the other activities (urbanisation, tourism). The current specific correctives measures for mountains, in spite of their positive effects in general, are not sufficient to compensate the higher costs of production of the Alpine agriculture. Scientist and local people discuss some ideas to improve the situation: diversification of farm income with tourist offers, improvement of marketing structures and development of local special products with high quality standards are solutions frequently mentioned.

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Conclusion and practical outputs

Alpine economic growth, the key function of agricultural land in the development of Alpine tourism, the policy of quality, already implemented by Alpine farmers, the good image of products, etc. may put Alpine agriculture in a better situation to implement the new production methods required by the new economic and environmental constraints than many intensive agricultural systems in the lower areas. Thus, we may assume that Alpine areas are good experimental sites to test the capacity of agriculture to change its relationships with society and nature and to meet the challenge of sustainability.

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- **Integrating global and local issues of sustainability**. Associating a scientific assessment based on an analysis of sustainability objectives in political texts on the Alpine scale, and the assessment of local actors may be used to solve frequent contradictions between global and local sustainability problems. Examples are air and climate change, and some aspects of biodiversity (e.g. a species that is rare on the European level and abundant on the local level). These topics are not easily understood by local groups. The scientific assessment of sustainability and the possibility to debate its results in the local groups are an efficient contribution to integrating global issues of sustainability in local concerns.
- **Deriving short term plans of action from long term perspectives**. The method of prospective reflection by actors is focussed primary on the long term, but it leads to a plan of action for the short term. This makes it possible to take into account the temporal dimension of the sustainability, i.e. acting today to avoid compromising the future of later generations.
- **Implementation of new governance processes on the local level**. The project formulation stage followed by the implementation of action is a factor favouring the progressive establishment of the participation principle. First during project design, then its actual implementation by the local actors in three of the five regions participating in SAGRI-ALP. This favours the implementation of new governance methods that are more democratic and participative, and better suited to sustainability.
- **An operational and reproducible method on the Alpine scale**. In our work, we used the "future workshops" method and a list of indicators. The different steps of the process are presented in order to be reproducible on the Alpine scale and the list of indicators will measure the level of sustainability and monitor the evolution of agriculture.

This process has been structured and organised in a methodological set of "Guidelines to formulate local plans of action for sustainable agriculture" presented in this final report, including the successive steps in the process, their objectives, as well as the tools, methods and expected results at each step.

Policy recommendations to strengthen the implementation of sustainable agriculture are also one major practical output. To infer perspectives, priorities and policy recommendations for sustainable Alpine agriculture, we used four main tools representing the major results of the SAGRI-ALP project:

- the objectives of sustainable agriculture from the viewpoint of local people and on the basis of the political texts (European and world levels) (task 1);
- an assessment of sustainability involving both scientists and local people in five Alpine areas (tasks 2 and 3);
- a simulation of the foreseeable impacts of Agenda 2000 (CSE (1996)) and of the local and scientific scenarios (task 4).

The recommendations concern both general policies implemented on a large scale (Rural development regulation, market policies, etc.) and tools to enhance local participation (leader +; Interrge 3, local agenda 21). Targeting practical implementation, we address both possibilities of using current policies and general strategies.

Future actions :

The end of the program carried out in the five research areas confirms the interest and the effectiveness of the process used to mobilise local actors and accompany them in the elaboration of a sustainable-agriculture project, from the territorial-assessment phase to the elaboration of a plan of action. The success of the process in the five research areas shows that the tools and methods used are well suited to the diversity of the Alpine territories and are reproducible. The SAGRI-ALP project enabled the elaboration, testing and validation of an efficient process to involve local people in the formulation of plans of action for sustainable agriculture in the Alps.

Now it's time to implement the action plans in each area. That's why we proposed to realise a demonstration project managed by local people and framed by scientists in order to give a scientific value to this work. This demonstration project has been submitted to the 5th research and technological development program in October 2000 ("demonstration of sustainable agriculture implementation in alpine mountain", acronym: IMALP, Dossier : QLRT-2000-01282). Despite a negative evaluation of independent experts ("the proposal does not qualify as a demonstration"), the willingness of local actors remain very high. We are now searching more relevant programs to implement the action plans and to assess them with scientific methodologies (i.e. LEADER +, INTERREG III).

We wish to publish a management framework presenting in details the guideline to build up local action plan in favour of sustainable agriculture. This handbook will include a complete presentation of each phase of the process, including detailed step-by-step procedures, check lists, elaboration of alternative methods, work techniques (leading the local group, scientific assessment with indicators of sustainability, farm and scenario analysis), etc. This will enable easier implementation of the process and the guide will be helpful in implementing different procedures such as RDP, LEADER +, etc. The current objective is to find an editor and financial aid to publish this handbook.

1. Introduction

1.1 The objectives of SAGRI-ALP

The overriding aim of this project is to develop guidelines for proper land use in agriculture in terms of sustainability. We analyse the bottom-up capacities for sustainable agricultural development in the Alps by specifying the conditions of sustainability in a mountain context on the basis of the points of view of both local people and scientists. The issues of sustainability are defined according to ecological, economic and social criteria, with regional adaptations to the specific conditions of the Alpine mountain regions. Five countries in the Alps are involved in this project, namely Austria, France, Germany, Italy and Switzerland.

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1.2 Scientific background

1.2.1 Historical overview - the emergence of sustainability concerns for agriculture

In recent decades, repeated **crisis situations** in agriculture have led to the widespread opinion that both worldwide and locally, agriculture has not been following a sustainable path into the future. (European Commission (1993), FAO (1994), Roberts (1995), UNCSD (1992), National Councils for Sustainable Development (1997); Cocklin and al. (1997), European Commission (1999), Fischler, (1999)). Diffuse pollution, a growing problem for water-quality management, is largely the result of agriculture. Agricultural land management has emerged as a critical issue with regard to the destruction of biodiversity resources for the future generations (Keeney (1990), Allen et al. (1991), Farshad and Zinck (1993), Abelson (1995), Landais (1998), Panell & Schilizzi (1999)). The recent issues concerning mad cows revived general concern about the quality of agricultural products, notably pesticides, herbicides and antibiotics in food. The welfare of animals is another concern currently on the rise in public opinion.

Large-scale agriculture involving excessive use of energy, chemicals and capital is often considered the root of all these problems (Neher (1993), Altieri (1995), Bonny (1998), European Commission (1999), Panell & Schilizzi (1999)).This type of agriculture was encouraged by the Common Agriculture Policy in the 1970s to cover EU food deficits. Price supports and subsidies were the driving force in the development of a dominant production model

based on increased productivity (Table 1). Since that time, the general political context has changed significantly to one of oversupply, environmental problems, increasingly global exchanges, drops in prices and a drastic change of the image of farmers. New changes are now foreseeable and in addition to the profound evolution of the CAP in the 1980s and 1990s (milk quotas and direct payments), we may expect new agricultural policies over the mid-term due to international pressure (decoupling of subsidies in the framework of the World Trade Organisation negotiations). All these changes will have important consequences on farming and agricultural land.

Table 1: selected aspects of European policy for agriculture

Policy milestones	European policy guidelines	Specific evolution of alpine agriculture
1992 : CAP Reform 1994 : Swiss new policy 1994 : GATT agreement (URUGUAY round)	CAP reform to ensure world competitiveness, no over-production, maintenance of budget environment preservation and WTO constraints by : • Reduction of prices • Direct payments related to the surfaces and number of livestock units • Reduction of export subsidies • Agri-environmental policies (reg. 2078/92) • Maintenance of production regulations (quota, fallow)	High rate of closing down of farms. Alpine agriculture income lower than in plain. Environmental problems different from those observed in plain: land abandonment in slopes associated with intensification on accessible land Existence of early (since the sixties) positive experiences of sustainable agriculture in the fields of quality and local products, multi-functionality, environmental services, etc. Current trend: enlargement of these experiences (especially in the field of quality products)
Agenda 2000 (EU) AP 2002 (Switzerland)	Objective of world competitiveness and rural development policy with respecting WTO constraints: • Continuation of 1992 CAP policy • Direct payments with ecological constraints (AP 2002 + eco-conditionality) • Rural development policy as "second pillar" of CAP (reg. 1257/99) • Reinforcement of subsidiarity	

The collective awareness of pollution in the rural environment has already led to attempts to change agricultural practices. The objective was initially to implement new practices in view of reducing environmental damage by using best-management practices (particularly nutrient and pesticide management). But this greening of technological progress was not enough and the need for a more profound change in the overall agricultural system has emerged since the 1990s. A critical review of the entire agricultural-development model has been carried out, through the question of "sustainability" of production means related to natural resources or to landscape management. The analysis centred on a common set of principles, i.e. "not sacrificing future availability of resources for present needs", "reducing energy inputs", "recycling", "working with the ecosystem, not against it", etc. (Harwood (1990), Keeney (1990), Allen et al. (1991), Panell & Schilizzi (1999)). More recently, social terms of sustainability and economic achievement have been included in the formulation of sustainability (Landais, 1999 ; Brodhag, 1999). But the translation of the whole concept of sustainability into concrete environmental targets is limited by the lack of models drawn up for action (Landais (1998)). Consequently, scientists can now provide a clear picture of what kind of evolution could be or is going to be unsustainable, but new management methods are just emerging or are still the object of debates (Bonny 1998, Costanza (1996)).

1.2.2 Specific Alpine issues in agriculture

The Alps are often considered by local people or tourists as a unique natural and cultural heritage. Similar to other mountains regions, the area has steep environmental gradients (altitude gradient, slopes, exposure). But in a sense, the Alps are specific because these biophysical contrasts have interacted for centuries with a wide range of agricultural, pastoral and forestry land use. Such complexity of the ecological and human factors coupled with biogeographic factors explain the remarkable contribution of this area to biodiversity in Europe. Often, the

Alps, like many other mountain ranges in the world, are considered "islands of biodiversity". Their role as mineral and water reserves for low lands is also very important (Messerly et Yves (1997)). The Alps are undeniably one of the richest and also one of the most complex and fragile large ecosystems in Europe. Agriculture is often responsible for this high environmental value and many rare species, biotopes with national and European value, valuables landscapes, etc. depend on specific agricultural practices such as mowing, grazing, various forms of fertilisation, maintenance practices concerning hedges, the edges of forests, etc. (European Commission (1995), Euromontana (1997), Dax & Wiesinger eds. (1998), Fleury et al. (1999), MacDonald and al., 2000)).

Consequently, the natural and cultural resources so often admired are partly the result of the past and are therefore very sensitive to variations in human conditions (economic and political). The global change (climatic changes) could also be a threat to the status of mountain agriculture and associated natural and cultural resources.

In comparison with intensive agriculture in the low lands, Alpine agriculture still has *a good public image* (Pruckner (1995), IUCN, FAO, ICALPE (1996), Euromontana (1997), Fleury (1999)) of a low-input agriculture, developed in natural areas, producing high quality products (cheese). But economists and sociologists have pointed out that mountain agriculture is generally a declining sector. The distances involved and physical disadvantages reduce competitiveness and place severe limits on adaptation. Farmers have difficulties in developing new strategies suited to the changing economic and social environment.

This process could be explained by changing economic conditions and competitive disadvantages compared with non-Alpine regions (Bazin (1995), European Commission (1995)). Social changes are also underway with a general decrease in agricultural communities which impacts on the social and cultural environment. (Pruckner (1995)).

The weakness of current and future Alpine agriculture has produced some negative environmental changes. But the environmental symptoms (EC (1995), Dax & Wiesinger (1998), Euromontana (1997), Fleury (1997), MacDonald & al., 2000)) are different than those observed in the low lands:

- conversion of agricultural land to other uses (urbanisation is taking place throughout the Alps, particularly in the larger valleys, ski resorts and forests);
- wide-spread land abandonment (abandonment is mainly due to difficult access, poor land quality and steep slopes);
- agricultural intensification on accessible land with local over-use of organic fertilisers and overgrazing.

All these changes may have negative impacts on biodiversity and the beauty of landscapes, and occasionally increase natural risks (danger of avalanches on slopes and fires with the increase of shrubs). Water quality is also affected, but the main issue is bacteriological contamination and not chemical pollution. The complexity of the interactions between the environment and Alpine agriculture is exacerbated by the extreme local and climatic differences within the Alps as well as by the considerable differences in economic development. **It is obvious that a single form of agriculture does not exist in the Alps, but rather a multitude of different types of farming systems with considerable differences in their development and in their potential for land maintenance and environmental impact.**

Consequently, the magnitude of the changes differs among the various regions of the Alps, but in general, agriculture remains the primary economic sector and is active in managing ecosystems which are the basis for other activities (Cristofini & al (1999)). The current state of agricultural land is considered good when compared with other European regions.

Alpine economic growth, the key function of agricultural land in the development of Alpine tourism, the policy of quality, already implemented by Alpine farmers, the good image of products, etc. may put Alpine agriculture in a better situation to implement the new production methods required by the new economic and environmental constraints than many intensive agricultural systems in the lower areas. Thus, we may assume that Alpine areas are good experimental sites to test the capacity of agriculture to change its relationships with society and nature and to meet the challenge of sustainability.

1.2.3 Sustainability, the concept and it characteristics

The debate as to the meaning of the term sustainability remains open. Sustainability is a rich and complex concept in the field of natural resources, social fabric and economic development. The complexity is daunting and often results in the perspective that sustainability is not a useful concept, but just a temporary keyword. Just a vague concept pertaining to maintaining natural resources. On the other hand, the sustainability concept is sometimes considered a major controversial principle offering “the possibility to link debate on social equity with ecological debates” (Becker & al. (1997)).

Historically, the concept of sustainable development was defined in 1987 by the Brundtland-Commission as a means to "meet the needs of the present generation without compromising the ability of future generations to meet their own needs" (Brundtland (1987)). At the 1992 Earth Summit in Rio de Janeiro, Brazil, the world’s largest gathering of national leaders recognised this principle and endorsed Agenda 21, the global blueprint for action on environmental and development issues. The thirteenth chapter of this document, entitled "Managing Fragile Ecosystems: Sustainable Mountain Development" concerned mountain regions and developed the Mountain Agenda (UNCED (1992)).

Following these general principles, many political documents have been drafted to specify and to implement the basic concept of sustainable development. Agricultural sustainability was first envisioned as a system of principles needed to reduce the impact of agricultural activities on ecosystems and to maintain resources (nutrients, soil structure, biodiversity, etc.) for the future. However this set of "best-management practices" may be insufficient to sustain agriculture. Agriculture is an interconnected component of the larger human and natural ecosystem. In addition to food production, farms influence the quality of water, create biodiversity, produce the working landscape that attracts tourists and provides quality of life for local people, provide the livelihood of farmers who contribute to forging the identity of local communities. Thus, agriculture exists in a complex bio/social/cultural/environmental system which suggests that sustainability may need to be framed within this larger context. Sustainability as a biological concept should be expanded to an ecological-economic and socio-cultural concept (Fischler (1999)). Consequently, *sustainable agriculture* must be technically feasible (benign for ecosystems, adequately productive), its outputs (food products, ecological services, socio-cultural functionality) must be economically rewarded and the lifestyle socially desirable. Technical evolution might be associated with not only another way of using resources, but also with other interactions with society, and finally a different type of job for farmers.

These concepts constitute the framework of the project, but a workable, "scientifically tested" definition is not still available. To be more concrete, Bonny (1994) suggests that changing the current agricultural system first requires answers to a set of questions, namely, what is not sustainable, what are the needs, what aspects of the current systems must be maintained and how, and what new components and processes must be introduced. Concerning this last point, it is deemed important to evaluate the capacity of local forces to organise themselves in view of carrying out such changes.

Concerning the Alps, the Alpine Convention, the international "agreement on the protection of the Alps" co-signed in 1991 by the European Commission and different countries of the Alps, is of major importance. Despite this general agreement, the negotiations regarding the implementation protocols on subjects such as transport, tourism and mountain agriculture, revealed differences of opinion on the development of the Alps. This, as well as other mechanisms concerning sustainable development, shows the difficulty of specifying and implementing the concept.

Two main difficulties concerning the successful implementation of the concept of sustainable development may be mentioned (Meppem & Gill (1998), Brodhag (1999)):

- the negotiation and definition of common objectives between different actors, planners and policy-makers who may have divergent interests and priorities concerning the balance between the economic, socio-cultural and ecological components of sustainability;

- the implementation itself. Which policies, mechanisms and practices are likely to introduce change in the direction of improved sustainability?

After ten years of debate on sustainability, it is now clear that this concept, though acknowledged, will never be a recipe. It is more a direction, a balancing of a variety of goals, in which no one objective can be pursued alone, i.e. it is a "moving target" (Schleicher-Tappeser & Strati (1999)) because society is always changing. In line with this point of view, Keeney (1990) suggests that the definition of sustainable agriculture will ultimately come from the farm level where research and action programs demonstrate the consistency of sustainable practices. We assume that this can be extrapolated for local-development projects involving farmers and local society. The conceptual definition of sustainability will come from the analysis of local projects bringing together all the various actors and entities involved.

2 MATERIAL AND METHODS

2.1 A framework for evaluating dimensions of sustainability

The investigations concerning the definition and models of sustainable agricultural land use in Alpine regions must be formally organised in order to compare and share the diversity of viewpoints, according to the local scale, the regional areas, without loosing the overall coherence. This is why we adopted an **integrated framework** to organise our investigations (Figure 1). The need for an integrated framework for interdisciplinary analysis is emphasised in numerous scientific papers (e.g. Hyman and Werntedt (1994)). A conceptual model of the real world helps to organise collaboration between scientists from different fields. Sharing a common model is also a way to limit the variations of prospective-analysis and vocabulary among individuals and groups involved in a project.

The framework adopted is based on the representation of levels of reality. It shows the links between local development, man and the environment, and the global dynamics between political and economic change. This model can be subdivided in three interacting subsystems.

Subsystem 1 representing the system of interactive social and cultural **values** which are the references for action and the evaluation of conditions (human rights, the principles of democracy, sustainability, social equity, protection of nature, etc.). This system is made up of ideas, concepts and "ideologies" and research is in the field of political philosophy. These different values are in interaction and change over time.

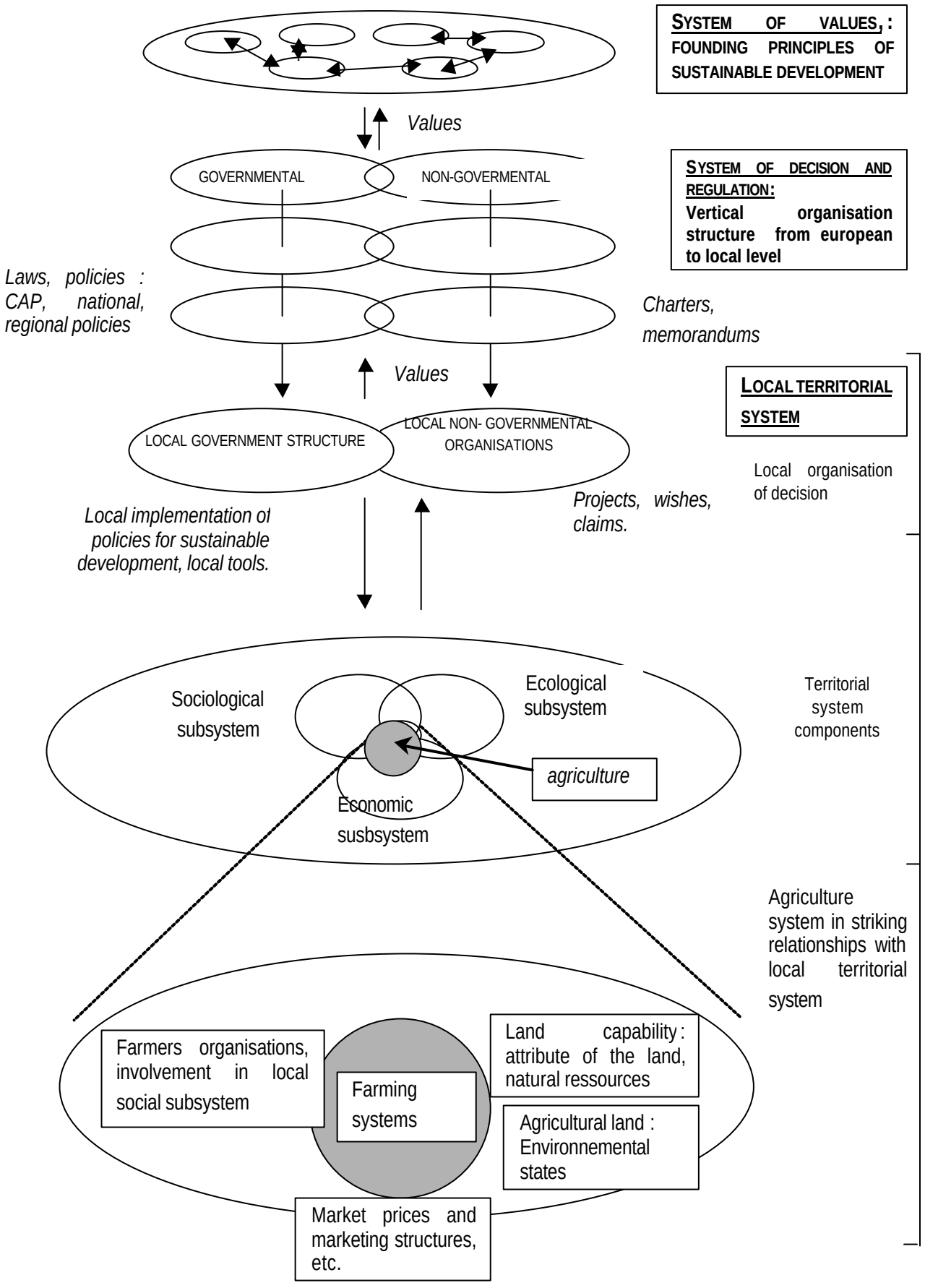
Subsystem 2 representing the system of **decision and regulation**, resulting from the interaction of governmental and non-governmental organisations and institutions. This system is vertically organised from the European to national, regional and local levels. It aims at producing socio-economic rules and means (laws, policies) and guidelines (charters, memorandums, etc.) to regulate action. The behaviour of this system depends on the preceding system of values, which orients, refines, modifies or adjusts institutional behaviour (even if this view is oversimplified, it makes it possible to take into account the diversity of cultures and social contexts). This system falls into the fields of sociology and economy.

Subsystem 3 representing the system of **action** on the local scale, seen as a territorial system including human activities and the biophysical environment. At this level, our point of view is focused on agriculture and agricultural land use, and their relationships with the other components of the territorial system. Consequently, the landscape system is seen as a cluster of interacting ecosystems with flows of matter, energy and information between compartments and activities. This system falls into the field of landscape ecology, agronomy and economy.

On the local level, the general socio-economic system constitutes a **pressure** translated by market prices, environmental constraints and subsidies. The local system reacts to these pressures by changing practices applied to the landscape, particularly agricultural practices, and by changing the social and economic position of agriculture within local society due to the interaction between agricultural land use and quality of life for the whole of society. These changes may have an impact on the state of the environment, on the social fabric and on mental representations, and finally determine **a societal response** of the local system. This response is a bottom-up feedback, it includes local development projects, claims and diverse action, organised in order to modify the general system of values and the institutional rules.

From a system-analysis perspective, we may say that sustainability means adjusting the feedback between the three subsystems identified in this framework. We assume that the local level is a main issue for implementation of sustainability, a "connection" level between global values and institutional regulations on one hand, and the desires, projects and actions of local actors on the other. To achieve this objective, we assume that innovative cooperation and partnerships must be found on the local level. Therefore, the formulation of local projects oriented toward a sustainable form of agriculture constitutes the central object of the research.

Figure 1: from the principles of sustainable development to their implementation at local level



2.2 Methods employed

2.2.1 Work hypothesis

In line with the conceptual model developed in Figure 1, the Sagri-Alp programme is based on four work hypotheses.

1. The implementation of sustainable development on the local level requires **a territorial-system approach**. The concept of Local Territorial Systems, including the biophysical environment, human activities and their social regulation, can constitute an efficient framework to share information on the local and Alpine levels.
2. Progress towards sustainability requires a **bottom-up approach** to meet the objectives formulated by institutions, with an evaluation of the Local Territorial System. Therefore, specific indicators are necessary to assess limits and define margins of progress toward sustainability. The role of research is to define a set of indicators adapted to local Alpine situations.
3. Sustainability is a **global concern** and cannot be improved by a sectorial approach (the agricultural system especially, because its specific land use, is in striking interaction with the other components of the territorial system). Therefore, improving sustainability on the local level means collective changes in behaviour by all involved and requires a common view of the long term evolution of the territory. To achieve this, we assume that new ways of sharing information and making decisions must be implemented on the local level, by bringing together local government structures with local economic and social organisations and representatives of involved parties. To help local people in this evolution, research can propose methods to facilitate local coordination, prospective reflection and scenario analysis.
4. These types of approaches on the local territorial level, when applied to different Alpine situations, make possible **comparative analysis and results on the Alpine scale**, and a synthesis in terms of guidelines for sustainable development and policy recommendations.

2.2.2 Organisation of the project in tasks

Following these work hypotheses, the Sagri-Alp project is planned in five tasks and figure 2 presents their contributions to the conceptual model:

Task 1: Definition of sustainable agriculture on basis of legal and political documents. Using the international and national relevant documents, a general model for sustainable land use has been elaborated. This general model represents the political framework and will be a basis for a global evaluation of sustainability in different selected research areas in the Alps of the different member states (Austria, France, Germany, Italy), and in Switzerland.

Task 2: Selection and assessment of Alpine research areas. To improve this first framework of sustainable land use and adapt it to different contexts of the Alps, case studies in five selected research areas (one per country) have been carried out. An assessment of the situation of the rural development and of environmental problems has been realised on each research area, within their economic, social and policy context.

Task 3: Definition of criteria of sustainable land use from the point of view of scientists and local people. These case studies constitute the data base for a comparative analysis between the research areas, to create a list of regionally adapted sustainability criteria from the point of view of scientists. On the other hand, local people and regional decision makers involved in rural development have been mobilised in each research area. By means of the " future workshop " method, their wishes and objectives for sustainable land use have been listed and their own sustainability criteria collected.

Task 4: Scenario analysis and evaluation. The scientific and the local people criteria have been further developed by the means of scenarios to evaluate their concrete expectable economic and ecological effects.

Consequently, potentials of development of sustainable land use in rural areas have been investigated. Different strategies to implement sustainable land use have been examined.

Task 5: Synthesis: guidelines for sustainable land use and recommendations for EU policies. The synthesis of the results includes learning on the way the local people draw scenarios about sustainable land use, regional guidelines for a sustainable agricultural development; method to evaluate potentials of development of sustainable land use and final recommendations for EU policies.

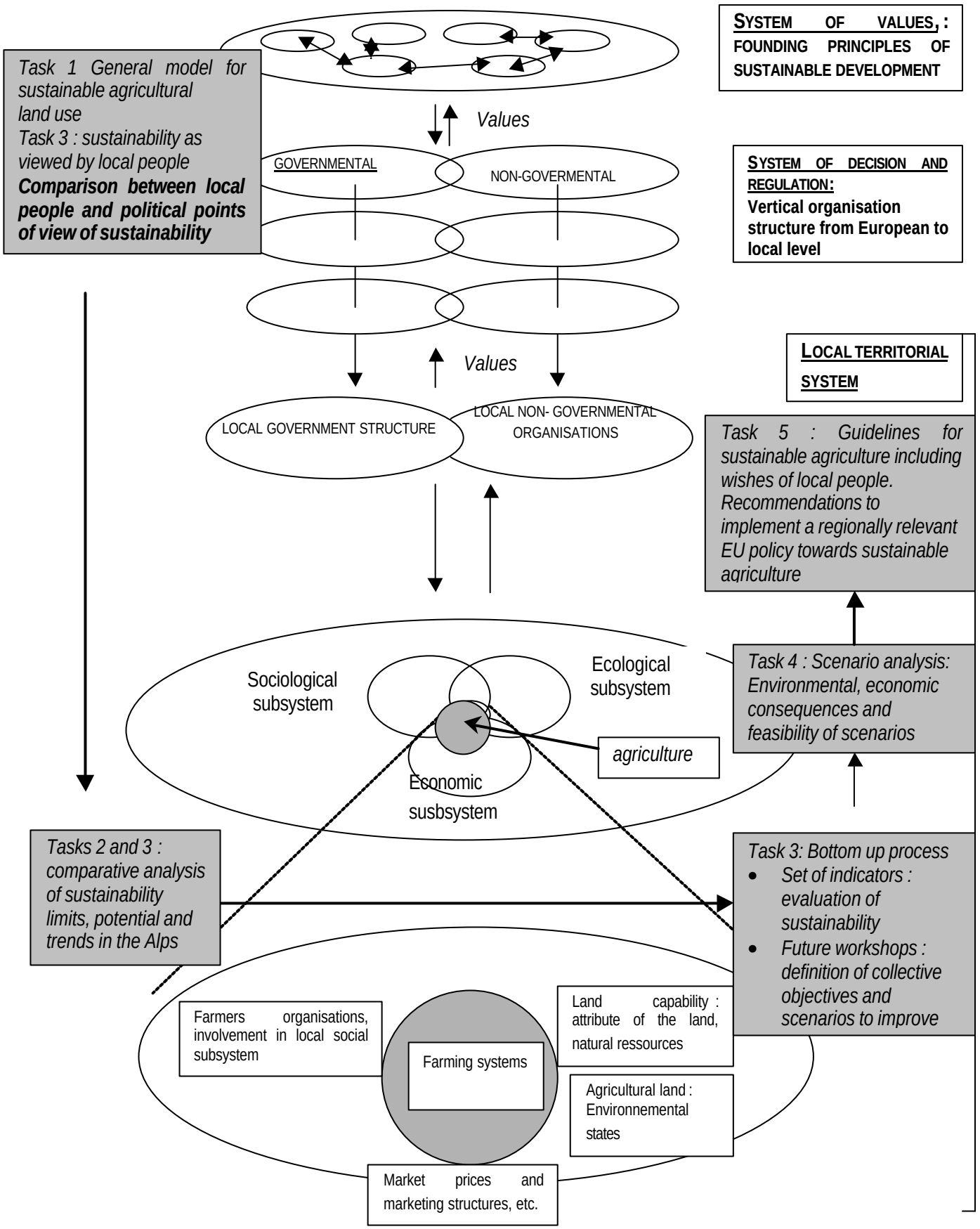
2.2.3 Methodologies applied

We used different methodologies:

1. **To take into account and involve both scientists and local people**. In each research area a team of local actors is established and involved in the project during the whole period. By means of the « future workshop » method, the wishes and objectives of local people for sustainable land use are determined and their own sustainability points of view are understood.
2. **To analyse the relationships between environmental states, agriculture and other activities, policy measures and aspirations of the local population**. A system approach in an interdisciplinary research including ecology, geography, agronomy and economy is developed.
3. **To imagine and to evaluate scenarios to improve sustainability** we combine quantitative assessment (Linear programming) with qualitative approach (assessment of social component of sustainability thanks to the formulation of scenarios by the local team).
4. **To take into account global and local size of sustainability** we combine different levels of investigations: the classification of sustainable agricultural land use objectives is established both at European, national, regional levels (using international and national documents) and at local level (case studies).
5. **To produce scientific results and also practical tools** and diagnosis for the farmers, the agricultural services and the decision-makers in rural development the project involves public and private teams oriented towards research/development activities.

The innovative aspect of SAGRI-ALP is to combine these different methodologies into a consistent approach and not to use one after the other, separately.

Figure 2: from the principles of sustainable development to their implementation at local level : contributions of the Sagri-Alp project



2.3 Presentation and representativeness of the five research areas

To carry out a comparative analysis of sustainability of Alpine agriculture from the point of view of scientist and local people we have chosen 5 areas (Figure 3):

- Moyenne-Tarentaise (France);
- Bassa Valle di Sole (Italy);
- Oberes Drautal (Austria);
- Ostallgäu (Germany);
- Glarner Hinterland (Switzerland).

To ensure good possibilities for a comparative analysis we have taken into account three parameters which are comparable between research areas:

- " Alpine " characteristics of the territories (gradient of altitude, share between agricultural area) ;
- rural or semi-rural regions according to regional typology of Bätzing (1993) ;
- territories with customs of common works and projects between communities ;
- relative homogeneity of extension of the area, total population and number of farms.

According to other factors taken into account to handle the diversity of the Alps (see below) we have in our different research areas similarities of scales, the necessary condition to produce a comparison.

Figure 3 : Selected research areas of the SAGRI-ALP project

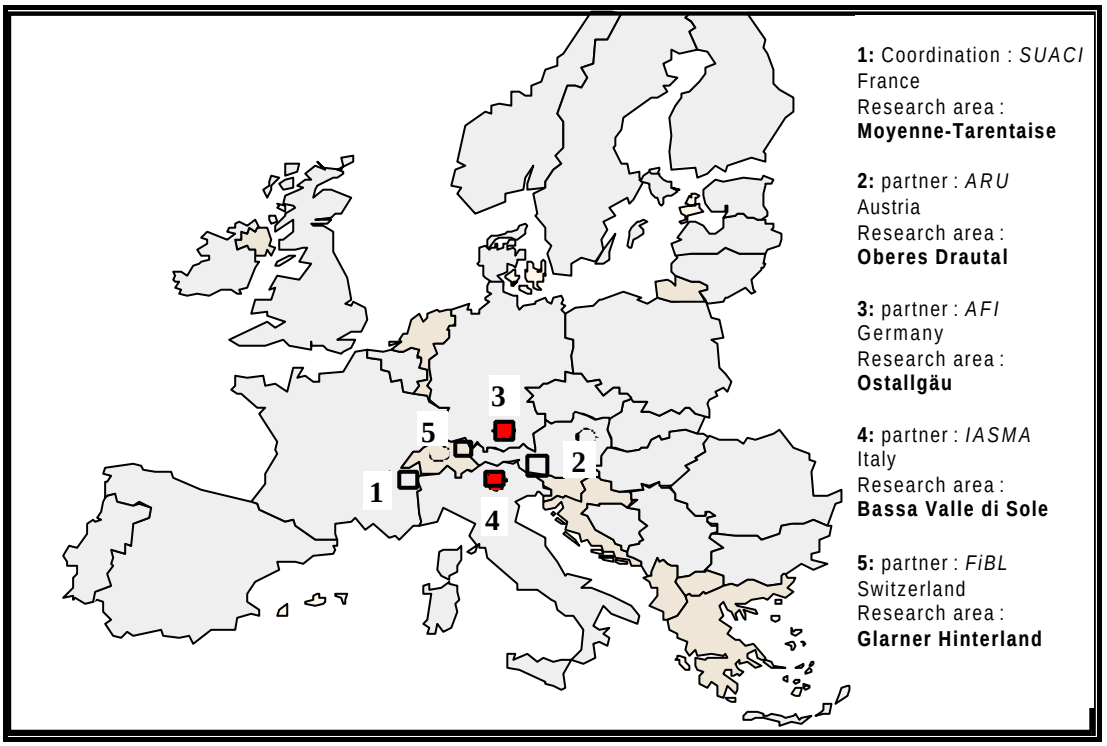


Table 2 : Presentation and representativeness of the five research areas

Country	France	Italy	Austria	Germany	Switzerland
Name of the selected research area	Moyenne-Tarentaise	Bassa Valle di Sole	Oberes Drautal	Ostallgäu	Glarner Hinterland
Extension in ha	87 400	20 177	54 419	30 733	43 010
Height above sea level	400-3800 m	541-3443	600-2200	812-2082	500-3600
Geographic sector	Western Alps	Eastern Alps	Eastern Alps	Eastern Alps	Western Alps (border with Eastern Alps)
Bätzing type	Non-centre dominated region with agrarian character	Non-centre dominated region with agrarian character	Non-centre dominated region with agrarian character	Semi-rural	Non-centre dominated region with industrial character
Total Population (tendency in the last ten years)	24 150 (increase)	6 533 (stability)	12 230 (decrease)	27 050 (increase)	11 394 (increase)
Total working farm population (% in total working population)	8	12	9,4	4,3	8,7
Total utilized agricultural area (ha) (percentage in total area)	20 000 (22%)	6 176 (31%)	19 604 (36%)	8 254 (27%)	13 738 (32%)
Total number of farms (area more than 1ha)	253	278	998	368	250
Number of full time farms (%)	74	48	20	54	68
Community measures applied on the RA	Rural development policies (objective 5a);	Reg. 2078/92 4 municipalities in 5b objective, directive habitat partly in the area	Reg. 2078/92 Whole area in 5b objective	Reg. 2078/92	None

2.3.1. Abiotic and biotic preconditions

Our five research areas take into account the physical and geographical diversity of the European Alps with the exception of the south-western Alps and the southern foothills (Table 2) (just a part of the Austrian research area covers the southern calcareous Alps). However, this choice is rational because the southern part of the Alps is subjected to Mediterranean or Adriatic influences. This has important consequences on the suitability of land for agriculture, on farm systems and more generally on the situation in rural areas. It was not possible to introduce such a variety of factors in a five-area sample. The risk of rendering comparative analysis impossible would have been to high.

2.3.2. Socio-economic conditions

In accordance with Bätzing's typology(1993), the different partners have chosen a "non centre-dominated region with agrarian character" or semi-rural regions. The regions dominated by an urban centre were excluded. The diversity of regions is high with rural and semi-rural regions and with the different demographic tendencies of the Alps, namely, stability, increasing and decreasing population. Three of the five research areas are increasing in population according to a general trend in the western and eastern parts of the Alps.
Two major types of region appear:

1. Regions with significant local development, e.g. the Moyenne Tarentaise valley with tourism, the Glarner Hinterland with industry and the Ostallgäu with tourism and recent local development of industry;
2. Regions with more economic difficulties in spite of local activities, e.g. the Bassa Valle di Sole and the Oberes Drautal where the percentage of agricultural activity is higher in the economy and in the population.

The research areas are representative of the internal diversity of rural and semi-rural regions in the northern Alps while taking into account different economic orientations (industry, tourism, or a continuation of agriculture) and different levels of development which is generally high.

2.3.3. Agriculture

The general situation for agriculture in the Alps is marked by a number of common characteristics:

- the percentage of part-time farming is relatively high in all regions, in conjunction with tourism or industry (in comparison with the weak number of AWU (Average Working Unit) per farm);
- the size of the farms is generally small (average surface area less than 28 ha per farm);
- the percentage of permanent grasslands and pastures is very high (greater than 90%) and livestock farming is the dominant type of agriculture in the different research areas;
- a general decrease of the number of farms except in Austria where the decline is very slight.

Depending on the research area, we note different types of production related to Alpine diversity:

- in a first group, comprising the Moyenne Tarentaise, Glarner Hinterland-Sernftal and Ostallgäu, dairy farms followed by other grazing livestock farms represent virtually all farms in the research area;
- the second group, Oberes Drautal and Bassa Valle di Sole, have farms with specific products, e.g. forestry farms in Austria and fruit farms in Italy.

Attempts to identify new sources of income are a general characteristic of the research areas. In the Moyenne Tarentaise valley, quality products (PDO cheese) have been developed, in Bassa Valle di Sole, the local cooperatives are integrating this type of approach, in Oberes Drautal, more and more farms are resorting to direct sales due to tourism; and in Ostallgäu, an increase in part-time farming and a desire to diversify production can be interpreted in this sense. Only in Glarner Hinterland-Sernftal have these initiatives been less developed up to now. This point is related to a general first impression of low adaptability to modifications in the political and economic context (in Glarner Hinterland-Sernftal as well with the current reform of agricultural policy).

2.3.4. Policies applied

Agri-environmental measures exist in each research area with Regulation 2078/92, specific agricultural policy in Switzerland (AP 2002) or specific local measures. The main common type of action targeted by these measures includes extensification of production and maintained use of pastures.

An important difference concerns the European zoning. Bassa Valle di Sole in part and Oberes Drautal as a whole lie in 5b zones. Development policy based on 5b measure attempts to help tourism, agriculture and forestry, as well as local industries.
Switzerland stands out for its specific policy where the relative importance of direct payments is increasingly high, including a significant percentage of ecological direct payments.

2.3.4. Environmental conditions and problems

The five research areas include zones of high environmental quality (biodiversity, landscape and water supply), as is made clear with the number of protected areas. Agriculture is often responsible of this high environmental value. Many rare species, biotopes with national and European value, landscapes, etc. depend on specific agricultural practices such as mowing, grazing, the level of fertilisation, maintenance practices concerning hedges, the edges of forests, etc.

2.3.5. Local teams and motivation of actors for the project

The diversity of people and entities involved in the local teams of the different areas is high and includes farmers, administrations, nature-protection associations, hunting associations, tourism and commerce organisations, mayors or members of communities, etc. This diversity takes into account all actors and entities concerned by sustainable development in agriculture. The involvement in a local team is a voluntary act, i.e. the diversity of the involved entities shows that agriculture and land use concern not only farmers, but also a wide range of other actors.

In the five research areas, local people showed their interest in sustainability and the SAGRI-ALP project. In several research areas, different members of the local teams, especially the farmers, expressed their fears concerning the research projects and the SAGRI-ALP programme, namely that no concrete action would follow the research work. But following long debate, they agreed that a "demonstration project" offering the possibility of putting into practice the results of their scenarios concerning sustainable agricultural land use was a very interesting and motivating opportunity to seize. Furthermore, they also hoped to gain realistic ideas on drawing up positive future scenarios. The above explains the wide and active support for the project by representatives of farmers in the different research areas.

2.3.6. Conclusion

In our sample, the five research areas would appear to be highly compatible. There is also a high degree of complementarity between research areas, taking into account the diversity of the situations in the European Alps, namely the abiotic and biotic conditions (except the south-western and dry Alps), socio-economic characteristics (population fluctuation, main economic activities), types of agriculture (main production, land use, trends), environmental problems (land abandonment, water quality, biodiversity, etc), European policies (areas in and out of 5b zones, subject to European regulation 2078/92 or not).
The major expectations of local people concerning the project depended on the research areas and ranged from better understanding of the current position of farmers in the local society to analysis of the region, comparison and exchanges with other Alpine regions, work in view of improving the situation of agriculture and possible synergetic effects with ongoing local efforts.

3 - KEY FINDINGS ON LIMITS, CAPACITIES AND REQUIREMENTS FOR SUSTAINABLE LAND USE IN THE ALPS

3.1 Different meanings and convergent understanding of sustainable agriculture in the Alps

Sustainable development has become a central element in a number of public policies, particularly for agriculture and rural development. Since the beginning of the 1990s, sustainability has gradually become the touchstone of policies and programs on all levels, European, national, regional and local (UNCED (1992), EC (1993), IUCN, FAO, ICALPE (1996)). Compared to the initial concept, which focussed almost entirely on environmental concerns, the current concept has become more complex and open to a wider array of interpretations. On the basis of an analysis of texts (Task 1: Definition of sustainable agriculture on basis of legal and political documents) and debates between actors (Task 3: Definition of criteria of sustainable land use from the point of view of scientists and local people), we have identified different meanings concerning sustainable agriculture.

3.1.1 Objectives for sustainable agricultural land use for the Alps in political and administrative documents

A systematic examination of relevant national and international documents was carried out. We combined different levels of investigation, namely European, national and regional (not below the NUTS 2 level: regioni (I), régions + Dom (F), Regierungsbezirke (G), Bundesländer (A)). A total of 105 documents dating from 1990 or later, including laws, decrees, resolutions, declarations, treaties, agreements, trend reports and NGO papers, were analysed. In each document, objectives referring to sustainable agriculture were extracted. The decision to choose a document and extract an objective was based on the Bruntland definition of sustainability (Brundtland (1987)). This study identified 624 separate objectives in a general model for sustainable land use in Alpine regions organised in different fields, including the ecological, economic and social as well as rural development objectives; and on different levels, corresponding to technical terms of the ISO 14 000 standard, namely very general objectives or visions (promotion of balanced and sustainable economic and social progress), policy commitments (conservation of natural resources) and specific objectives (minimising water use). The objectives have been sorted in a table, which as a whole can be described **as a general model of sustainable Alpine agriculture (table 3).** Table 3 shows the variety of detailed objectives according to the political level (European, national, regional, and NGO's). Differences between countries indicate different priorities regarding sustainable agriculture as well as its ecological, economic, social and political components. Despite this diversity there is a common agreement and a common guideline of general objectives in order to achieve a sustainable agriculture in Alpine regions which could be sum up as follow:

Now, implementation of sustainable agriculture is clearly related to integrated rural development and local diversity. Comparing ten years of documents on sustainability reveals some changes in the objectives and priorities. Specific objectives (ecological, economic or social) have given way to a global approach to sustainable agriculture. Recent documents focus on the links between ecological, economic and social objectives. It shows that sustainable agriculture tends to be approached as a system and not as a sum of subjects. The aim is not to optimise one single objective (as in the recent past, the ecological objectives of NGO's for environmental protection or the economic objectives of farmers' organisations), but to examine all the objectives and the interaction between objectives. Moreover, "sustainable" farming systems are often perceived as a double production system for both market (agricultural products) and non-market goods (biodiversity, soil and water protection, landscape, etc.). The major costs connected with such positive non-market products must be recognised in some way by the society and paid back to farmers.

Table 3: General model for sustainable Alpine agriculture drawn from political and administration documents, summary of the objectives

GENERAL OBJECTIVES:

European framework for development with high social and political consent

- Promotion of human health as a basic individual and social right.
- Promotion of balanced and sustainable economic and social progress.
- Reduction of the differences concerning the stage of development of the different regions and backward areas.
- Maintenance of sustainable rural agriculture.
- Taking into account special conditions in mountain areas (major natural hazards, compensation for natural and ecological constraints, etc.).

Specification of the European framework with a generally high degree of agreement

Development, market and employment

- Promotion of a high level of employment and a high level of social protection, equal status for men and women, constant non-inflationary growth.
- Development and pursuit of a policy to strengthen economic and social solidarity.

Rural development

- Promotion of a form of development maintaining sustainable quality and attractiveness of rural regions for future generations and providing the essential basis for supplementary economic activity.

Mountains and the Alps

- Development and improvement of the necessary knowledge concerning the ecology and sustainable development of mountain ecosystems.
- Permanent balance between the needs of agriculture and requirements in terms of natural conservation in the public interest.

OBJECTIVES RELATED TO RURAL DEVELOPEMENT AND INTEGRATION OF AGRICULTURE: Creation and implementation of integrated rural development programs (policy commitment)

Specific issues

- Distribution of competencies between levels (European, national, regional, community) according to the principle of subsidiarity by strengthening national and regional responsibilities for agrarian policy, recognition and implementation of specific measures for mountains, development of plans for mountain agriculture including local specificities and problems.
- Implementation of a multifunctional agriculture, which must be sustainable, environmentally friendly, competitive and with economic importance for other activities such as tourism.
- Adaptation of agriculture to the local situation of development through implementation of cooperative structures (farmer cooperatives, marketing organisations) and relationships between agriculture and other activities (tourism, contractors and the development of local eco-business).

ECOLOGICAL OBJECTIVES: Protection, conservation of the natural environment and natural resources (policy commitment)

Specific issues

- Detailed protection goals including water, soil, biological diversity (species, biotopes, genetic, etc.), forests, natural and cultural landscapes, grasslands.
- Reduction of negative environmental effects of agriculture and promotion of environmentally friendly practices, namely a decrease in inputs (nitrogen, pesticides, etc.), extensification, maintenance of hedges, slope cultivation, use of renewable resources, expansion of ecological areas, etc.
- Maintenance of mountain agriculture for environmental reasons or for rural-planning reasons and adaptation of agriculture in line with sustainability, taking into account of local situation.
- Promotion of organic farming.
- Increasing public awareness and education of farmers about environmental concerns.

ECONOMIC OBJECTIVES: Improvement of agricultural income, maintenance of the farming systems and employment (policy commitment)

Specific issues

- Maintenance of and incentives for productive functions.
- Promotion of diversification of agriculture income, including various crafts, agro-tourism, processing of local products, etc.
- Fulfilment of quality demands, namely security, high environmental standards, mountain products.
- Support for entry into the farming trade and the creation of jobs.
- Promotion and remuneration of the services carried out by farmers in the public interest, including cultivation of landscapes, maintenance of natural areas, biomass-production, conservation of local livestock breeds, maintenance of non-polluting agriculture in sensitive mountain regions, etc.
- Support for agriculture by funding and relevant policies, including co-financing of poor regions, mobilisation of local funds, financial compensation of natural disadvantages in mountain regions, distribution of direct payments to guarantee both ecological services and agricultural income, etc.
- Management and improvement of market organisations on different levels, regional, national, European and global.
- Regulation of price mechanisms through the creation of flexible market structures suited to the European context, creation of new marketing structures to increase the added value of regional agriculture, strengthening of competitiveness, etc.

SOCIAL OBJECTIVES: Improvement of living conditions and of social, economic and cultural vitality for rural areas (policy commitment)

Specific issues

- Maintenance of social solidarity between regions and different population categories (farmers, young people).
- Reduction in the disparity in income and in legal responsibility between groups of population and areas (rural, urban, rich and poor areas, women).
- Management of the demographic balance between urban and rural areas and reduction of depopulation in mountain areas through the extension of rural infrastructure, maintenance or improvement of public services(education, regional and technical training, research, etc.).
- Increasing awareness and social recognition on the part of society for mountain, rural and agricultural problems and functions through public information, integration of mountain and rural problems in the educational system, including the environment, regional traditions, culture and language.
- Promotion of the principle of participation by involving the population and the farmers in processes concerning implementation of sustainable development and agriculture.
- Recognition of agricultural practices and of agriculture as cultural and social values by ensuring that the identity and social life of the rural world, as well as cultural and aesthetic aspects are taken into account by politicians and regional development planners.

3.1.2 Sustainable agriculture as viewed by local actors

At local level, in each area, the discussions of the local groups allow us an analysis of the points of view of local actors. These groups of people are numbering about 15 to 20 and include persons involved in rural development (farmers, mayors of communities, members of environmental-protection NGOs, tourism, etc.). By means of the "future workshop" method, their wishes and objectives for sustainable agriculture were expressed and discussed. The future workshop method is a prospective-analysis technique for groups which requires the creative involvement of all participants. In addition to these local groups which drew up a project for sustainable agriculture, interviews were carried out on a larger sampling of people.

In the Alps, concerning sustainable agriculture for farmers and for community leaders, we identified three major perceptions:

1 – **Economic factors are the primary concern**, the maintaining of farms requires sufficient income. Today the major threat is that agricultural income in mountain remains lower than agricultural income in low-lying and plains regions for economic and workload reasons. Present-day farmers feel more and more like producers of goods and business managers. Such an attitude is common among young farmers, who clearly separate meadows with high agronomic value for agricultural production from poor, difficult fields which could be maintained for landscape reasons with financial support from society.

2 – **The quality of rural life is the secondary factor of concern**. The social impact of farmers is now low and still declining. Farmers have some difficulties in finding a new social position which could be a problem in founding a family and in taking part in the decisions of the community. The frequent work overload on farms is also a major concern. Such an attitude is common both among farmers and representatives of communities.

3 – **The environmental topic is rarely mentioned by farmers** (except positive landscape impacts of agriculture or locally some problems referring to water quality). We can summarise a common point of view of farmers concerning the relationship between agriculture and the environment in the following sentence. "The landscape and the rural area are the result of our work, environmental quality depends on agriculture, so the balance between the negative and positive impacts of agriculture is always largely positive". Such an attitude, common in the different Alpine countries, is more pronounced in regions with Latin culture than in regions with German culture, where from an historic point of view "wild nature" is more important. However, for NGOs involved in environmental protection, the reduction of negative environmental effects by agriculture and the promotion of environmentally friendly practices are important.

Briefly, we find two reference models concerning sustainable agriculture:

1 - Sustainable agriculture equals traditional agriculture. Maintaining traditional practices and agriculture is a guarantee for the environment and the key element for rural development.

2 - Sustainable agriculture equals new and up-to-date agriculture. To define and manage the multifunctional dimensions of agriculture and of agricultural land , there is a need to define a new project with society and to manage it in the new context where countryside is no longer chiefly dependent on farming activity.

Whatever the definition, three major limits for the implementation of sustainable agriculture are stressed by the rural world:

1 - On the agricultural level, external factors, more than territorial aspects, exert considerable pressure on production management, namely world trade and prices, industrial and marketing strategies, consumer demands, sanitary standards, etc. Because of the consequences on their income, such topics are the major concern for farmers. National and European policies are interpreted as being increasingly focused on liberalisation of markets and exports, resulting in

price decreases and the increased size of farms, and are also often mentioned as a limitation for sustainable agriculture.

2 – On the rural-development level, some communities are not able to take into account medium- and long-term considerations for sustainable development. The short term is considered so difficult that it is the single priority.

3 – The lack of consistency between objectives of political tools targeting sustainable agriculture and their administrative implementation:

- **time perspective of subsidies: in general to short according to the context of long-term planning of farm activities and investments;**
- **current increase of the administrational constraints to obtain subsidies ;**

In conclusion, in the Alps, farmers and community representatives stress more economic and social objectives as components of sustainability than environmental representatives and scientists. In fact, we did not observe a lack of sensitivity toward nature on the part of farmers and community representatives, but rather differences in perception between them and environmental representatives and scientists. The first are more concerned with cultural landscapes and their evolution (land abandonment) and the second are more aware of the flora and fauna, pollution risks or energy balances prevalent in international debates on global issues of sustainability. However, we observe strong motivation on the part of all local actors in the Alps to design projects that take into account all three dimensions of sustainability. In such groups, the actors are led to develop a new perception of what it means to be a farmer and to include the long term in their rural-development projects. That is very different than a simple integration of more environmentally friendly practices.

3.1.3 Convergent understanding in order to achieve a sustainable agricultural development in the Alps

Despite this diversity and differences in the balance between the different components of sustainability, there is some convergent understanding concerning sustainable agriculture and rural development in the Alps. It should be noted that the objectives for sustainable agricultural land use in the Alps concern four main points:

- **The first point is the management of the relationship between agriculture and the environment**. Most of the actors, not only on the political and administrative levels, but also the farmers themselves are aware of the relationship between agriculture practices and the environment. Because agriculture is considered to have both negative (excessive intensification) and positive (landscape and biotopes maintenance) impacts, objectives do not concern only the protection of natural resources and limiting negative environmental effects. There is a will to maintain agriculture to cultivate the landscape and to limit abandonment of land. Nevertheless, a "nostalgic perception" can sometimes be observed. Many people have the impression that they have always produced in an environmentally friendly manner and that the current debate ignores that fact.
- **The second point deals with the protection of farmers' income**. Concerning this point, the political documents focus on promoting quality products as well as diversification. For local actors and farmers, production should be the main source of income in the future, completed by non-agrarian income. Direct payments should be an additional factor, but not represent a too high percentage of the total.
- **The third point is related to the social component of sustainability**. Concerning agriculture, the documents stress that identity, cultural and aesthetic aspects have to be taken into consideration by politicians and regional development planners. Furthermore, agriculture and forestry must be recognised as a social and cultural factor in rural regions. For local people cultural and social functions of agriculture are of major importance: both for local people and political documents, farmers who offer multifunctional services and contribute to the social life of the rural world are a necessity

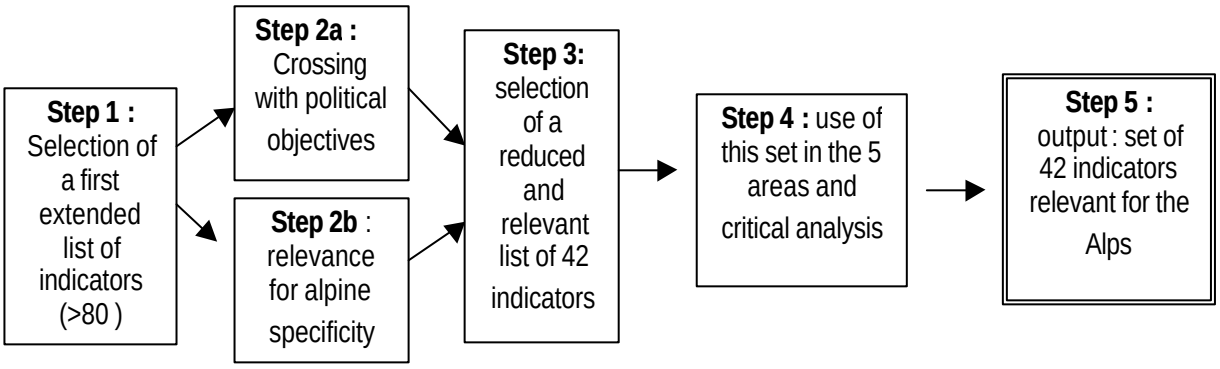
- **The fourth point is the clear relation between implementation of sustainable agriculture and integrated rural development stressed both by political texts and local people**. Clearly, implementation of sustainability requires concrete interpretations in specific contexts. One must take into account local diversity and define not only ideal objectives for each component of sustainability, but also rank required action according to priorities defined into integrated rural development projects.

3.2 A set of indicators to measure sustainability in Alpine agriculture

3.2.1 A continuous building process

The development of appropriate sustainability indicators is debated in many papers and meetings (UNCSD (1996), Rennings & Wiggering (1997), Baldock (1999)). **The role of indicators is to measure the level of sustainability and to monitor the evolution of agriculture.** They are essential in guiding policy implementation. Often, indicators are defined on the basis of a definition of sustainability produced by scientific literature. From our point of view, specific indicators and criteria make sense only in relation with development objectives which have to be set by actors and political decision-makers. To produce a relevant set of indicators, we used the approach presented below (Figure 4).

Figure 4. Formulation of a set of sustainable-agriculture indicators relevant for the Alps.



Step 1. Selection of a large initial list of indicators (> 80) mentioned in scientific literature. References include FAO Economic and Social Development Paper (1994), Linckh H. & al. (1996), Van Mansvelt & Van der Lubbe (1999), Neunteufel, M. (1997) and the list of indicators from the EC (1997) and the OECD (1991, 1995 and 1996) and from the UNITED NATIONS (1995).
Step 2a. Integration with political objectives. We created a matrix of sustainability objectives noted in legal and political documents with the different sustainability indicators selected in the bibliography. **The role of this matrix is to assess the relevance of the different indicators in measuring progress toward the different sustainability objectives**. This approach shows how great the difference between scientific concepts and political texts can be, especially concerning two points, namely, some political objectives such as multi-functionality of agricultural land and diversification of agriculture are not or are poorly covered by existing indicators, and secondly, for the environment, we find a disproportionately large variety of scientific indicators compared with those for other topics. Finally, objectives concerning "integrated rural development", dealing with multi-functional aspects of agriculture and complementarity between activities, are difficult to assess with existing indicators. For such topics, we have proposed new indicators, e.g. ENV 18: use of areas on slopes, ENV 19: forest management, ECON 7: agri-tourism activities, ECON 8: economic efficiency of agri-tourism activities, ECON 13: importance of farm products with quality standards.

Step 2b. Analysis of the relevance of the indicators in terms of Alpine specificity and diversity. This analysis was based on both the results of project task 2 (assessment of research areas) and the necessity of having easily obtainable indicators (data availability, simple field or farm measurements).
Step 3. Selection of a reduced and relevant list of 42 indicators based on the results of Step 2. Different changes have been made taking into account the results of the matrix and specific Alpine aspects:

- the elimination of indicators where the first list was too extensive;
- the elimination of indicators not relevant to the Alpine situation;
- the creation of new indicators where the first list was not sufficient or not relevant;
- specification of the required data and indicator-calculation methods, taking into account specific Alpine aspects.

Step 4. Use of this set of indicators in the five areas, followed by critical analysis. The values of each of the 42 indicators were calculated in each area with the help of data banks and farm surveys. The definition of sustainability limits was carried out during this step. The definition of limits is based on:

- the use of legislative limits, especially for ecological indicators;
- for most of the economic and social indicators and for some environmental indicators, no legal minimum or maximum limits exist. In these cases, limits were constructed in accordance with political guidelines issued by governmental or non-governmental organisations or in comparison with average values (e.g. comparison of farm income with average regional income).

Some limits are valid in all five research areas while others are adapted to a given regional situation. In each area, the method used to specify a limit is explained in detail. In order to compare the current situation of the indicators with the objectives of sustainability, a "traffic light" system is used:

- **the term "green" refers to sustainable performance;**
- **the term "orange" refers to a worrisome trend with respect to sustainability;**
- **the term "red" refers to unsustainable performance.**

Critical analysis of the use of this set of indicators in the 5 areas and a comparison of local viewpoints on sustainability have been carried out.

Step 5. The result is a set of relevant indicators for the Alps.
Table 4 shows the project results. It presents the complete set of indicators which is reusable for assessment of agricultural sustainability in other Alpine areas. (Detailed information on the calculation method for each indicator and the establishment of the regional limits is required to use this set of indicators. Contact the project coordinator).

We did not propose a hierarchy of indicators to avoid injecting our personal values and objectives concerning sustainability. Our goal was to produce a set of indicators capable of measuring progress toward different sustainability objectives defined by both political texts and local people.

To provide a synthetic view which is difficult with 42 indicators generating a mass of basic information, indicators are organised into 12 general groups describing sustainability of Alpine agriculture on the local level. The same traffic-light system is used for the limits. This synthetic view of sustainability could be used both during debates with local people and for synthetic reports. Depending on the topic, we used one indicator or a general evaluation is made using a number of indicators. This synthesis is built up as indicated below (the basic indicators are ranked in descending weight).

Environment:

Risk of water pollution by agricultural practices: ENV3: Nitrogen balance +ENV6: Fertilisation (whole farm except Alpine pastures) +ENV7: Farms capacity to adapt the manure spreading to the season +ENV8: Utilisation of polluting substances in the farm +ENV9: Utilisation of pollutants and fertilisers nearby surface and ground water +ENV11: Animal stocking rate

Contribution to global changes (air and climate): ENV13: Energy consumption + ENV8: Utilisation of polluting substances in the farm

Land abandonment and landscape maintenance: ENV18: Use of areas on slopes+ ENV15: Evolution of farm land at local level + ENV16: Evolution of land use by farm type +ENV17: Evolution of landscape structures

Relationships biodiversity/agricultural practices: ENV14: Species richness +ENV17: Evolution of landscape structures + ENV3: Nitrogen balance +ENV6: Fertilisation (whole farm except Alpine pastures) +ENV15: Evolution of farm land at local level + ENV16: Evolution of land use by farm type

Economy:

Agricultural income: ECON9: agricultural income (with subsidies and direct payments)

Persistency of farms: ECON1: Timelessness of farming activity + SOCIO5: Handing down of farms+

Trading structures and potential of local market: ECON12: Efficiency of trading structures+ ECON2: Potential trade capacity of the local market + ECON3: Local structures of the market

Diversification of farms and added value with quality standards: ECON13: Importance of the farm production with quality standards + ECON7: agri-tourism activities + ECON8: Economic efficiency of agri-tourism activities + ECON5: Evolution of agricultural mutli-activity + ECON6: Payment for public services

Social:

Working load: SOCIO 4: Working load

Collective organisation of farmers: SOCIO10: Collective organisation of farmers

Farmers' awareness about environmental concerns: SOCIO8: Awareness on ecological subjects and position towards environmental measures + SOCIO6: Educational level of farmers + SOCIO7: Participation to continuing education for farmers

Social recognition of farmers in local society: SOCIO3: Perception by farmers of their position in the local society+ SOCIO9: Participation of farmers in local political life

3.2.2 Presentation of the set of indicators (table 4)

Column1: acronym and name of the indicator. The acronym ENV, ECON, SOCIO refers to three study fields, respectively, environment, economy and social.

Column 2: application field of the indicator. This column shows the application field of each indicator with the objective of sustainability informed, and the indication given by the indicator.

Column 3: needed data. This column shows the needed data and the way of calculation of each indicator. More details in an internal report are available at the co-ordinator address.

Column 4: level of relevance. Some indicators are relevant at farm level and some other at research area level. Indicators calculated at farm level (for each farm type of an area) are after assessed at area level (on the basis of the diversity between farm types of the values of these indicators. According to the available data, for this an average between farm types or a weighted average by the frequency of each farm type has to be realised).

Column 5: reasoning of sustainability limits and Alpine limits. In this column we show the way of reasoning the sustainability limits chosen and their regional adaptation. Referring to the traffic light system already described, we have three kinds of limits:

- The red limit: over this limit, there are sustainability problems.
- The orange limit: over this limit, there are limited sustainability problems (worrying trend).
- The green limit: over this limit, there are no problem of sustainability.

The pertinence of a limit common to the whole Alps is variable according to the indicator. In the table we indicate if we have retained a common Alpine limit or if we established regional limits. It has often been able to define a common Alpine limit for the red zone, the green and orange zones being more frequently adapted to the regional context.

Column 6: Alpine relevance of the indicator. According to the results of the critical analysis of the use of the indicators in 5 areas we add a precision for the Alpine relevance of the indicators. Many indicators are to be associated with others for a complete information, specially social and economic indicators.

Table 4 : set of indicators of sustainability in alpine agriculture**.**

Indicators	Application field of the indicator : - Objective of sustainability informed - - Indication given	Needed data Cf. technical annexe for further details	Level of relevance	Reasoning of sustainability limits and alpine limits adopted	Alpine relevance of the indicator
ENV1 : actual erosion on arable land	-Objective : soils preservation from erosion. -Indication : erosion negative impact more or less strong on the yield potential of soils.	Soils and climate data for the calculation of the Wischmeier equation (t/ha/year) . Calculation made by an expert.	Farm (with arable land)	A legal limit does exist in Switzerland. No legal limit for other countries.	Weak : few surfaces concerned, Wischmeier equation not fitting the alpine topography.
ENV2 : micro-organisms, pesticides and other pollutants content in water.	-Objective : preservation of the water quality. -Indication : water quality level : amount of micro-organisms, pesticides, nitrogen, phosphorus.	Amount of micro-organisms, pesticides, nitrogen, phosphorus in the surface, ground and drinking waters. Information given by official institutes (mg/l, presence/absence)	Research area	National and European legal limits (quality standards for drinking water)	Strong: specially for micro-organisms
ENV3 : nitrogen balance	-Objective : inputs decrease and nitrogen cycle balance in the farm. -Indication : nutrients balance at farm level.	Nitrogen input and output (N unit /ha/year). Farm survey; standards of nitrogen amount in food and manure.	Farm (alpine pastures to distinguish from other parts of the farm)	Limits set on the base of existing references in Europe : nitrogen balance values by production type, farm type,…) Red alpine limit : >+50 et <-50 kg/ha/y of N	Strong
ENV4 : irrigation	-Objective : preservation of water resource from a quantitative point of view. -Indication : intensity of the farming flow for irrigation.	PET, available quantity of the resource, farming flow for irrigation. Estimation of the water used by irrigation (%). Calculation made by an expert.	Research area	No legal limit, to be adapted regionally regarding the climate	Weak, few areas concerned in the Alps
ENV5 : drainage	-Objective : improvement of the soil fertility, limitation of the artificial environment by agriculture. -Indication : importance of surfaces with water management by drainage.	Percentage of drainage areas for the whole usable agricultural area (%) Farm survey or agricultural data banks.	Farm	No legal limit, to be adapted regionally regarding the climate and the soils	Weak : few surfaces concerned, often ancient modifications of the nature
ENV6 : fertilisation	-Objective : preservation of natural resources : water and biodiversity. -Indication : potential risk of water pollution or biodiversity decrease due to over-fertilisation.	Quantities and types of fertilisers spread (Kg/ha/year of N,P,K) Farm survey.	Farm (alpine pastures to distinguish from other parts of the farm)	1 – red limit : legal limits 2 – orange and green limits : limits established due to knowledge about relationships between fertilisation and pollution risks of water, biodiversity, forage production Green alpine limit: <110 N, 52 P, 144 kg/ha/y (in pasture and grassland) Red alpine limit : >275N, 130P, 360 kg/ha/y(“)	Strong

Indicators	Application field of the indicator : - Objective of sustainability informed - - Indication given	Needed data Cf. technical annexe for further details	Level of relevance	Reasoning of sustainability limits and alpine limits adopted	Alpine relevance of the indicator
ENV7 : farms capacity to adapt the manure spreading to the season	-Objective : preservation of water resource towards manure spreading during risky periods. -Indication : possibilities to avoid manure spreading during risky periods.	Storage capacity / manure quantity produced in housed animal (months) Farm survey.?	Farm	Legal limits Green alpine limit : > 6 months storage Red alpine limit : <5months	Strong
ENV8 : utilisation of polluting substances in the farm	-Objective : preservation of the water resource, decrease of the pollution risk by agricultural inputs. -Indication : quantity of pollutants used by the farmer.	Utilisation of pesticides (kg/ha). Farm survey.	Farm	Limits set on the base of existing references	Middle
ENV9 : utilisation of pollutant s and fertilisers nearby surface and ground waters.	-Objective : preservation of the water resource, reduction of the pollution risk by agricultural inputs and manure. Indication : practices used to minimise the risks nearby ground and surface water catchments : distance for pollutants spreading, etc.	Distance of pollutants and pesticides spreading from the catchments and from the surface water (meters). Farm survey.	Farm	Legal limits Red alpine limit : <30m catchment); 10m (surface water without vegetation on banks), <5m (surface water with vegetation on banks)	Strong
ENV10 : adjustment of sprayer machines	-Objective : preservation of air quality : respect for proportioning pesticides. -Indication : air and water pollution risk by product loss.	Frequency of maintenance and adjustment of sprayers. Farm survey.	Farm	Limits set on the base of existing references in integrating crop (adjustments every 4 years)	Weak, few farms cncerned
ENV11 : animal stocking rate	-Objective : preservation against environmental risks coming from animal pressure (water pollution, biodiversity, extension of shrubs, erosion). -Indication : stocking rate as indicator of level of nutrients input and grazing capacity.	Usable agricultural area of the farm. Stocking rate on the different areas of the farm (different altitudes, etc.) (LU/ha/year) Farm survey.	Farm (alpine pastures to distinguish from other parts of the farm)	Limits set on the base of legal limits (fixed limits for access to subsidies (ICHN in France, ÖPUL in Austria,…) and knowledge (e.g. : links between animal stocking rate and water pollution) Red alpine limits: Alpages : >0.8 LU/ha/y Farm : >2LU/ha/y	Strong
ENV12 : importance of crops favouring biological activity in soils	-Objective : preservation of natural biological activity of soils ; development of organic farming techniques. -Indication : application of organic farming methods, utilisation of organic means instead of chemical treatments.	Number of organic interventions /number of total interventions (%)	Farm	No legal limit, indicator adapted to a qualitative analysis.	Weak, hard calculation for traditional farms, regional indicator better with organic farms percentage

Indicators	Application field of the indicator : - Objective of sustainability informed - - Indication given	Needed data Cf. technical annexe for further details	Level of relevance	Reasoning of sustainability limits and alpine limits adopted	Alpine relevance of the indicator
ENV13 : energy consumption	-Objective : limiting the use of not renewable energies. -Indication : input of external not renewable energies and dependency towards these types of energy.	Usable agricultural area. Consumption of fuel, gas, electricity, food. Production of renewable energy. (biogas, solar energy, wind energy, etc.) (GJ/ha/year, %) Farm survey + utilisation of standards on energy values of gas, du fuel, etc.	Farm	Limits set on the base of existing references by production type : Energy consumption per ha Red alpine limit : >10.4 GJ/ha	Strong
ENV14 : species richness	-Objective : preservation of biodiversity. -Indication : percentage of farming areas with few intensive practices as indicator of potential species richness.	Surface with few intensive practices/ usable agricultural area (%) Farm survey.	Farm	Limits set on the base of the goals fixed in the policies favouring environment. Red alpine limits :<10%	Strong
ENV15 : evolution of farm land (extensification /intensification) at local level	-Objective : limiting the negative evolution of the territory usage and its consequences on the environment (landscape, biodiversity, water quality). -Indication : percentage of farm land with intensification or extensification evolution.	Surface of transformed areas; hay into pasture and the opposite, etc/ usable agricultural area during ten years (%) Farm survey and/or statistics.	Research area	Limits set on the base of the evolution intensity. Limits to be interpreted regionally Limit : -5 à +5%: stable indicator	Strong Equal to ENV16 at farm level
ENV16 : evolution of land use by farm type	-Objective : limiting the negative evolution of the land use and its consequences on the environment (landscape, biodiversity, water quality). -Indication : percentage of farm land with intensification or extensification evolution.	Surface of transformed areas; hay into pasture and the opposite, etc/ usable agricultural area during ten years (%) Farm survey and/or statistics.	Farm	Limits set on the base of the evolution intensity. Limits to be interpreted regionally Limit : -5 à +5%: stable indicator	Strong Equal to ENV15 at local level
ENV17 : evolution of landscape structures	-Objective : maintenance of landscape structures diversity (hedges, boundaries, etc.) -Indication : evolution of edges density and linear structures as indicator of the habitats and landscape diversity.	Evolution of boundaries number between meadows and forest, hedges (%) Aerial photographs survey between to periods (10 years)	Research area	Limits set on the base of the evolution intensity. Limits to be interpreted regionally Limit : -5 à +5%: stable indicator	Strong
ENV18 : use of areas on slopes	-Objective : landscape preservation. -Indication : percentage of grasslands on steep slope used in the farm as indicator of maintenance of difficult areas.	Surface of permanent grassland on slopes over 30%/ usable agricultural area (%)	Farm	Limits to be adapted regionally	Strong
ENV19 : forest management	-Objective : favouring a respectful management of the environment for the forest. -Indication : forest management practices taking into account the environment preservation.	Description of the practices. Particularities of the natural plant community. Farm survey and data bank.	Farm	Limits to be adapted regionally, reference to forest management planing	Weak, where forest management is separated from farming, Strong, elsewhere

Indicators	Application field of the indicator : - Objective of sustainability informed - - Indication given	Needed data Cf. technical annexe for further details	Level of relevance	Reasoning of sustainability limits and alpine limits adopted	Alpine relevance of the indicator
ECON1 : timelessness of farming activity	-Objective : maintenance of farming activity renewal of farmers. -Indication : age structure of farmers.	Number of farmers of less than 30years old /number of farmers of more than 60 years old * 100 (%) Statistics .	Research area	Limits set with regional or national references	Middle, to be analysed with SOCIO5
ECON2 : potential trade capacity of the local market	-Objective : to develop direct sale. -Indication : number of potential consumers for the permanent and seasonal markets.	Number of tourists and not rural inhabitants in the research area and nearby (30-50km) Statistics	Research area	Regional limits set referring to values at country scale or mountain area scale	Middle, to be completed by ECON3 and 12
ECON3 : local structures of the market	-Objective : improvement of the efficiency of local trade structures. -Indication : qualitative evaluation of the efficiency of trade structures (stability, diversity, …).	Interviews of experts with qualitative enquiry.	Research area	Experts advice codified on a scale from 1 (efficient local structures) to 6 (insufficient local structures) Red alpine limit : average expert advice>4.5	Middle, to be completed by ECON2 and 12
ECON4 : position of agriculture in the local labour market	-Objective : to maintain a minimum load of the agricultural sector in the local economy. -Indication : agricultural sector load in the local employment.	Total number of farmers/ total number of workers in the research area (%)	Research area	Regional limits set referring to values at country scale or mountain area scale	Middle, indicator to be associated with other social and economic.
ECON5 : evolution of agricultural multi-activity	-Objective : diversification of income sources for farmers. -Indication : evolution of multi-activity in the research area.	Evolution of the percentage of multi-activity workers in the last decade (%) Statistics	Research area	Regional limits set referring to values at country scale or mountain area scale	Middle, evolution of this indicator difficult to analyse in terms of sustainability
ECON6 : payment for public services	-Objective : promotion and remuneration of services done by farmers in the public interest. -Indication : importance in the agricultural income of the public subsidies bound to a service.	Amount of the subsidies allocated for a collective service. Total agricultural income (%) Farm survey.		Regional limits set referring to values at country scale or mountain area scale	Middle, taking into consideration national or regional reasoning for subsidies
ECON7 : agri-tourism activities	-Objective : diversification of income sources with tourism. -Indication : percentage of farms with tourism activities.	Percentage of farms with tourism activities. (%) Farm survey.	Farm	Regional limits set referring to values at country scale or mountain area scale	Middle, indicator to be associated with others indicating a diversification (ECON 5, 7,6,8)

Indicators	Application field of the indicator : - Objective of sustainability informed - - Indication given	Needed data Cf. technical annexe for further details	Level of relevance	Reasoning of sustainability limits and alpine limits adopted	Alpine relevance of the indicator
ECON8 : economic efficiency of agri-tourism activities	-Objective : promotion of the diversification of the agricultural income. -Indication : percentage of the agri-tourism income in the total income of the farmer.	Income emerging from agri-tourism activities/ Income emerging from other farming activities (%) Farm survey.	Farm	Regional limits set referring to values at country scale or mountain area scale	Middle, indicator to be associated with others indicating income components (ECON5,6,7,8)
ECON9 : agricultural income (with subsidies and direct payments)	-Objective : improving agricultural income. -Indication: agricultural income per AWU (with subsidies) in comparison with the average regional income.	Annual agricultural income at farm level with subsidies + number of working hours at farm/ regional average income (%) Farm survey	Farm and research area	Limits set compared with regional average income and national legal minimum income Green alpine limit : agricultural income per AWU>= regional average income Red alpine limit : agricultural income per AWU< national legal minimum income	Strong,
ECON10 : agricultural income (without subsidies and direct payments)	-Objective : improving the agricultural income part external to subsidies. -Indication : agricultural income per AWU (without subsidies) in comparison with the average regional income.	Annual agricultural income at farm level without subsidies + number of working hours at farm/ regional average income (%) Farm survey	Farm and research area	Limits set compared with regional average income and national legal minimum income. Same limits as ECON9	Middle, indicator to be associated with ECON 9
ECON11 : financial autonomy of the farm	-Objective : Insuring the farm handing down by the renewal of the production system with limiting the running into debts. -Indication : Financial volume invested in comparison with the agricultural income.	Capital invested on an average of the last decade. Agricultural income.	Farm	Limits set referring to available values in statistics (FADN network)	Weak, difficult to analyse in terms of sustainability
ECON12 : efficiency of trading structures	-Objective : Improving the economic profitability by the sale of farm products. -Indication : comparison between local average prices and national average prices and efficiency of the production and trade strategies.	Comparison between local average prices and national average prices	Research area and country	Limits set compared with national average prices. Red alpine limit : local average prices<national average prices.	Strong, to be associated with ECON2, 12
ECON13 : importance of the farm production with quality standards	-Objective : satisfying a demand in matter of local quality products and improving by this way the agricultural income. -Indication : proportion of local quality products in the total farm sales.	Proportion of local quality products in the total farm sales. Farm survey.	Farm	Regional limits set referring to values at country scale or mountain area scale	Middle, to be associated with others dealing with income components (ECON5,6,7,8)

Indicators	Application field of the indicator : - Objective of sustainability informed - - Indication given	Needed data Cf. technical annexe for further details	Level of relevance	Reasoning of sustainability limits and alpine limits adopted	Alpine relevance of the indicator
SOCIO1 : perception of their working conditions by the farmers	-Objective : to give more attractiveness to the farmer job. -Indication : how do the farmers consider their working conditions?	Qualitative enquiry. Farm survey.	Farm	Farmers advice codified on a scale from 1 (satisfied) to 6 (unsatisfied) Red alpine limit : average farmers advice>4.5	Strong, to be associated with other social indicators
SOCIO2 : conception of the farmer job and point of view on landscape issues	-Objective : aiming at the evolution of farmer job towards the consideration of numerous functions, in particular landscape and environment managing. -Indication : importance given by farmers to landscape and cultural functions of agriculture.	Qualitative enquiry. Farm survey.	Farm	Position of farmers on different questions : food, environment, landscape. Codes on a scale from 1 (multi-functionnality of farming acknowledged) to 6 (multi-functionnality of farming not accepted) Red alpine limit : average farmers advice>4.5	Middle, to be associated with other social indicators
SOCIO3 : perception by farmers of their position in the local society	-Objective : improving the social recognition of the farmers by the local population. -Indication : Quality of the relationships between farmers and not agricultural population.	Qualitative enquiry. Farm survey.	Research area	Farmers advice codified on a scale from 1 (acknowledged) to 6 (refused) Red alpine limit : average farmers advice>4.5	Middle, to be associated with other social indicators
SOCIO4 : working load	-Objective : social parity with other professional sectors. -Indication : average of the daily working time for farmers compared with the national legal daily working time.	Daily working time: seasonal work (hours/ day in annual average) Farm survey.	Farm	Legal limit of working time Red alpine limit: > 6 h/day (annual average)	Strong, to be analysed regarding seasonal work peaks.
SOCIO5 : handing down of farms	-Objective : maintenance of the farm web. -Indication : percentage of farmers over 50 years old without successor.	Number of potential successors/ number of farmers over 50 years old X 100 (%) Farm survey.	Research area	Regional limits set referring to values at country scale or mountain area scale	Middle, with ECON1
SOCIO6 : educational level of farmers	-Objective : promotion of education for the farmers. -Indication : evaluation of the educational level of farmers regarding the duration and nature of studies.	Educational level : elementary, secondary, agricultural, etc. Farm survey.	Farm	Regional limits set referring to the national average educational level	Middle, with SOCIO7
SOCIO7 : participation to continuing education for farmers	-Objective : promotion of the continuing education for farmers. -Indication : degree of participation of farmers in the continuing education programs.	Number of days of participation per year and number of participants.	Farm	Regional limits set referring to national statistics	Middle, with SOCIO 6

Indicators	Application field of the indicator : - Objective of sustainability informed - - Indication given	Needed data Cf. technical annexe for further details	Level of relevance	Reasoning of sustainability limits and alpine limits adopted	Alpine relevance of the indicator
SOCIO8 : awareness on ecological subjects and position towards environmental measures	-Objective : improving the farmers awareness on environmental questions. -Indication : degree of awareness and position of farmers towards ecological and environmental issues.	Qualitative enquiry. Farm survey	Farm	Farmers advice codified on a scale from 1 (very sensitive to environmental items) to 6 (insensitive) Red alpine limit : average farmers advice>4.5	Middle, to be associated with other social indicators
SOCIO9 : participation of farmers in local political life	-Objective : promotion of the participation of farmers in local political life. -Indication : percentage of local elected farmers.	Number of elected farmers/ Total number of representatives at community level. Statistics	Research area	Regional limits set referring to values at country scale or mountain area scale	Middle, to be associated with other social indicators
SOCIO10 : collective organisation of farmers	-Objective : Improving the social and economic efficiency by the development of the co-operation between farmers. -Indication : existence and importance of local co-operation structures (co-operation between farmers, market organisation, working organisation).	Total farming population. Number of collective structures. Number of farmers in theses structures/ total number of farmers (%)	Research area	Regional limits set referring to values at country scale or mountain area scale	Middle, to be associated with other social indicators

3.3 Sustainability in Alpine agriculture today

After a short presentation of the approaches used, this chapter presents:

- an Alpine-farm typology analysing the links between production means, land usage, management of farms and their sustainability;
- the values of the sustainability indicators in the five areas;
- a synthesis of the problems of sustainability in the Alps.

3.3.1 – The use of consistent approaches for this assessment

This analysis is based on:

- the use of the set of indicators in the five areas (task 3);
- the results of the discussion in the local groups (task 3);
- a system-based approach (Task 2.c Assessment of the Alpine research areas) involving the points below.

  1. Standardised investigation of abiotic and biotic preconditions: general geographical characteristics (altitude, climate), geological conditions, hydrology and water resources, type of land cover (Corine land cover), altitudinal zonality, surface in protected areas (national parks, etc.). This assessment consists in collecting existing data, maps, etc.

  2. Description of agriculture in its socio-economic context. Three levels are considered: 1) Regional structure (economic, socio-economic and demographic situation and evolution, socio-economic function of agriculture and relationships with other activities, recent evolution of agriculture), 2) Agricultural-product markets (evaluation of market value of agricultural products, potential for new orientations).

  3. Farming-system analysis: diversity and typology of farming systems, production processes, strengths and weaknesses of farm types, relationships between types of farming systems and patterns of land use and agricultural practices. This work is based upon on the analysis of existing data, interviews of local actors and a survey on a sample of representative farms of each area.

  4. Evaluation of land use and analysis of environmental conditions: analysis of land use with regard to its influence on nature and landscape. Landscape will be subdivided into area units according to the land use and landscape ecological criteria. For this step, we used cartographic analysis and landscape surveys.

3.3.2 - Typology of Alpine farms and evaluation of their sustainability

An Alpine farm typology has been built up to specify the diversity of the values of sustainability according to farm types. Comparable farms (including both similarities in the farming system, size, production means and agricultural practices) have been included in the same farm types. The FADN (Farm Accountancy Data Network) classification has been used as a basis to develop this typology and the Alpine typology is consistent with the FADN classification. The most important FADN type is No. 41 (dairy farms), in relationship with the major agricultural production system of the Alps. The economic size of dairy farms (expressed by milk sales in euros) is used to divide the FADN type No. 41 into more precise types. Some types are more specific (permanent crops in the Italian research area, mixed cattle and forestry farms in Austria).
The list of the farm types in the different research areas includes 31 different types which could be organised into six "farming systems" (Table 5). Table 6 shows some characteristics of the different farm types.

The diversity of dairy-farm types is very important (Table 6). The Swiss dairy farms often have a small economic size, but they have off-farm income. The milk price is low in Ostallgäu, whereas it is relatively high in the Moyenne Tarentaise (due to the PDO Beaufort cheese market). Except for the pastoral association (type F2pa) in Moyenne Tarentaise, the work force is mainly the family. The highest stocking rates are in Bassa Valle di Sole, then in Oberes Drautal. Table 7 presents the sustainability of these different Alpine farm types.

Table 5: Typology of alpine farms: list of the farms types

Dairy farms, small economic size

- Type **S4**, Switzerland: mixed dairy and rearing or fattening cattle (calves) farms between 4 and 10 ha / part time (FADN 4.3)
- Type **F3**, France: Little traditional dairy farm (less than 15 dairy cows or less than 50000 litres of milk quota) / part time (FADN 4.3)
- Type **G3**, Germany: Specialised dairy farm (or mixed dairy + rearing / fattening cattle) with alpine pasture (no milk produced on alpine pasture) / part time (FADN 4.1)
- Type **A2**, Austria: Specialised dairy farm between 15 and 20 ha/full time (FADN 4.1)
- Type **S1**, Switzerland: specialised dairy cattle farms between 4 and 10 ha / part time farmer (FADN 4.1)
- Type **S2**, Switzerland: specialised dairy cattle farms between 10 and 20 ha / full time (FADN 4.1)
- Sub-type **S2alp**, Switzerland: specialised dairy cattle farm: phase alpine pasture management (FADN 4.1)
- Type **G5**, Germany: Specialised dairy farm (+ rearing or fattening cattle) / full time / organic farming (FADN 4.1)
- Type **I1**, Italy: specialised dairy cattle farms less than 20 livestock units (FADN 4.1)
- Type **S5**, Switzerland: mixed dairy and rearing/fattening cattle farms more than 10 ha / full time (FADN 4.3)

Dairy farms, medium economic size

- Type **S3**, Switzerland: specialised dairy cattle farms more than 20 ha / full time (FADN 4.1)
- Type **F4**, France: medium specialised dairy farm without alpine pasture (between 50000 l. and 150000 litres quota) / full time (FADN 4.1)
- Type **F1**, France: Medium specialised dairy farm with alpine pastures (manage less than 40 dairy cows in alpine pastures, or produce less than 50000 l. milk quota) /full time (FADN 4.1)
- Type **I2**, Italy: specialised dairy cattle farms between 20 and 40 livestock units /full time (FADN 4.1)

Dairy farms, large economic size

- Type **G1**, Germany: Specialised dairy farm with alpine pasture (no milk on alp. past.) / full time (FADN 4.1)
- Type **G2**, Germany: Specialised dairy farm without alpine pasture / full time (FADN 4.1)
- Type **I3**, Italy: dairy cattle (more than 40 livestock units) with orchards (less than 2 ha) farms /full time (FADN 4.1)
- Type **I6**, Italy: mixed dairy cattle (more than 40 LU) and orchard (more than 2 ha) farms full time (FADN 7.1)
- Type **F5**, France: Big specialised dairy farm without alpine pastures (more than 150000 l. quota)/ full time (FADN 4.1)
- Type **F2**, France: Big specialised dairy farm with alpine pastures (more than 40 dairy cows in alp. past.) (family farm) /part time (FADN 4.1)
- Type **F2pa**, France: Big specialised dairy farm with alpine pastures (more than 40 dairy cows in alp. past.), pastoral association (FADN 4.1)

Breeding and fattening cattle

- Type **G4**, Germany: Specialised rearing and fattening cattle / part time / organic farming (FADN 4.2)
- Type **A1**, Austria: Specialised suckler cow farms up to 15 ha (little milk production is possible) / part time (FADN 4.2)
- Type **A3**, Austria: Specialised breeding and fattening farms between 20 and 30ha / part time (FADN 4.2)
- Type **A4**, Austria: mixed breeding or fattening farms with forestry activity / part time (FADN 8.2)

Sheep and goats farms

- Type **F7**, France: Specialised goat farms (more than 30 goats during the year or manager of an alpine pasture and more than 50 goats in summer) (FADN 4.4)
- Type **S6**, Switzerland: sheep (or goats) farms more than 4 ha / part time (FADN 4.4)
- Type **A5**, Austria: Sheep (or goats) farms more than 10 ha (FADN 4.4)
- Type **F6**, France: Specialised sheep farms (more than 50 sheep during the year or manager of an alpine pasture and more than 100 sheep in summer) (FADN 4.4)

Tree crops farms

- Type **I5**, Italy: specialised orchard / part time / intensive (FADN 3.9)
- Type **I4**, Italy: specialised orchard / full time / intensive (FADN 3.9)

In brackets: Farm Accountancy Data Network (FADN) classification according to EU classification (85/377/CEE).

Table 6: Presentation of the different alpine farm types

Farm type	LU	animals (heads)	milk quota litres	milk price euros/ l.	UFA (ha) alpine past. not included	Annual Work Units (AWU)	family AWU	complementary description	subsidies / farm income (%)	stocking rate LU/UFA without orchard
Dairy farms, small economic size		dairy cows								
T. **S4**, Switz. 4 to 10 ha / part Time	6	6	18000	0,47	8	1,4	1,1	calves, off-farm inc.	115	0,8
T. **F3**, France <15 dairy cows/ part T	12	9	15000	0,66	30	1,0	1,0	cheese proc., off-farm inc.	23	0,4
T. **G3**, Germ.: <15 dairy cows/ part T.	17	9	48000	0,32	17	0,9	0,9	off-farm income	90	1,0
T. **A2**, Austria: 15 to 20 ha)/full T.	29	10	50000	0,33	17	2,8	2,8		50	1,7
T. **S1**, Switz.:4 to 10 ha /part T.	8	6	36500	0,47	7	1,4	1,3	off-farm income	163	1,2
T. **S2**, Switz.: 10 to 20 ha /full T.	16	11	35000	0,47	15	2,2	2,2	off-farm inc. (alp. past. manag.)	141	1,1
T. **S2alp**, Switz. phase alpine pasture	50	23	35000	0,79	30	1,1	0,8	cheese processing	40	1,7
T. **G5**, Germ.: organic farming/ full T.	27	18	61000	0,34	32	1,4	1,4	agritourism, organic farm	54	0,8
T. **I1**, Italy: < 20 livestock units	12	11	63000	0,43	4	2,1	2,0	off-farm income	45	3,0
T. **S5**, Switz.: 10 to 20 ha/ full T.	16	11	57000	0,47	17	2,1	1,8	off-farm income	166	0,9
Dairy farms, medium size										
T. **S3**, Switz.: > 20 ha / full T.	24	17	87000	0,47	25	2,3	2,2	off-farm income	172	1,0
T. **F4**, France: 20 to 40 DC /full T.	50	37	90000	0,49	85	1,8	1,8		61	0,6
T **F1** France: 20 to 40 DC, alpine pasture	29	20	92000	0,50	30	1,0	1,0	off-farm income	45	1,0
T. **I2**, Italy: 20 to 40 LU/full T.	40	30	111000	0,43	9	2,6	2,6		52	4,4
Dairy farms, large economic size										
T. **G1**, Germ.: alpine pasture / full T.	61	36	182000	0,32	45	2,2	2,2		95	1,4
T. **G2**, Germ.: no alpine past. / full T.	58	37	237000	0,32	49	2,7	2,7		77	1,2
T. **I3**, Italy: >40 livestock units/full T.	50	40	187000	0,43	19	3,4	3,2	orchard (1,8 ha)	35	2,9
T. **I6**, Italy: mixed >40 LU /full T.	52	40	240000	0,43	28	3,2	2,5	orchard (2,6 ha)	20	2,0
T. **F5**, France: >40 dairy cows/full T.	110	80	280000	0,49	110	3,2	3,2		40	1,0
T. **F2**, France: >40 DC, alpine pastures	90	90	190000	0,84	80	2,5	2,0	cheese proc., off-farm inc.	20	1,1
T **F2pa**, France: >40 DC, pastoral association	260	180	250000	0,91	(1000) alp.past	4,0 (in summer)	1,0	cheese processing	4	0,3
Breeding and fattening cattle		suckler cows								
T. **G4**, Germ.: organic farm/ part T.	12	8			14	1,2	1,2	agritourism, organic farm, off-farm inc.	60	0,9
T. **A1**, Austria: < 15 ha/ part T.	12	8	10000		12	2,2	2,2	agritourism, off-farm inc.	40	1,0
T. **A3**, Austria: 20 to 30 ha / part T.	47				21	2,2	2,2	off-farm income	60	2,2
T. **A4**, Austria: + forestry/ part T.	40				25	2,5	1,7	forestry activity, off-farm inc.	60	1,6
Sheep and goats farms		sheep or goats								
T. **F7**, France: >30 goats	8	50 g.			14	1,5	1,5	off-farm income	26	0,6
T. **S6**, Switz.: > 4 ha / part T.	8	50			8	1,4	1,4	off-farm income	130	0,9
T. **A5**, Austria: > 10 ha	30	200			17	1,4	1,4		70	1,8
T. **F6**, France: > 50 sheep	48	320			50	1,5	1,2	1800 sheep in summer, off-farm inc.	200	1,0
Tree crops farms										
T. **I5:** , Italy: orchard part T./intensive	-	-			2	1,4	0,7	orchard (1,4 ha)	30	-
T. **I4**, Italy: orchard full T. / intensive	-	-			2,8	2,0	1,0	orchard (2,8 ha)	4	-

Abbreviations: Part T: part time farm activity ; Full T: full time; DC: dairy cows; LU: livestock units ; UFA: Utilised Farm Area; inc: income

Table 7: Sustainability of the different alpine farm types

Farm type	Farm income / family AWU (euros)	Total income / household (euros)	Persistency of farm	Risks of water pollution	Land abandon-ment	Work overload periods	Social recognition in local society
Dairy farms, small economic size							
T. **S4**, Switz. 4 to 10 ha, calves / part T.	11900	52000	Old build.				
T. **F3**, France <15 dairy cows/ part T	8800	Off-inc.	Old build.				
T. **G3**, Germ. <15 dairy cows/ part T.	7400	Off- inc.	No succ.				
T. **A2**, Austria 15 to 20 ha)/full T.	8000	22000		Sil. Maize			
T. **S1**, Switz.4 to 10 ha /part T.	7000	38000	Ageing				
T. **S2**, Switz. 10 to 20 ha /full T.	9800	21600	Old build.				
T. **S2alp**, Switz. phase alpine pasture	+12300	+9800	Old build.				
T. **G5**, Germ. organic farming/ full T.	16300	23000					
T. **I1**, Italy < 20 livestock units	1800	Off- inc.	Low inc.	Stock. rate			
T. **S5**, Switz. 10 to 20 ha/ full T.	9600	23900	Old build.				
Dairy farms, medium economic size							
T. **S3**, Switz. > 20 ha / full T.	10400	26000					
T. **F4**, France 20 to 40 dairy cows /full T.	11400	20600					
T **F1** France 20 to 40 DC, alpine pasture	12000	18000	Old build.				
T. **I2**, Italy 20 to 40 LU/full T.	4800	13000		Stock. rate			
Dairy farms, large economic size							
T. **G1**, Germ. alpine pasture / full T.	6400	14000	Low inc.				
T. **G2**, Germ. no alpine pasture / full T.	6400	17200	Low inc.				
T. **I3**, Italy >40 livestock units/full T.	11000	36000		Stock. rate			
T. **I6**, Italy mixed >40 LU /full T.	Variable	Variable	Variable	Stock. rate			
T. **F5**, France >40 dairy cows/full T.	16800	18000					
T. **F2**, France >40 DC, alpine pastures	53000	Off- inc.					
T **F2pa**, France >40 DC, pastoral association	Highincome/cow						
Breeding and fattening cattle							
T. **G4**, Germ. organic farm/ part T.	8200	Off-inc.					
T. **A1**, Austria < 15 ha/ part T.	10000	32000	Ageing				
T. **A3**, Austria 20 to 30 ha / part T.	15000	55000		Stock. rate			
T. **A4**, Austria + forestry/ part T.	24000	55000					
Sheep and goats farms							
T. **F7**, France >30 goats	7000	Off- inc.	Old build.				
T. **S6**, Switz. > 4 ha / part T.	11000	36000	Old build.				
T. **A5**, Austria > 10 ha	16000	22000		Intensific.			
T. **F6**, France > 50 sheep	7500	Off- inc.					
Tree crops farms							
T. **I5:** , Italy orchard part T./intensive	Low	Off-inc.	Ageing	Intensific.			
T. **I4**, Italy orchard full T. / intensive	Medium	Off- inc.		Intensific.			

Abbreviations: Part T: part time farm activity ; Full T: full time; LU: livestock unit ; DC: dairy cows: low inc: low income ; Intensific: intensification; Old build. old building; Off-inc: off-farm income; stock. Rate: stocking rate

Legend:

Sustainable performance

Unsustainable performance

Medium problems of sustainability

Limits of indicators used in table 7

Farm income per family AWU: three levels (< 10000 Euros (red) , 10000 to 15000 Euros (orange), ≥ 15000 Euros (green)

Total income: household's (= farmer + spouse) off-farm activities included. Three levels (< 18000 € (red), 18000 to 30000 € (orange), ≥ 30000 € (green)). NB it is often difficult to assess off-farm income level.

Persistency of the farm: combination of variables**:** succession if farmer > 50 years old; means of production (state of livestock buildings), economic viability (level of income) if farmer <50 years old

Risk of water pollution: according to risk factors: high level of stocking rate, grazing near water catchment, uses of chemicals and pesticides.

Land abandonment and landscape maintenance: risks of scrub development and land abandonment in current situation and coming years (agricultural practices in steep slopes and remote fields)

Working load: periods of work overload (especially in summer, sometimes in winter when the farmer has an off-farm activity (for instance in a ski resort).

Social recognition in local society: integration in local society and social recognition by local people.

Table 8. Most frequent sustainability values for each farming system.

Farming system	Farm income / family AWU	Total income / household	Persistency of farm	Risks of water pollution	Land abandonment	Workload	Social recognition in local society
Dairy farms, small economic size							
Dairy farms, medium economic size			Var				Var
Dairy farms, large economic size	Var	Var	Var				Var
Cattle breeding and fattening	Var		Var		Var		
Sheep and goat farms	Var		Var	Var	Var	Var	
Tree-crop farms	Var	Var	Var				

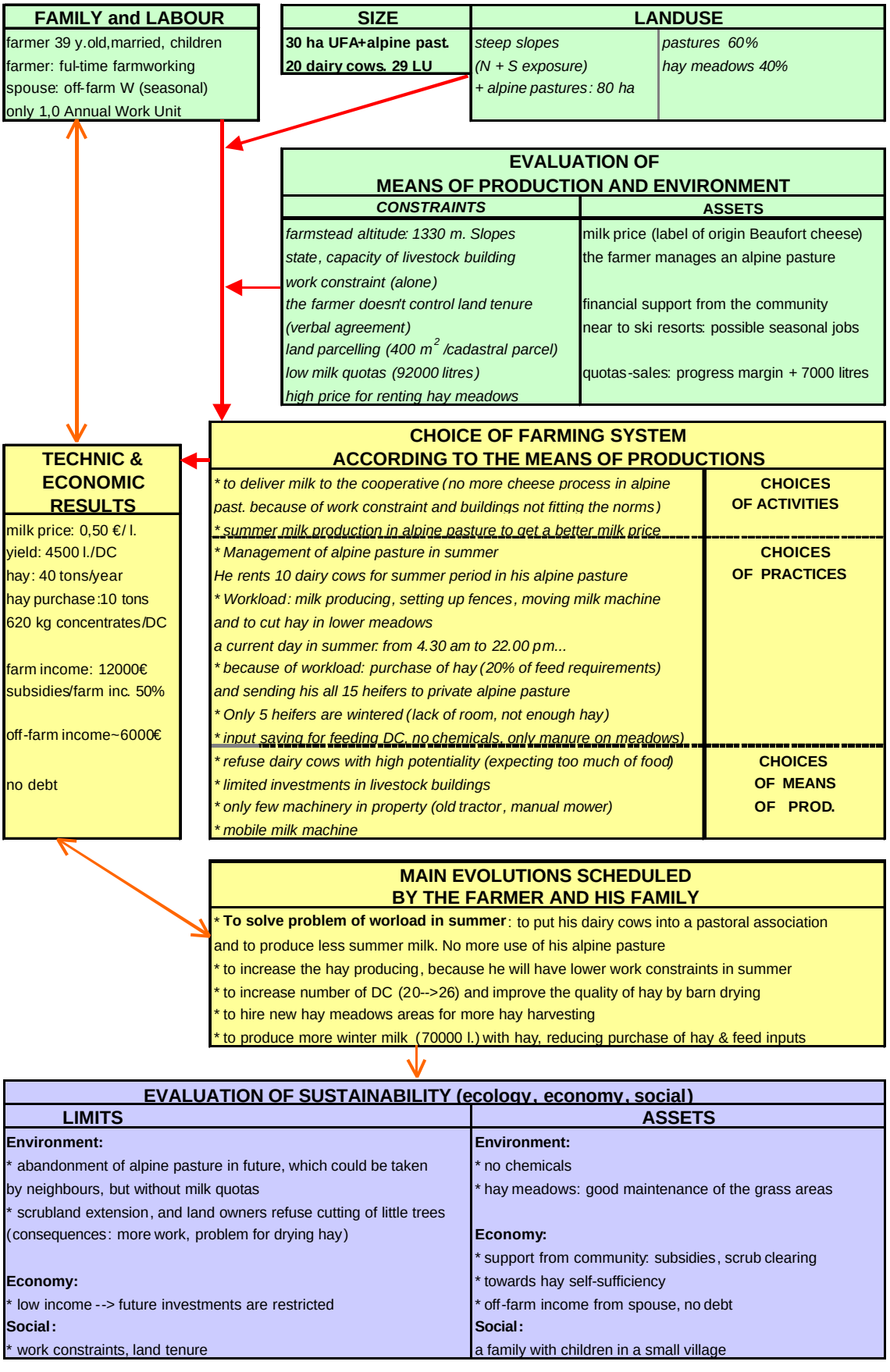
The colour indicates the most frequent sustainability value for each farming system. Due to unavailable data, these values are not weighted with the rate of frequency of each farm type in the farming systems.

Legend:

	Sustainable performance
	Unsustainable performance
	Medium problems of sustainability
Var.	Due to large differences between areas no clear alpine trend

For each farm type, we formulated a detailed functional plan (adapted from Capillon and Manichon (1991)) based on a concrete farm case, considered a representative case of the type (Figure 5). These functional plans represent the links between different components of the farms (objectives of the farmer and his family, production means, land use, choices of agricultural practices, etc.), technical and economic results, and an evaluation of sustainability concerning environmental, economic and social aspects. These functional plans make it possible to analyse the factors explaining the current problems and assets of Alpine agriculture, e.g. analysis of the relationship between production means, farm households, land use and sustainability values.

Figure 5: Functional plan of a farm type
Example of the farm type 1, France: "medium specialised dairy farm with alpine pasture



These results are used to infer trends between farming systems (production means, land use, farm management, agricultural practices) and sustainability:

- **The low level of farm income per family AWU** (Average Working Unit)**, particularly for the small and medium economic size farm types**, but the total household income is generally 'medium' (around 20 000 to 25 000 euros) because of off-farm activities by the farmer or his spouse. The subsidies to farm income ratio (in %) is difficult to interpret. The highest rates are on sheep farms (because of low mutton prices) and in the Swiss farm types. That testifies to public support for mountain agriculture in Switzerland.

- **The most frequent problem of sustainability is the excessive workload which affects nearly all the farm types, especially in the summer**. The diminution of family labour is hardly compatible with the growing in size of the farms. **This also explains the high risk of land abandonment and scrub development** resulting from different changes in agricultural practices and land uses, including conversion of hay meadows to grazed pasture land, simplification of livestock practices (decrease in guarding), decrease of stocking rate on steep slopes and in remote fields, managed afforestation, land abandonment.

- **In farms of medium and small size, problems of persistency**, i.e. family help declines when the parents age and the economic size is not sufficient to support an associated farmer. These farm types are not sustainable from economic point of view as well (low income, old livestock buildings).

- **In most cases, the environmental problems concerning the "risk of pollution" are related to localised problems or to organic manure distribution and not to excessive use of chemicals and pesticides**.
    - Grazing near water catchments in Alpine pastures with risks of bacteriological pollution (France, Switzerland). In France, these practices of grazing and high levels of organic manure in specific fields are clearly involved in the poor quality of water in some catchments.
    - A high stocking rate in some Italian dairy farms (with the purchase of hay to feed animals), resulting in a high level of organic manure to spread per hectare.
    - Another problem (France, Italy) is the lack of land to spread manure (difficult on steep slopes or near villages), resulting in high level of organic fertilisation on some flat fields and in possible conflicts between farmers, local administrators and local people.
    - In Italy, the fruit sector is concentrated in the bottom of the valley. Even if it is a very intense form of cultivation, with ongoing research to increase productivity, use of chemicals is relatively low. This is because farmers use integrated crop management, with rigid agreements on restricted use of chemicals. Even if risks of pollution exist, they are low.
    - In Germany, a great problem is the pollution of the Hopfensee lake (particularly by chemicals), caused by nitrogen and phosphate inputs from agriculture. In Austria, groundwater is endangered by agriculture (nitrate-based fertiliser) and also by forestry (logging increases surface run-off).

- **Social recognition of farmers is low**, particularly in Italy (dairy farms) and in France (small dairy farms and sheep and goat farms).

3.3.3 - Values of the sustainability indicators in the five areas

The detailed values of the sustainability indicators are presented in Tables 9, 10 and 11 respectively for environmental, economic and social components of sustainability. These results are commented in the section *Problems of sustainability in Alpine agriculture* which is a synthetic presentation of the diverse investigations carried out to analyse the current state of sustainability in Alpine agriculture.

Table 9 : Values of the environmental indicators in the 5 areas

Indicator		**Oberes Drautal** Austria	**Glarner Hinterland** Switzerland	**Ostallgäu** Germany	**Moyenne-Tarentaise** France	**Valle di Sole and di Rabbi** Italy
ENV2 : micro-organisms, pesticides and other pollutants content in ground and drinking water	Pesticides (					
	NO3					
	PO4					
	Microorganism					
ENV3 : Nitrogen balance						
ENV6 : Fertilisation (whole farm except alpine pastures)	Input of fertilizer – N					
	Input of fertilizer - P					
	Input of fertilizer - K					
ENV7 : Farms capacity to adapt the manure spreading to the season	storage – capacity of manure					
ENV8 : Utilisation of polluting substances in the farm						
ENV9 : Utilisation of pollutants and fertilisers nearby surface and ground water	Surface water					
	water catchement points			no data		
	Special management					
ENV11 : Animal stocking rate	Alpine pastures					
	Rest of farm area					
ENV13 : Energy consumption	Renewable energy/E consumption					
	Energy consumption / area unit					
	Input of direct energy consumption		no data			no data
ENV14 : Species richness	Areas with species richness					
ENV15 : Evolution of farm land at local level	Extensification					
	Intensification					
ENV16 : Evolution of land use by farm type	Extensification – **F**arm level					
	Intensification					
ENV17 : Evolution of landscape structures						
ENV18 : Use of areas on slopes	Land use with low intensity			no data		
ENV19 : Forest management	R - Forest management plan (Regional level)				not relevant	not relevant
	R - Forest roads					

The indicators estimated with low alpine relevance in the critical analysis of the indicators are not mentioned in this table

Legend :

(Rather) sustainable performance
(Rather) unsustainable performance
Medium problems with sustainability (or level of sustainability varying between farm types into the area)

Table 10 : Values of the economic indicators in the 5 areas

Indicator	Oberes Drautal (A)	Glarner Hinterland / Sernftal (CH)	Ostallgäu (D)	Moyenne-Tarentaise (F)	Bassa Valle di Sole and Valle di Rabbi (I)
ECON1 : Timelessness of farming activity (young/old farmers)					
ECON2 : Potential trade capacity of the local market					not relevant
ECON3 : Local structures of the market					
ECON4 : Position of agriculture in the local labour market					
ECON5 : Evolution of agricultural mutli-activity					
ECON6 : Payment for public services					
ECON7 : agri-tourism activities					not relevant
ECON8: Economic efficiency of agri-tourism activities	no data	not relevant		not relevant	not relevant
ECON9 : agricultural income (with subsidies and direct payments)					
ECON10 : agricultural income (without subsidies and direct payments)					
ECON11 : Financial autonomy of the farm					no data
ECON12 : Efficiency of trading structures					
ECON13: Importance of the farm production with quality standards					

Table 11 : Values of the social indicators in the 5 areas

Indicator	Oberes Drautal (A)	Glarner Hinterland / Sernftal; (CH)	Ostallgäu (D)	Moyenne-Tarentaise (F)	Bassa Valle di Sole and Valle di Rabbi (I)
SOCIO1 : perception of their working conditions by the farmers					
SOCIO2 : Conception of the farmer job and point of view on landscape issues					
SOCIO3 : Perception by farmers of their position in the local society					
SOCIO 4 : Working load					
SOCIO5 : Handing down of farms (Potential successors for farmers >50 years old					
SOCIO6 : Educational level of farmers					
SOCIO7 : Participation to continuing education for farmers					
SOCIO8 : Awareness on ecological subjects and position towards environmental measures					
SOCIO9 : Participation of farmers in local political life					
SOCIO10 : Collective organisation of farmers					

Legend :

(Rather) sustainable performance

(Rather) unsustainable performance

Medium problems with sustainability (or level of sustainability varying between farm types into the area)

Table 12 : Sustainability of alpine agriculture : scientific and local people points of view

Topic	**Oberes Drautal** Austria		**Glarner Hinterland** Switzerland		**Ostallgäu** Germany		**Moyenne-Tarentaise** France		**Valle di Sole and di Rabbi** Italy	
Point of view	Scientific	Local people	Scientific	Local people	Scientific	Local people	Scientific	Local people	Scientific	Local people
Environment										
Risk of water pollution by agricultural practices										
Contribution to global changes (air and climate changes)										
Land abandonment and landscape maintenance										
Relationships biodiversity/agricultural practices										
Economy										
Agricultural income										
Persistency of farms										
Trading structures and potential of local market										
Diversification of farms and added value with quality standards										
Social										
Working load										
Collective organisation of farmers										
Farmers' awareness about environmental concerns										
Social recognition of farmers in local society										

Legend :

	Scientific point of view	**Local point of view**
	(Rather) sustainable performance	Not considered as a problem or considered as an asset
	(Rather) unsustainable performance	(Rather) unsustainable performance, to be improved
	Possible problems with sustainability or level of sustainability varying between farm types	Considered as a limited problem
		Not mentioned in the local team

The scientific point of view is based upon a synthesis of the values of the different indicators in tables E, N, S.
The local point of view of sustainability is based upon on an analysis of the discussion during the future workshops : topic mentioned or not, considered as a problem by the whole group, only by some members, decision to include it as priority for the scenario.

3.3.4 – Problems of sustainability in Alpine agriculture

According to the debates in the local groups (table 12), to the scientific diagnosis and to a review of literature, problems of sustainability in Alpine agriculture could be sum up as follow:

Economic

From an economic point of view, the Alpine area is one of the most important growth areas of Europe. The number of inhabitants is 13 millions in the limit of the Alpine convention (Bätzing (1993), 70 millions for the European Commission which considers the areas linked to the economy of the Alps. The Alpine area is included in very dynamics regions (Bavaria, Lombardy, Rhône Alpes…) among the most dynamic of the European Union. Thus effects of urbanisation are present all over the Alps especially in greater valleys. Nevertheless, lower levels of development in some territories like southern French Alps and Italian Alps (excluded the autonomous regions) are still remaining (European Commission (1995).

The economic situation of Alpine agriculture is in striking contrast to this general positive trend. In spite of specific political mountain measures the recent evolution shows the maintenance of some difficulties:

1. **The agricultural income remains lower to plain agricultural income in each research area (about 30 to 40 percent in average according to Eurostat data).** These differences can be explained by a lower size of farms in comparison with the plains, and overcosts in equipment in case of comparable levels of modernisation (Bazin (1995). In mountain areas, physical disadvantages place severe limits on technical and structural adaptation and reduce competitivity of agriculture. Such a difference in income is common to the whole Alps, including Switzerland. This explain the needs of other sources of income (part-time farming or diversification inside the farm) and the cessation of farming at the moment of the succession between parents and children.
2. **In some areas, prices of the products remain weak except in the case of quality production like in Moyenne Tarentaise with Beaufort and Valle di Sole** (cheese and apples). Nevertheless the apples production per ha is in Valle di Sole about the half of that obtained in the close valleys of Provincia di Trento at lower altitude.
3. **Alpine agriculture can be in deep concurrence with the other activities: urbanisation linked to tourism or increase of population often use some of the best parcels** (ex: flat meadows).
4. **Alpine agriculture tend to decline. The magnitude of the decline depends on the country**. The number of farms has decreased from about in the ten past years: -3,5 % per year in Moyenne Tarentaise (France), -2% per year in Glarner Hinterland (Switzerland), - 1,3% per year in Italy, - 0,27% per year in Oberes Drautal (Austria). However the decline is comparable (and in some situations lower) than in the whole Europe: - 4,4% per year in France between 1988 and 1997, - 1,5% per year in Austria between 1990 and 1997, - 2,6 % per year in Europe (15 countries) between 1995 and 1997. The remaining Alpine farms increase their size, but because of the important physical constraints, they concentrate their activities on accessible and better quality areas (see part "environment").

This economic diagnosis is shared both by scientist and local people who discussed and emphasised some ideas to improve the situation: enhancement of diversification of farm income with tourist offers (e.g. holidays on farm, sleeping on straw, Alpine trekking). These new services are seen as an opportunity to maintain little farms and to settle new farmers in the coming years. The improvement of marketing structures and the development of local special products with high quality standards are also solutions frequently mentioned.

Environment

In the Alps, agricultural environmental problems are clearly related to two trends in the evolution of agricultural land use, namely intensification and land abandonment (figure 6). **Few areas are affected by either abandonment or intensification alone. The process of agricultural land-use adaptation to socio-economic pressures is an abandonment/intensification phenomenon: intensification on accessible and better quality land and abandonment elsewhere.** The main reasons for abandonment are difficult access,

poor-quality land, steep slopes or land with high labour requirements. This can be observed both on the level of the farm and on the level of a whole valley.

The environmental impact of intensification identified in the research areas are due to: local over-use of organic fertilisers, the occasionally use of pesticides and herbicides, and overgrazing or grazing near water catchments in Alpine pasture. All these practices have negative impacts on biodiversity and water quality (bacteriology especially). Excepted some categories of persons (organic farmers, environmental representatives) local actors are less sensitive than scientist to these topics.

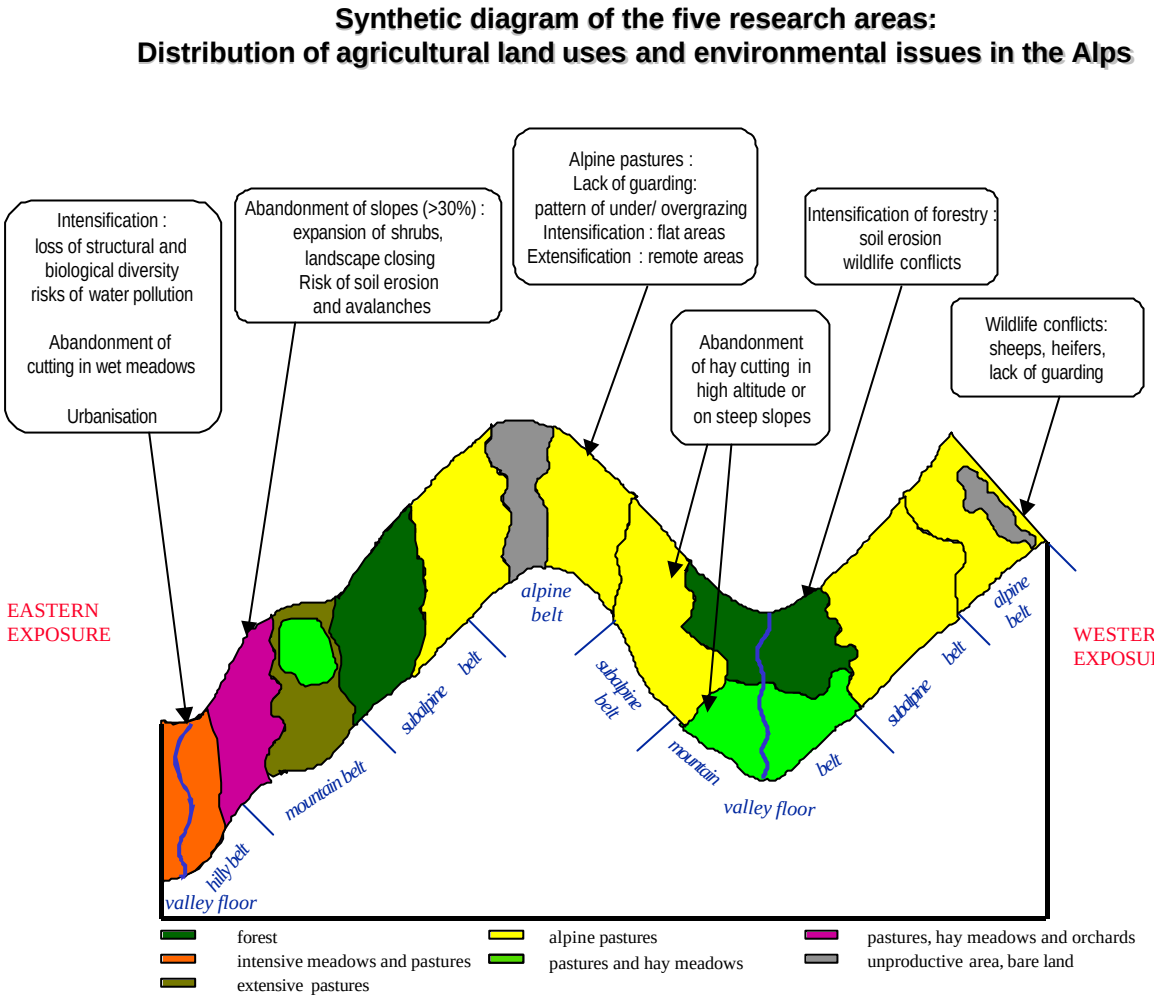
Land abandonment affects negatively biodiversity (especially for species living exclusively in open biotops like grasslands), landscapes and soils. The ecological processes involved are encroachment of vegetation onto old field sites and loss of grassland areas to scrub and forest. For local people of regions affected by land abandonment (France, Italy and secondarily Switzerland and Austria) such an evolution of land use is considered as a major problem for the coming years. During the discussion this evolution is linked to the diminution of number of little farms, the limiting working load and the capacity of local society to manage a better distribution of farms in the territory in the coming years. This problem is seen in connection with the tourism potential of the regions with the reference to an increasing demand for landscape quality by new residents and tourists.

These general tendencies observed at the Alps level, have to be specified at local or valley levels. In our five research areas we have analysed that those evolutions depend on the dynamics of the agriculture and of the current policies:

- Important phenomenon of intensification and research of productivity in the Italian research area (fruit farms especially) but with rigid agreements about a restricted use of chemical (integrated crop management) ;
- Specific problems of intensification and agricultural abandonment in Oberes Drautal (Austria) with forestry farms, afforestation of agricultural slopes with monocultures of spruces.
- Low rate of land abandonment in Swiss research area, the problem is related more to a substitution of traditional practices such as haymaking in high altitude by extensive pastures without sheep-herding.

Such an evolution has not only environmental impacts but also social, cultural and economic impacts on other activities. The magnitude of the changes differs among the various regions of the Alps, but in general the state of rural area is good compared to other European regions. In consequence it is impossible to shape the image of a established crisis but even more to speak about worrying trend.

Figure 6



Social

The social impact of farmers is now low, being closely linked with the decrease of agriculture. The economic development of the Alpine valleys is bringing new residents, with high exigencies on quality of life conditions largely based on quality of the near environment. For example, survey on local stakeholders have complained again farm buildings with bad smells inside the villages. This shows that farmers have some difficulties to find a new position in the new sociological context. Whatever this position cannot be as dominant as in the past and the current evolution of the social recognition of agriculture by local people is one of the major concern of farmers.

In general, the increase of the size of farms and/or the decrease of the number of AWU by farm, are at the origin of the increase in time of work. This high work time corresponds to a gap in comparison with the rest of the local society. The social relations with other populations (high celibacy rate among farmers for example) can sometimes be very weak because of this problem. And today, farmers long to new way of living (holidays, social life, etc). For farmers the problem is more related to lack of holidays and week-end, periods of work overload than to the average annual duration of work. From the direct point of view of the farmers, this problem of work time is one of their first constraints, in term of liveability which is an essential aspect of

sustainability. Another consequence is the difficulty for some farmers to assume maintenance tasks of their farm territory realised in the past.

Farmers feel themselves first as "producer" and not as "gardener". Farmers are attached to the traditional and original vocation of agriculture that is to say production of food. They refuse to ensure just environmental functions. Even including environmental functions into the farm corresponds to a change of profession for farmers. This is not yet realised and shows the necessity to accompany farmers in this mutation.

In general, most of the farmers seem not to understand the increase of administrative constraints, which has from their point of view dramatically increased since the reform of the CAP in 1992. For example, in Moyenne Tarentaise, the division of the property between the different members of the family is at the origin of very little parcels in the farms nowadays (till 200 m²). The surface declaration (for regulation 2078/92) can be very complicate and can dissuade some farmers to depose a file or to declare the whole surface. They expect not to have an additional increase through the measures of AGENDA 2000.

But on the other hand, farmers in general are looking for new partnerships to improve their position in policy-discussion. This explains sometimes a rapid and extensive reaction by professional organisations and by the farmers themselves on measures which seem to threaten their existence.

3.4 Simulation and evaluation using scenarios

3.4.1 Main principles of scenario analysis

A scenario is defined as a change in production conditions on farms (planned or hypothetical). These changes can be multiple and include alternative (new) techniques or products, new schemes in terms of incentives/constraints ; new agricultural policies and evolution of structural characteristics.

The general approach of this simulation phase consists in developing a method used to estimate the consequences of certain scenarios (trend scenario, scenario formulated by local people and scientific scenario) on the sustainability of agriculture in each region. The method uses linear programming, a form of mathematical programming for analysis on the effects of a new policy or a modification of production techniques on the regional and farm levels. It is an optimisation technique used to determine the optimal level of use of "production factors". Linear programming is generally used to solve problems involving maximisation of a linear function (objective function) subject to inequalities represented by linear constraints.

The different farm types modelled were chosen to be representative of farming-system diversity in each research area (3 to 5 farm types have been modelled per research area). The different models used for each farm type have common points, i.e. one model represents one farm type, the objective function is the gross margin of the farm and the linear constraints take into account political, technical and economic constraints on production or characteristics such as milk quotas, labour force, natural conditions (land units), buildings, etc. Different types of crops and breeding management have been tested (level of milk production, organic production, etc.) in different scenarios.
Only some of the variables relevant for sustainability can be analysed on the farm level with linear programming:

- economic variables (indications on changes in income by calculating the gross margin);
- some environmental indicators *via* changes in land use (level of intensification of agricultural practices);
- social indicators through analysis of the workload (in hours per month).

Some limits must be specified. Linear programming does not represent the "real world" where farmers must make multiple choices, some contradictory, which cannot be summarised exclusively by maximisation of the gross

margin of the farm (Cesaro &Giacomini (1993) ; Cesaro (1994)). Moreover, some parameters can be difficult (labour force and consumption, yield for some crops, etc.) or impossible (a majority of the of sociological indicators) to estimate. The simulations are carried out on the farm level, i.e. consolidation on the regional level is difficult (territory is not a sum of farms, relations between farms are not considered by the model, etc.). Consequently, the first phase in building a farm-type model is a comparison between results of the model and data and information drawn from the farm survey. This comparison is called model calibration.

As a consequence, the results of the simulations are not considered to be a prediction, but rather a means of reflecting on the possible future of agriculture in the different research areas and the possible means of improving sustainability. The quantitative analysis has been completed by a qualitative analysis to estimate effects of the implementation of a scenario on the other sustainability indicators.

3.4.2 Description of the scenarios analysed

Two types of scenarios have been modelled.

1. Trend scenarios.
2. Scientific and "local" scenarios to be formulated by the scientific team and by local people during the future workshops.

Trend scenario – Agenda 2000 (AP 2002 in Switzerland)

This scenario corresponds to the implementation of Agenda 2000 (EU) and AP 2002 (Switzerland) with the simulation of expected variations in prices and costs of production factors. It was carried out in a number of steps.

1. Parametric analysis on milk prices, milk quotas and, depending on local situations, prices of other products and production costs (labour, etc.). These intermediate steps make it possible to analyse the sensitivity of farms to step-by-step variations in some factors.
2. Implementation of Agenda 2000/AP 2002 in the modelled farms. The selected date is 2006 (last year of the various Rural Development Plans) and 2007 in Switzerland. **The contents correspond to the implementation of the reforms concerning the markets (direct payments for milk, beef, crops, increase in milk quotas) and to the implementation of the different Rural Development Plans in the regions taking into account the situation in May 2000.** This corresponds to the official situation indicated in the Berlin agreement and its eventual local adaptation. Concerning changes in intervention prices, some variations are indicated on the European level. Depending on the regional context, some hypotheses of price variations have been chosen, in general close to the decreases projected by the Commission.
3. The analysis concerns the consequences of Agenda 2000/AP 2002 on sustainability in terms of farm income, workload, land use, nitrogen balance and farm inputs.

Scientific and "local" scenario

These scenarios were formulated to ensure sustainability from the viewpoint of local people and scientists, based on the assessment of sustainability carried out in the previous tasks (task 2 and task 3). A scenario can be described in terms of general objectives (decreasing labour constraints on farms, etc.), means (increased size of farms, etc.) and constraints (elimination of overly extensive or intensive practices in fields).

From a technical point of view, these objectives, means and constraints have to be quantified and integrated in the model depending on their type (an increase in income remains an objective, but does not justify a modification of the model) and the possibilities of parameterisation. This translation step fixes the hypotheses proposed by the local people and the scientists and consequently participates in the formulation of the scenario (Table 13).

Table 13: examples of translation of a scenario into parameters for modelling**.**

Research area	Moyenne Tarentaise (France)	Oberes Drautal (Austria)
Scenario	Local people scenario	Scientific scenario
Objective of the scenario	*To improve sustainability of farms thanks to new production systems not only based on the milk production* *To decrease working charge*	*To maximize the extensive farm management (number of cuts, use of pesticides and fertilizers, number of heads, etc)* *Is the ÖPUL 2000 (agro-environmental plan based on the EU Regulation 2078/92, valid from 2001 till 2006) able to balance the gross margin of a farm which is managed in an extremely extensive way ?*
Modified parameters for the implementation of the scenario in linear programming	• Decrease of time of work of 2 days by month by AWU • Increase of milk quota (between + 5 % and + 20 % in function of farm types) • New activities : clearing of pastures and pension activity	New constraints applied in the model (examples): • 20% of arable areas on the whole farm land is the upper limit • 2 cuts are the upper limits for management of grass land • silage grass and silage maize were restricted to zero • Implementation of new measures from ÖPUL (examples) • Keeping and breeding of endangered animal-species • Cultivation of rare agricultural plants • Cultivation (planting) of arable areas in winter

Differences between "local" and scientific scenarios

Scenarios formulated by scientists and local people each have their own characteristics (Table 14).

- **Local people stress economic and social objectives. Moreover, these scenarios try to test the possibilities of decreasing workloads on the farm level and diversifying economic activities on farms through services or agro-tourism.** This does not mean that the environment is absent from the objectives of local people, but environmental problems deal more with local and cultural concerns (cultural landscape and land abandonment) than with global and pollution concerns (water quality, biodiversity). Secondly, environmental problems are perceived as new economic opportunities (remuneration of new services such as landscape maintenance for local communities).
- **Scientific scenarios insist more on environmental objectives through constra**ints (organic production, limiting land abandonment or reducing intensification). Depending on the scenario, this can be accompanied by incentives for environmental practices or by hypotheses on new markets. These scenarios can be considered complementary to those formulated by the local people. The first type of scenario is global and aims to combine economic, social and environmental objectives (Glarner Hinterland, Moyenne Tarentaise). The second is an environmental scenario designed to test the feasibility of environmentally friendly practices from the social (workload) and economic (income) viewpoints.

Table14 : objectives forecasted in the "local" and scientific scenarios

Region	"Local" scenario	Scientific scenario
Oberes Drautal Austria	Reduction of working charge thanks to a financial support of external work forces (temporary or permanent worker)	Maximisation of extensive farm management thanks to agro-environmental incentives
Glarner Hinterland Switzerland	Development of agri-tourism activity to limit the dependence from federal support and to find alternative sources of income Enlargement of the current extensive grassland area from 7% up to 20%	Development of a new economic branch : "organic pastured beef" Conversion of all farm types to organic farming
Ostallgäu Germany	Implementation of scientific limits of sustainability in the model (no test by modelling).	Implementation of scientific limits of sustainability in the model (nitrogen balance, density of livestock, richness of species, working charge, energy input)
Moyenne- Tarentaise France	Development of new environmental services and agro-tourism activities as an alternative to dairy production. To reduce the working charge	Same objectives as local people scenario plus To limit extensification in pastures and to maintain elaborated practices in alpine pastures
Valle di Sole and di Rabbi Italy	To decrease the working family charge replaced by salaries (substitutive services to organise at local level)	To limit intensification in farm by the decrease of LU/ha

Modelling of scenarios provides information on the possibility of attaining sustainability by different means, namely constraints (rules, etc.), incentives (new agro-environmental incentives, etc.) or new production activities.

3.4.3 Analysis of scenario results

Analysis is based on the linear programming results and is completed by qualitative analysis.

Trend scenarios: Agenda 2000/AP 2002

Impact on gross margins (Table 15).
Concerning the impact of Agenda 2000 on gross margins, we observe great differences between farming systems and countries. Because they are most frequent in Austria, cattle breeding and fattening farms were modelled only in Oberes Drautal (Austria). **For Austrian cattle breeding and fattening farms, the increase in**

gross margins is due to the fact that premiums for suckler cows have risen significantly in this area (+ 30% to + 130% depending on the farm type).

For dairy farms, the situation is comparable between countries, i.e. the average drop in gross margins is - 3.6% in comparison with the situation in 1999. Only one farm type showed an increase in gross margins (type G5 in Germany) due to specific new premiums for organic production. The modelling results for gross margins do not take into account possible adaptation of farms over the next five years through increases in size and/or in productivity. Moreover, the trend observed in the past will certainly continue because small farms do not have sufficient income and medium and large farms will compensate this slight decrease in gross margins with an increase of the farm size.

Effects on the environment

We do not observe any impact of Agenda 2000 on the current situation in terms of stability of livestock density, continuation of land abandonment in the different areas (except Ostallgäu where there is no problem) and risks of water pollution.

Effects on the workload

Concerning the workload of farmers, there are no significant changes due to Agenda 2000.

Table 15. Effects on gross margin of Agenda 2000/AP 2002 for different farm types.

Farming system	France			Austria			Germany			Italy			Switzerland		
	Farm type	Current situation (euros)	Agenda 2000 (year 2006)	Farm type	Current situation (euros)	Agenda 2000 (year 2006)	Farm Type	Current situation (euros)	Agenda 2000 (year 2006)	Farm type	current situation (euros)	Agenda 2000	Farm type	Current situation (euros)	AP 2002 (year 2007)
Dairy farms															
Small econ. Size	**F3**	17 500	-1.7%	**A2**	47 500	-2.5%	**G3**	16 500	-2.3%	**I1**	11 700	-7.2%	**S4**	36 200	*-11%*
							G5	35 000	+6.2%						
Medium econ. Size	**F4**	55 400	-1.6%							**I2**	54 400	-3 %	**S3**	53 700	*-23%*
	F1	47 670	-2.3%												
Large econ. Size	**F2pa**	38 700	-6.3%				**G1**	90 700	-10.6 %	**I3**	110 000	-3%			
	F5	123 750	-1.9%				**G2**	43 500	-9.9%						
Cattle breeding & fattening				**A1**	20 000	+22.7%	**G4**	10 000	+16.8%						
				A3	39 300	+30 %									
				A4	51 000	+14 %									
Sheep / goat farms				**A5**	15 110	+13 %							**S6**	17 900	*-14%*

Farm types correspond to those defined in the farm analysis (Table 5).

The current situation refers to gross margins (in euros) for each farm model for the year 1999, that is to say before the implementation of Agenda 2000. **The Agenda 2000 reforms included in the trend scenario are 1) market reforms (intervention prices and direct payments for milk, beef, crops, and increased milk quotas), 2) the various Rural Development Plans refer to the situation as of May 2000. In France and in Germany, the situation was not known at this date and we assume a continuation of the previous situation concerning indemnities for LFA and agri-environmental measures (grass premium). In Italy and Austria, the new procedures for LFA and agri-environmental measures are known and resulted in an increase in indemnities for LFA and in the amount of agri environmental measures.**

For Switzerland, the trend scenario is AP 2002, i.e. the results are not comparable with the other regions.

"Local People" scenarios

Scenarios formulated by local people suggest answers to their goals, namely a decrease in workloads in Oberes Drautal and Valle di Sole, and an increase in diversification in the Moyenne Tarentaise and Glarner Hinterland. In Glarner Hinterland, due to the development of the new "Sleep in Straw" activity, we observe an increase in gross margins of + 4% to + 13%, depending on the farm types.
However, the model results suggest limits concerning the possibilities of implementing the local scenarios.

Cost problems in attaining some local objectives**. In Oberes Drautal (Austria), to maintain farm income at the current level and reduce the family workload by 20% would require a 40 to 50% decrease in the cost of temporary or permanent labour.** In Valle di Solle (Italy), a one day per week decrease in work replaced by salaried labour at a cost of 10 euros by hour would cause a 7% to 30% drop in the gross margin, depending on the farm type. In both cases, public subsidies would be the only means to attain such objectives. The effectiveness of such public subsidies is not yet well known and requires a precise estimation of the costs and advantages.

Consistency between economic and environmental objectives. **In the Moyenne Tarentaise valley, diversification (agro-tourism and environmental services) could create competition between new farm activities and current production activities. From a strictly economic point of view, some farms should abandon their land requiring high labour (steep slopes) and develop new services (including landscape management beyond farm limits paid by communities).** In this case, we note a limit to off-farm development of activities and incentives.

"Scientific" scenarios

Most of the scientific scenarios are based on an improvement in the environmental situation, but as a consequence, the economic performance of farms decreases. A first set of scenarios shows that the environmental constraints applied have clearly negative economic consequences. In Ostallgäu (Germany) or in Valle di Sole (Italy), the implementation of environmental limits (limiting the density of livestock per hectare) causes a decrease in income. **In some scenarios, even the subsidies intended to compensate the costs of environmentally friendly practices are not sufficient to maintain income**.

- In Oberes Drautal (Austria), the scientific scenario is based upon the highest level of agro-environmental incentives (OPUL measures, reg. 2078/92 and 1257/99), i.e. management without chemical fertilisers, maintenance of small landscape structures, cultivation of rare agricultural plants, keeping and breeding of endangered animal-species. Extensive land management to improve biodiversity and reduce risks of pollution has been introduced in the linear programming, e.g. maximum 20% of arable land, no use of herbicides, fungicides, mineral fertilisers, no purchase of hay, etc. Under this hypothesis, there is a general trend toward lower gross margins for all farm types (- 6% for suckler-cow farms, -36% for dairy farms, - 55% for cattle-fattening farms, - 25% for forestry farms) except for sheep and goat farms (0%). **Where implemented, the agri-environmental measures induce a decrease in crop production and necessitate a reduction in livestock numbers per farm. This has a positive impact on the nitrogen balance and biodiversity, but the amount of agri-environmental incentives do not balance the financial losses due to the reduction in livestock (sale of products and premium per head).**
- In the Moyenne Tarentaise valley, the obligation to improve pastoral practices in Alpine pastures causes the abandonment of the pastures in one farm type to avoid an important decrease in gross margins.

A second set of scenarios combines economic evolution and environmental constraints. In Glarner Hinterland (Switzerland), economic and environmental concerns could be satisfied by conversion to extensive meat production (organic, grazing beef production). This type of production combines a high level of direct payments (due to organic and extensive use of land) and high prices (due to the "Weidebeef" label program developed by a Swiss retailer). These two factors, particularly the second, explain the positive economic impact of the conversion from milk production to organic, grazing beef production (+ 33% in gross margins for large farms). Moreover, beef production requires less work than milk production and enables extensive use of agricultural land. Consequently, in Switzerland, organic beef production could be a future innovative solution for sustainability.

Table 16 : Effects of the different scenarios (Agenda 2000/AP 2002," local" and "scientific" scenarios) on sustainability ; comparison with the current situation (1999).

Topic	**Oberes Drautal** Austria				**Glarner Hinterland** Switzerland				**Ostallgäu** Germany				**Moyenne- Tarentaise** France				**Valle di Sole and di Rabbi** Italy			
	Current situation	Agenda 2000	Local people	Scientific	Current situation	AP 2002	Local people	Scientific	Current situation	Agenda 2000	Local people	Scientific	Current situation	Agenda 2000	Local people	Scientific	Current situation	Agenda 2000	Local people	Scientific
Environment																				
Risk of water pollution by agricultural practices		No mod	No mod	⇑		Var	No mod	⇑		No mod	⇑	⇑		No mod	No mod	No mod		No mod	No mod	⇑
Land abandonment and landscape maintenance		No mod	No mod	Var		⇓	⇑	⇑		No mod	No mod	No mod		No mod	Var	Var		No mod	No mod	⇓
Economy																				
Agricultural income		Var	No mod	⇓		⇓	Var.	⇑		Var	⇓	⇓		⇓	⇑	Var		⇓	⇓	⇓
Persistency of farms		Var	⇑	⇓		No mod	No mod	⇑		⇓	⇓	⇓		No mod	No mod	Var		No mod	No mod	No mod
Diversification of farms and added value with quality standards		No mod	No mod	⇑		No mod	⇑	⇑		No mod	No mod	No mod		No mod	⇑	⇑		No mod	No mod	No mod
Social																				
Working load		Var	⇑	Var		No mod	⇓	⇑		⇓	No mod	No mod		No mod	⇑	⇑		No mod	⇑	⇓
Social recognition of farmers in local society		No mod.	No mod.	No mod.		No mod	⇑	No mod		No mod	No mod	No mod		No mod	⇑	⇑		No mod	No mod	No mod

Scientific point of view (current situation 1999)

- (Rather) sustainable performance
- (Rather) unsustainable performance
- Mediums problems with sustainability or level of sustainability varying between farm types

Effects of Agenda 2000/AP 2002, local people and scientific scenario on sustainability (tendencies)

No mod	No clear modification of the current situation
Var	Direction is different depending on the farm type
⇓	Rather worsen performance with reference to the current situation
⇑	Amelioration of the current situation

Limits of scenario analysis

The need to assess the feasibility of scenarios at different levels

In the simulations, we applied a micro-economic approach on the farm level. The models show that new products and services (organic products, meat, agri-tourism, landscape maintenance for communities, etc.) can have positive consequences for farmers and for sustainability of agricultural land. But, these new activities are often economic niches and development will be progressive at best (Glarner Hinterland, Moyenne Tarentaise). Market analysis is necessary to assess the feasibility of these scenarios based upon new and innovative forms of agriculture (market potential, potential prices, collective organisation for promotion activities, etc.).

Strengths and weaknesses of the hypotheses analysed using linear programming

Linear programming does not represent the real world. But we tried to specify the hypotheses to be modelled using linear programming by taking significant precautions in terms of our methods:

- on the farm level, analysis of farming-system management to understand the choices of farmers;
- on the local level, analysis of the wishes of local people;
- on the European level, analysis of the detailed contents of Agenda 2000 (in May 2000).

However, one major limit to that type of approach must be mentioned. The human choices are difficult to forecast. For example, in some scientific scenarios, we test the highest level of agro-environmental incentives on farms. But it can not be predicted how the farmers will integrate the new agro-environmental measures on their farms. It is even probable that similar to reg. 2078/92 in the previous CAP, they will developed a variety of solutions depending on the different farm types and their attitudes toward environmental concerns (EC (1998)).

4 – PRIORITIES FOR SUSTAINABLE ALPINE AGRICULTURE AND POLICY RECOMMENDATIONS

The purpose of this section is to discuss the major concrete results of the SAGRI-ALP project:

- **the outlook for sustainable Alpine agriculture;**
- **policy recommendations to strengthen the implementation of sustainable agriculture;**
- **guidelines to formulate local plans of action in favour of sustainable agriculture.**

To infer perspectives, priorities and policy recommendations for sustainable Alpine agriculture, we used four main tools representing the major results of the SAGRI-ALP project:

- the objectives of sustainable agriculture from the viewpoint of local people and on the basis of the political texts (European and world levels) (task 1);
- an assessment of sustainability involving both scientists and local people in five Alpine areas (tasks 2 and 3) (Table 17);
- a simulation of the foreseeable impacts of Agenda 2000 (CSE (1996)) and of the local and scientific scenarios (task 4).

4.1 Outlook for sustainable Alpine agriculture

4.1.1 Alpine agriculture and the environment: crisis or worrying trend ?

As a scientific team working both on the Alpine level and in close contact during the future workshop with local actors including farmers, community representatives and nature protection actors, we have to answer one major question: should we shape the image of a current crisis in relationships between environment and agriculture in the Alps ?

Our reply is clear and the team consensus was no, but the current trend is leading to a worrying future.

We will emphasise two main points relevant for further policy recommendations:

1. **In the Alps, despite some environmental problems related to negative impacts (intensified areas where in a simplified manner "agriculture damage environment"), in the major cases farming and the environment have to be explored in terms of environment as a result of agriculture practices (in a simplified manner "agriculture built up environment").** The analysis of objectives in political documents (task 1) shows that historically the first policies for integration of environmental concerns into agriculture was established to reduce the negative impact of agriculture. Today, political texts also stress the beneficial impact of agriculture on the environment. In the Alps, to strengthen such evolution of policies strategy is of major importance. **Even more, the current major threat to environment and agriculture relationship, in the Alps is the loss of agricultural working force used for the maintenance of land.**

2. **In the Alps, we have to deal with:**
   - **a state: natural and cultural richness (landscape) of the Alpine ecosystem in Europe**, the high level of aspirations of environmental and landscape qualities for the Alps related to tourism, local inhabitants, nature protection institutions and NGO's ;
   - **a worrying trend related to the evolution of agriculture. In the majority of the areas we face the end of the traditional farms** (closure of farms, increasing of livestock number and hectares

per farm and worker) **who was a manager of his own land family heritage for internal reasons to the farm. For economic reasons, and reasons of workload , present day farmers feel more and more like producers of goods and managers of economic enterprises.** Such an attitude is common with young farmers, who separate distinctly meadows with high agronomic value usable for agricultural production and poor and difficult fields which could be maintained for landscape reasons with a financial support from society.

Table 17: strengths and weaknesses of alpine agriculture

Strengths of alpine agriculture	Weaknesses of alpine agriculture
High ecologically, cultural and aesthetically richness especially in the highest altitudes: general quality of landscapes, biodiversity, with high portion of protected areas. **Typical agriculture products** which allow good prices (France, Italy). Good image of alpine products. **Opportunities of off-farm income:** agro-tourism represents a general development opportunity with the valorisation of mountain rural heritage (landscapes, traditional practices and products). Ski resorts bring regular winter jobs for farmers. **High potential of consumers for products and leisure activities due to tourism in alpine areas**. **High social demand for new functions of agriculture:** landscape keeping, services, local products. **Strong collective organisation of farmers:** milk and apples co-operatives, marketing of cheese, management of alpine pastures are traditional especially in France and Italy. **Good forage potential:** presence of huge alpine areas favourable to agriculture and offering a large forage potential (France and CH) which balance other natural constraints. **Engagement and welfare of the farmers:** most of the farmers have deep regional roots and traditional relations to their land. **Capacity of innovation of farmers and willingness to find new partnership with local society** **Local willingness to develop new partnership in favour of sustainable agriculture**	**Natural constraints :** high percentage of usable agricultural area is characterised by unfavourable conditions for farming. Steeps slopes, severe climatic conditions with short vegetation period. **Despite specific political mountain measures maintenance of some difficulties:** • **Economy :** agriculture income lower than in plain • **Work conditions:** work overload, especially in summer. • **Closing down of farms** and decrease of younger population • **The modelling shows that this current trend will certainly continue with Agenda 2000**. **Emergence of environmental problems:** extension of shrubs, risk of land abandonment, increase of wild fauna damages (Italy), use of fertiliser and pesticides on intensive pastures (Germany), risks of microbiotic contamination of water catchments or groundwater (France, Austria). **Low social recognition of farmers and Conflicts between agriculture, tourism and urbanisation:** problems of farm smell in villages and lack of area to spread manure. Competition for land with urbanisation on shelves. **Few diversity of agricultural products in some areas:** milk or cheese production (France, Italy, CH, Germany), milk and forestry (Austria), cheese and fruit (Italy). **Problems of marketing:** in Italy, Austria, CH, for basic products (milk) consumer markets are far away from production places. In Germany, there is a great dependency of farms on few milk factories, and a lack of processing structures for high quality products. **Awareness about environmental concerns:** limited to local concerns for the majority of farmers.

4.1.2 Bottom-up capacities for sustainable Alpine agriculture development

In the different research areas positives experiences concerning sustainable land use can come with the help of concrete political tools:

- In the field of rural development, in Glarner Hinterland (Switzerland), the implementation in the seventies of the Investment Support Act for the Promotion of Mountain Areas (Investitionshilfegesetz, further referred to as IHG) has led to a certain improvement of the economic situation in most of the less favourable Alpine regions in Switzerland. In order to obtain financial support, IHG-regions are obliged to work out a development concept, which includes also a diagnosis of the situation and the perspectives of agriculture. As an IHG region, Glarner Hinterland has its own organisation (called Regionalverband) formed by communities, responsible for the elaboration of the project.

- Quality products: organic agriculture, label, integrated production. In Bassa Valle di Sole, the foundation during the Seventies of the Agricultural Association, the S. Apollonia Fruit Association COFSAC scarl, has permitted an evolution from a non expanding economy to an economy for the market which was accompanying of investing in structure (i.e. rain plants). A market in the field of quality was found which gave the possibility to sell the product at a good price. As a result apple production increased and farmers came back to lands previously abandoned in the seventies.

- AOP products where territory and quality are associated (typical products) like Beaufort in Moyenne Tarentaise. This channel was organised by the farmers themselves where different topics were developed: high price of cheese by a quality policy (no silage for cows…) at the origin of a high price of milk (+ 50 % in comparison with the average French price), will to keep an animal feeding based on use of local grasslands (limitation of production at 5000 kg by cow and by year, limitation of buying of feed outside the AOP area). This policy product has participated to the maintenance of an important agricultural fabric particularly by comparison with other high mountains regions where agriculture has quasi disappeared (Oisans in France).

- "GAEC de village" (Groupement Agricole d'Exploitation en Commun). In France, farmers have the possibility to join different farms in one structure named GAEC. In the "GAEC de village", one of the objectives is to have a better organisation of the work, to improve the social life, to limit the investment in materials. Today such an innovative organisation of work allows in some farms an efficient division of labour between production activities (milking, cheese processing, etc.) and agricultural practices for the maintenance of the territory or for environmental concerns.

These results show the capacity of farmers to use opportunities and to have self organisation. The implementation of collective organisations between farmers (for the use of Alpine pastures, to process and to market products, etc.) is a tradition in Alpine agriculture and generally in mountain agriculture (Bätzing (1991 ; Bazin (1995) ; CE (1995 ; Euromontana (1997). Now the main stake is to develop real consultation and co-operation within the agricultural sector and other local people. Co-operation between different actors could be the key to success of policies linked to the territory which includes the new demands of society and the current assets and constraints of Alpine agriculture in its diversity.

4.1.3 Management of the new relationships between agriculture and society

Alpine agriculture, through its very close links with other activities, plays an essential role in maintaining the typical character of mountain regions. Alpine agriculture is linked to its territory and is not only a market-oriented agriculture. Today, a wide set of actors is concerned by agriculture and agricultural land in the Alps, in the fields of tourism, environmental protection, communities, administration, etc. Today, agricultural land is not only a family heritage, it is also a common heritage for the whole of society. This situation means that agricultural land must be managed in a system involving a variety of actors. Such a

collective governance is a necessity both to manage agricultural land according to objectives beyond farm level (Roeling (1994) and to facilitate the evolution of farmers profession from producers of food to a multi-functional profession including maintenance of ecosystems and different services. Policies and administrative documents stress the limits of top-down approaches to environmental concerns and emphasise the motivation and participation of the population. This type of action is very different than a simple encouragement with external incentives in favour of more environmentally friendly agricultural practices. **To manage agricultural territory taking into account integrated rural development requires a number of factors, including a decision on the desired direction, identification of common objectives between actors and institutions, and the establishment of co-operative organisations to define, implement and manage the project, etc.**

The participation of farmers and other local stakeholders in the "future workshops" in the 5 research areas of the Sagri-Alp project, and the intensive discussions people have had in these meetings have shown that local people are conscious of current Alpine evolutions, and willing to find new partnerships for local development. In this context and considering the diversity of the Alps, it would appear that local groups of actors could be a relevant level of management in finding acceptable solutions to meet the requirements of tourism or other activities and to take into account the local natural and cultural environment. On this level, our experience shows that horizontal interrelations between different categories of actors are possible and even more desirable for local actors. In local projects, actors are more easily motivated and it is easier to strengthen new co-operative practices targeting sustainable agriculture for territorial development.

4.2 Policy recommendations to strengthen sustainable agriculture

4.2.1 Priorities for sustainable Alpine agriculture

The Alps are and are seen as an area of preserved nature with a specific culture. This image is in part a "product" of agriculture. This desirable state of the landscape is sensitive to changes in the overall human and environmental conditions. For this reason, it is necessary to maintain agriculture for environmental, economic and social reasons.

The first priority is therefore to maintain the economic existence of agriculture and to enhance its multi-functionality. The major objectives of sustainability are to:

- **limit the reduction in the number of agricultural work units;**
- **reduce the social differences between farmers and the rest of society** (lower income, higher workload);
- **limit land abandonment and maintain cultural landscapes;**
- **preserve natural resources** (water quality, biodiversity);
- **develop new agricultural services including agri-tourism, cultural activities, etc.**

The second priority is the "promotion of local projects involving local people and targeting sustainable agriculture integrated in rural development". **It is related to the promotion of the principle of participation and to objectives aiming to take into account local diversity in development projects.** The capacity to innovate and horizontal relations exist among local people and farmers who have shown their ability to look beyond agriculture (part-time farming, etc.). The interest shown by local actors in the future workshops and political objectives (task 1) targeting local diversity and the promotion of local initiatives allow us to formulate this second priority. Incorporation of sustainability in agriculture requires deep changes in the farming profession and better identification of the desires and demands of local society. This cannot be achieved by a top-down approach, which is difficult to understand and to communicate to both the farmers and the local population. Farmers feel this type of approach is external and unsuited to the local situation. Moreover, this approach to problem solving risks not taking into account the diversity of the Alps.

The third priority concerns the improvement of relations between the local and global levels. The implementation of sustainable agricultural land use in the Alps must take different scales into account. The vertical relationships between different levels is of great importance and the principle of subsidiarity requires a new interpretation. **The major requirement is to develop EU policies which go beyond simple hierarchical links between the global and the local levels**. **The notions of consistency between policies (market measures, rural development plans, community initiatives, national and regional policies) and administrative complexity are also of major importance.**

4.2.2 Impact of current policies and emerging policy recommendations

Concerning the impact of current policies, the SAGRI-ALP project sheds light on a number of points.

- **Compared to the previous CAP, Agenda 2000 (market reforms + rural development plans) will not have any major new impact on the sustainability of Alpine agriculture.** The current observed trend in terms of agricultural income, workload, land use and the environment will continue. This result of the modelling techniques is based upon a number of hypotheses and some factors impossible to predict can affect this trend, i.e. planning the use of agro-environmental measures in farms, etc. Another major result that must be stressed is the considerable importance of incentives for Alpine agriculture. **If all incentives paid directly to farmers were eliminated** (direct payments for market measures, agro-environmental subsidies, incentives for less favoured areas, etc.), **the result would be a considerable decrease in gross margins**, systematically higher than 30% in Austria, and 25% to 34% in France (only 12% for large farms with Alpine pastures). In every case (Europe and Switzerland), the decrease in agricultural income is so sharp that the long-term continuation of the activity is deemed doubtful. **Consequently, maintaining public support for Alpine agriculture is of major importance. This will be a major concern in the future, if incentives for less favoured areas are eliminated or if compensatory payments are modified following the WTO negotiations**.

- **Product prices and milk quotas**. The current success of some local Alpine products (high added value) with a collective organisation and official protection (PDO) shows that it is possible to achieve high prices (e.g. local cheeses in France and Italy or the possible conversion of farms to organic beef production in Switzerland). If Alpine farmers received only world market prices (e.g. for milk), the disappearance of farms and the related risk of land abandonment would increase. World prices do not provide sufficient income due to the extra costs of production under the severe Alpine conditions. **Polices enhancing the development of quality products (farm production and structures of marketing) and a European legal framework to protect and promote quality and local products would be major elements in efforts to improve the prices of Alpine products. For the same reasons, the possible elimination of milk quotas on the European level could have dramatic consequences for Alpine agriculture and land. The economic competition between low areas and Alpine regions for milk production runs the risk of eliminating more Alpine farms.**

- **Farming systems, workloads, the environment and the economy. The purpose of several policy tools (e.g. agro-environmental measures) is to reimburse farmers for the costs and labour connected with positive non-market products such as quality management of nature and of our cultural heritage (Fischler (1999)). The calculation of incentives is based upon an assessment of the supplementary costs and labour incurred by these services generally estimated in Euros per hectare (or per livestock unit). The results of the scenario analysis in SAGRI-ALP show two limits of such an approach.**

  1- **It reinforces the current trend to increase the size of farms to obtain sufficient income.** This phenomenon is well known and policy makers use different means in specifying measures to limit it, including minimum and maximum threshold values and access conditions (including eco-conditionality).

2 – **But above all, on the farm level, this approach diminishes the consistency between different components of sustainability. Excessive workloads are a major problem for sustainability in Alpine agriculture. Agro-environmental measures imply additional work (landscape maintenance, haying poor meadows for biodiversity, etc.), but the amounts paid and the attribution conditions do not permit sustainable adaptation of farm management to this new function.** The only way for farmers is to fulfil this type of contract with additional work. The current level of incentives paid per farm make it impossible to reduce the livestock and transfer working time from production to the environment. Labour costs for temporary or permanent workers are too high, the duration of contracts (five years) introduces an element of uncertainty and investment in equipment is rarely possible, etc., etc. This is particularly true for small farms for which direct payments calculated per hectare or per livestock unit are not suitable. **The improvement in the environmental component of sustainability and the resulting increase in farm incomes due to agro-environmental incentives are offset by a worsening of the social component of sustainability due to the increase in workloads for farmers. A major current requirement is to draw up policies and incentives encouraging an integrated approach, on the farm level (and/or the local level with collective farmer organisations), for the three sustainability components, social (workloads), economic and environmental.** Some existing policy instruments or local action (e.g. CTEs (contrats territoriaux d'exploitation) in France, some policies implemented in the framework of reg. 2078/92, the "integrated agriculture" policy in Switzerland) target such an integrated approach and could be used as a framework to develop this type of strategy.

- **Top-down and bottom-up approaches**

  1. **In the fields of environmental, economic and social policies, local people stress problems concerning local implementation of the principle of subsidiarity.** For example, in the Moyenne Tarentaise, there are some negative effects due to the success of Beaufort PDO cheese (e.g. concentration of farms). There are no usable means to counter this problem because 1) the principle of subsidiarity is often implemented by the hierarchical distribution of competencies between levels. The differences between countries are considerable but in all countries, there are few relations between levels and they are generally limited to adjacent levels. **Consequently, depending on the country, there is little leeway for implementation of some political tools on the local level; 2) local actors are not aware of the entire range of EU tools, or tools appear complicated and difficult to manage (Leader, Interreg, etc.).**

  2. **Policies acting simultaneously on different levels are of major importance. In Switzerland, with the new policy law AP 2002, the major part of direct payments are now tied to ecological performance. For an Alpine farm for instance, this means devoting at least 7% of land as an ecological area (e.g. extensive or non-intensive use), maintaining a correct nitrogen balance and ensuring sufficient capacities for organic manure given a winter period of five to six months, etc. This change in policy was started in 1990 and has resulted in a complete modification of Swiss agriculture. In 1998, 73% of all Swiss farms has initiated the switch to this form of "integrated production". However, in spite of this reform and the considerable percentage of direct payments in Swiss farm revenues (gross margins would drop by 80 to 100% if all incentives were eliminated for all farm types), the future workshops were a great success in the research area. This is because the AP 2002 reform, though popular in Swiss society as a whole, is often not to the liking of farmers because it modifies their trade and place in society (Mieville-Ott, (2000)). The reform has not eliminated the need for new relations between agriculture and local society, on the contrary, the new directions that society is proposing for agriculture increase the importance of this debate.** For the participants in the local Swiss group, this type of cooperation offers the opportunity to take into account local diversity, the possibility for farmers to choose and to specify the type of measures, discussions with local actors in view of identifying a new social function for farmers, innovative ideas, etc. Another point is that today, in the AP 2002 context, the Swiss cantons have no means to manage and adapt the volumes and the priorities to regional requirements. Recently however, there have been efforts to transfer responsibility

for a larger part of the direct payments from the national to the regional level. The objective is to create more flexibility and to manage farm structures and agriculture according to regional needs.

In the context of efforts to establish sustainable agriculture, it is therefore important to succeed in combining general agricultural support and orientation policies with supportive policies for local action. To that end and in compliance with the principle of subsidiarity, it would appear necessary when locally implementing general policies to maintain a certain degree of flexibility (in particular for agri-environmental measures and certain aspects of rural-development regulations such as the conditions governing access to incentives in less-favoured areas). **This would be the means, while respecting the overall goals of the general policies, to adapt certain aspects of their implementation of the goals of local projects (e.g. goals formulated in a Leader project and/or in a Local Agenda 21** (Laferty (1998)). **It is true that certain policies can already be adapted, but depending on the country, implementation of the subsidiarity principle is often limited to the upper levels, i.e. regions, Länder and provinces, and on the local level there is no or only very little leeway for implementation of political tools. This recommendation requires also to find a tender balance between the needs of administrative simplification and of local flexibility.**

4.2.3 Summing up: Different levels of policy recommendations

In compliance with the three priorities defined for Alpine agriculture:

1. **maintain the economic existence of agriculture and enhance its multi-functionality;**
2. **promote local projects involving local people and targeting sustainable agriculture integrated in rural development;**
3. **improve the relations between the local and global levels;**

the policy recommendations emerging from the SAGRI-ALP project may be organised in several groups (Table 18).

- **Maintain public support for Alpine agriculture taking into account the general world and European trade organisations** (decoupled aids, environmental constraints, etc.) and the unbalanced economic and social conditions between low-land and mountain agriculture in Europe. This support must include:
  - **organisation of the different market measures to ensure a minimum degree of stability in farm income** (including the system of milk quotas or the replacement system to manage agricultural production in case the quotas disappear) ;
  - **a policy for less-favoured areas, or in case that disappears, easily accessible green payments capable of encouraging overall maintenance of an Alpine agriculture** necessary for environmental, cultural and social reasons; (e.g. green payment simply based, on the farm level, on livestock density threshold values and maintenance of grassroots agricultural practices (grazing or hay cutting) necessary for environmental reasons ; e.g. like “prime à l’herbe” in France in the framework of reg. 2078/92).
  - **a European legal framework to protect and promote quality and local products**.

- **Improve the vertical relations from the European to the local level by clearly defining margins for flexibility in the local implementation of certain policy tools,** notably especially in the Rural Development Plans. The goal is to ensure consistency between large-scale policies and local projects with respect of a need of a balance between the wishes of administrative simplification and of local flexibility.

- **Draw up policies bringing together in an integrated approach, on the farm level (and/or the local level with collective farmer organisations, e.g. a work bank to solve excessive workloads ; a collective promotion and marketing of products) the different economic, environmental and social components of sustainability**. In particular, that means finding a way to calculate environmental incentives based not only on an estimation of the additional costs per contract hectare (or livestock unit),

but also taking into account the small average size of Alpine farms (i.e. the definition of a minimum threshold for agri-environmental incentives per farm in the framework of a contract concerning the entire farm).

- **Establish supportive policies for local action favouring local participation and adaptation to local situations** using different procedures or legal frameworks such as Leader +, Local Agenda 21, ... The local territorial level is concerned with relations between agriculture and society as a whole. To establish local projects, the existing policy tools exist are not linked with other policies and there are few possibilities to specify the implementation of these general policies according to the goals of local projects (however examples such as the CTEs in France and rural development programs negotiated on the local level in Switzerland should be mentioned).

Table 18: Political framework for sustainable Alpine Agriculture

Priorities	Strategy and current policy tools	Level of definition and specification of policies
Maintenance of agriculture and enhancement of its multifunctionality • Limit the reduction in the number of work units • Reduce the social differences between farmers and the rest of society : lower income, higher workload • Limit of land abandonment and maintain cultural landscapes • Preserve natural resources (water quality, biodiversity) • Develop new agricultural services including agri-tourism cultural activities	**General economic frame** : Stability of market policies: → *regulation of common organisations of market* Less favoured areas policies → *Rural Development Regulation (reg 1257/99)* To protect and promote quality and local products ® *Reg 2081/92 and reg 2082/92 on PDO and label products*	European level; Existing leeway on National or Regional levels Juridical frame at European level
	Environment : To develop eco-conditionality in support for agriculture To promote farming systems relevant for the local environmental concerns (land abandonment, intensification…) and/or in the line of multifunctionnality (services, agro-tourism…) ® *Rural Development Regulation (reg 1257/99)*	European level European, national and regional frames ; local flexibility to improve
Improvement of relations between local and global levels	**To develop links between levels** *Developing flexibility in the implementation of the above policy tools based upon the objectives of local level projects*	
To promote local projects involving local people and targeting sustainable agriculture integrated in rural development. • Improvement of mutual understanding between agriculture and society • Strengthening bottom-up initiatives to favour local co-operation • Creation and development of new partnership between agriculture and the whole local society • Taking into account local diversity	**To develop and to implement local action plans in favour of sustainable agriculture** According to the experimental dimension of such action plans a scientific assessment of their implementation is necessary The further table shows the different actions planned during the SAGRI-ALP project ® *Leader +, INTERREG 3, local agenda 21 (local project + network between projects)* ; **in the current situation it is more easier to find policy tools to establish local plans than to implement them**	Policy tools permitting a maximum of local initiative

4.3 Guidelines to establish local plans of action in favour of sustainable agriculture

The end of the program carried out in the five research areas confirms the interest and the effectiveness of the process used to mobilise local actors and accompany them in the elaboration of a sustainable-agriculture project, from the territorial-assessment phase to the elaboration of a plan of action. The success of the process in the five research areas shows that the tools and methods used are well suited to the diversity of the Alpine territories and are reproducible. The SAGRI-ALP project enabled the elaboration, testing and validation of an efficient process to involve local people in the formulation of plans of action for sustainable agriculture in the Alps (Table 19).

This guideline is a practical result of the SAGRI-ALP project corresponding to the second priority for sustainable Alpine agriculture, i.e. the promotion of local projects involving local people and targeting sustainable agriculture integrated in rural development.

In order to ensure wide access for development actors of the Alpine range, this process has been structured and organised in a methodical set of "Guidelines to establish local plans of action for sustainable agriculture". These guideline present the successive steps of the process, their goals, as well as the tools, methods and expected results at each step.

Table 19: detailed actions planned in local projects in favour of sustainable agriculture

Level of action	Objectives	Corresponding actions
Agricultural production systems 1. Farming systems	To develop new and improved farming systems aiming at: - Developing environmentally-friendly practices - Diversifying and improving agricultural income	**1. Improvement of agricultural practices :** test of environmentally friendly practices (land use maintenance activities, water quality, soil erosion…). **2. Evolution of farming systems : demonstration of innovative settlements or diversification of farms**. - Organic farms - Multifunctional farms : agro-tourism activities, services… - New local products (goat cheese, wool, beef…)
2. Agricultural products markets and collective organisations of farmers	To improve farm income and quality of life by development or reinforcing of : - management of local agricultural services and quality products - collective organisations between farmers	1. **Development of local processing :** improvement of existing structure in refining local agricultural and forestry products 2. **Development of collective promotion and marketing of local agricultural and forestry products.** 3. **Creation and test of functioning for one community of a collective farmer's structure, aiming to :** - Develop farmer's offer of services (i.e. landscape maintenance, manure management, …) - Organise a "labour bank" between little and big farms, to solve excessive working loads, and create new services.
Local level : **New partnerships at territory level**	- To improve public awareness for situation and importance of alpine agriculture - To improve farmer's awareness for environmental and local population concerns - To create or enlarge partnerships between agriculture and local society, towards ecological, economical and social purposes.	**Permanent mobilisation of a group of local actors** (farmers and other stakeholders), to define and manage all actions during the whole programme **Raising up awareness for agricultural concerns** and underlining the role and the needs of agriculture: projects with regional education institutions (ground schools); creation of public events (visit of farms). **Elaboration and implementation of specific training sessions for farmers aiming to** : 1 - promote and facilitate the evolution of farmer's job; 2 - raising farmer's awareness for environmental concerns **Materialisation of new partnerships between agriculture and local society beyond the demonstration project :** contracts between farmers and local communities ; Drawing up of "sustainable agriculture charter" as part of development plans for rural areas.

Complementary action at the Alpine level is planned to strengthen the exchange of experiences at the Alpine level between the actors: Alpine conferences; preparation of an Alpine memorandum.
Each local action plan don't forecast to implement all actions, depending of the local objectives a limited set of actions was specified in each area by local people..

4.3.1 Why develop guidelines to establish local plans of action for sustainable agriculture?

The goals
Favour, on the local scale, contacts between farmers and other actors in view of:

- the elaboration of a local sustainable-agriculture project, meeting environmental, economic and social objectives over the short and mid-term;
- the concerted implementation of the corresponding plan of action.

The process in few points
This process aims to mobilise a group of local actors and to accompany them in the progressive elaboration of the project, providing:

- a framework for contacts and progress from the assessment phase to the complete project;
- direct support in terms of methods, providing the group the knowledge, tools and methods needed to carry out the work steps, notably indicators and information for the land-sustainability assessment, prospective methods for the elaboration of evolution scenarios over the mid-term, an evaluation system to monitor the action.

Why is a new process for sustainable agriculture required? What does it offer above and beyond the current action and measures?
It may be used to:

- reposition agriculture in local development, according to currently emerging territorial policies;
- highlight consultations between local actors instead of simply providing information;
- mobilise actors for the definition of objectives and a mid-term project before formulating a plan of action;
- innovate in creating partnerships in order to bring out the potential of local complementarity.

4.3.2 The guideline process in detail

↳FIRST PREREQUISITE - Have the territory assessed by scientists

- To understand the relationships between actors and the different points of view on agriculture and its evolution (what are the stakes, what are the desires?).
- To collect the data necessary for the assessment of agriculture and the territory from the economic, social and environmental viewpoints.
- To establish a synthetic list of indicators to enable an assessment of agricultural sustainability from the point of view of scientists and local actors.

↳SECOND PREREQUISITE - Constitute a work group to take part in the process

- **The local group, the driving force in the process**. **The work group of local actors is in charge of formulating the assessment, establishing the scenarios for change and drafting the plan of action.** Consequently, the local group must:
  - represent the diversity of actors concerned by agricultural development and its relation with the local environment, i.e. farmers, representatives on the communal level, mayors, economic actors highly dependent on agriculture (tourism, forestry industry, environment), economic actors with no dependence on agriculture, associations, etc.;
  - bring together motivated people for a long-term project and constructive consultation with other local actors. During the assessment phase (the next step), we can identify the diversity of actors, detect the nature of social relations (who speaks to who, what can be a source of conflict or, on the

other hand, a source of convergence). A group of about 20 people seems to be a good compromise between representativity and smooth operation.

- **Participation by one and all**. **To ensure the success of the future workshops, a number of factors are essential, namely involvement, speaking rules, listening to others, expression of ideas, creativity, sharing the same goals and respecting the different members, no judgement of others. One of the main points of the process is to focus on the construction by the actors, rather than by the experts**. Consequently, it is very important before starting to present the guidelines, the general rules of the game and the roles of the various participants.
  Some main points that should be stressed:
  - a progressive and structured process, with a chronology of the phases, a set number of work sessions, expected results.
  - clear definition from the start of the different roles. The local group plays the leading part, accompanied by the organisation team (experts, organiser, mediator) which provides the procedures, methods and assessment tools.
  - a written summary of each meeting, listing the main points, that is sent to the members of the local group, to avoid and misunderstandings.
  - an effort to avoid focussing on purely short-term considerations, which means accepting uncertainty and favouring creativity. This last point is a key condition for success.

↳ SHARING THE TERRITORIAL ASSESSMENT

Using the assessment provided by the scientists, local people analyse the present situation and identify the strengths and weaknesses of agriculture and the territory. They discuss farming activities and the farming job situation, the local social relations, the desires of the population in the territory, etc. The organisers must take care to structure the discussion with groups of topics, e.g. farms (income, workloads, land use, livestock), regional concerns (tourism, traffic, infrastructure, rural areas), administrative affairs (policy, administration, bureaucracy), etc. **At the end of this step, the local group should have defined and structured the main concerns and objectives for sustainable agriculture from their point of view. On the basis of these main points, they formulate hypotheses for change which constitute the starting point for the formulation of the scenarios**.

↳ IMAGINATION PHASE

On the basis of the hypotheses, the group builds up common set of consistent and realistic ideas for sustainable agriculture and land use over 20 years. The precision of these ideas must be high, taking into account every component of local development, i.e. which kinds of activity, what population and where, which farm types and networks, what local political organisation, which relations between activities, etc.

At this point, the role of the organisers is, on the one hand, to favour group creativity (with specific tools, brain-storming, the "Metaplan" method, small groups, expression of individual dreams and wishes), and on the other, to ensure the consistency of the ideas. **At the end of this step, the result should be scenarios for a possible and desirable future for sustainable agriculture, capable of reinforcing the weak points detected in the diagnosis and ensuring social recognition of agriculture and its many roles in the territory**.

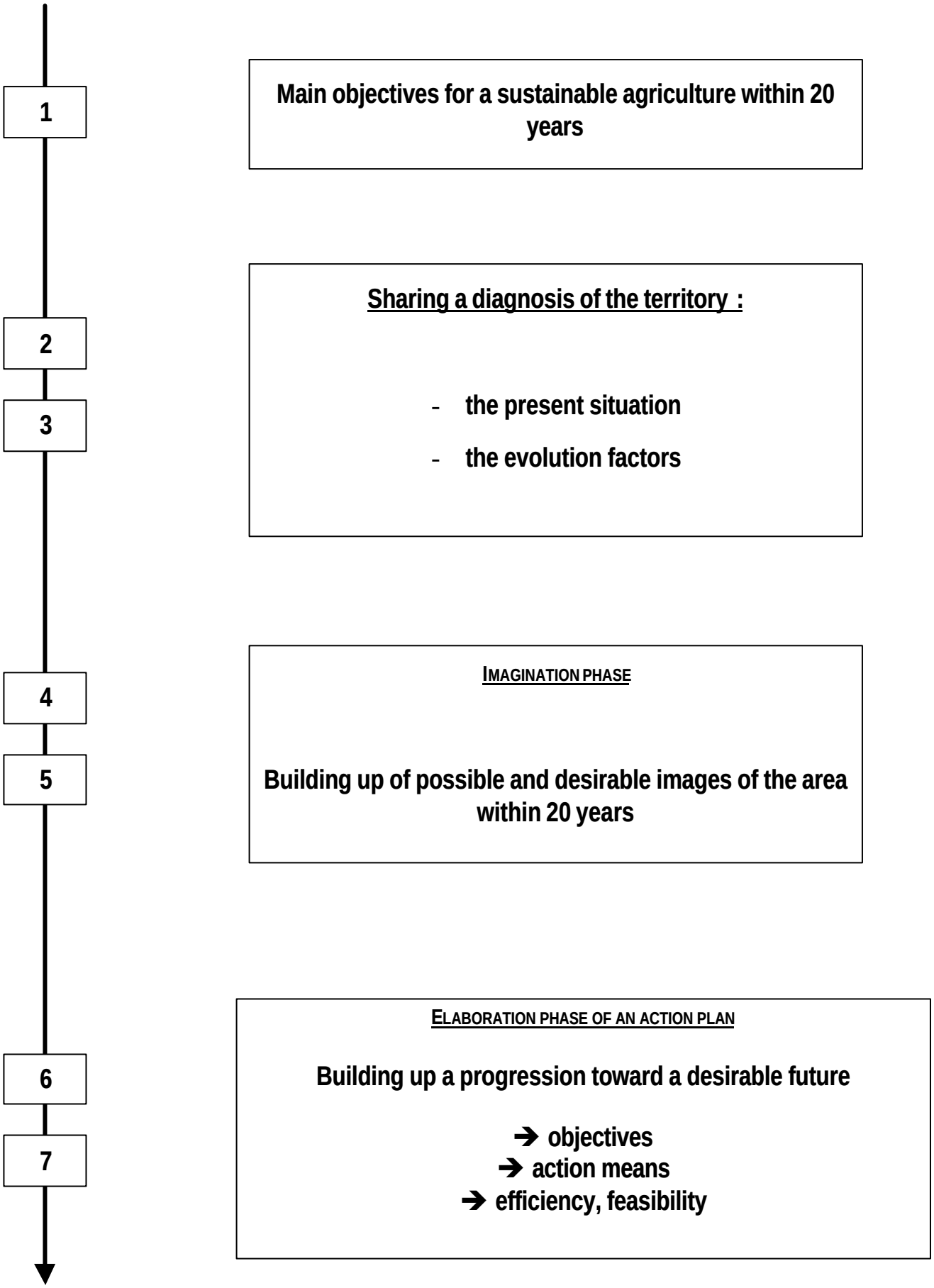
It is possible to establish and compare different scenarios, reflecting different points of view on the future. For example, "specialised dairy farms with quality products" versus "development of multi-functionality in farms".

↳ ELABORATION PHASE OF A PLAN OF ACTION

This is the translation phase of the desirable ideas into concrete plans of action. The local group identifies a succession of steps that must be implemented and the means that must be mobilised to realise their "dreams".
The scientists carry out a computer simulation of the different scenarios in order to evaluate their impact on sustainability and help the group formulate their plan of action with better chances of success. **At the end of this phase, the result is a collective project translated into an operational plan of action.**

The process presented above is reproducible and could be used for the elaboration of further local projects for sustainable and multi-functional agriculture. To enable practical use of this process, our objective is to publish a handbook usable by local leaders and persons involved in rural development. This management framework will include a complete presentation of each phase of the process, including detailed step-by-step procedures, check lists, elaboration of alternative methods, work techniques (leading the local group, scientific assessment with indicators of sustainability, farm and scenario analysis), etc.

Figure 7 : The main steps of the build-up of a concerted project, in 7 working sessions of a local group of actors



5 - DISCUSSION ON THE METHODS EMPLOYED

5.1 Developing tools at the interface between science and policy

5.1.1 From the principles of sustainable agriculture to the conditions for their implementation in the Alps, the assets and originalities of a specific method

The analysis of the sustainable-agriculture concept, translated into the legal and political documents and discussed in the debates among the local actors on the Alpine scale, led us to define a convergent understanding in order to achieve development toward sustainable agriculture in the Alps. Three major points emerged.

- The need for an integrated approach to sustainability combining ecological, economic and social objectives.
- An implementation clearly related to integrated rural development and taking into account the local diversity of territories.
- The need for participation by local actors in the implementation process of sustainable development.

This led us to set up the "Guidelines to formulate local plans of action for sustainable agriculture", presented in the previous chapter. These guideline are based on two principles:

1. systemic and general assessment by scientists of the sustainability of local agriculture.
2. mobilisation of local actors in future workshops in order to formulate a sustainable-agriculture project.

Systemic and general assessment of agriculture by scientists. This assessment combines a number of tools:

- a set of indicators for sustainable agriculture;
- a system analysis of farms and territory using functional diagrams;
- linear programming which may be used, afterwards and for the different farming systems, to test the impact of scenarios on the progress of sustainability (income, work load, land use and agricultural practices).

The results of this assessment carried out by scientists are organised in synthetic form to enable presentations and debates in the groups of local actors. However, we preferred a participative process with local actors and the results are not presented systematically, but according to the needs of the group that formulated the assessment. **The goal is thus to allow local actors to take into account the global issues of sustainability in their own assessment of their territory. The main difficulty in terms of the method consists in combining the complexity of viewpoints with the synthesis and the organisational qualities required for restitution in view of understanding and debate by a local group.**

The mobilisation and cooperation between local actors, whether farmers or not, for the elaboration of a local project is of primary importance. The process is based on the mobilisation and the organisation of a local group showing the diversity of all actors concerned by agricultural development. **The main difficulty concerns the diversity of those actors** (Mermet (1992) ; OECD, (1998)). **How can different actors pool their collective knowledge of their territory and its agriculture, and define together shared objectives and a plan of action for sustainable agriculture?** The future-workshops method (Jungk & Muller (1996)) is an effective means to accompany local groups for sustainable agriculture projects, from the assessment stage to the formulation of the plan of action. Local actors must:

- carry out their own sustainability assessment;
- formulate scenarios for change over the medium term;
- formulate a sustainable-agriculture project.

5.1.2 Governance process and local groups of actors

As a development process, sustainability is still an emerging process. Its implementation has to face the difficulty of finding a common line between different scales of development processes and decision levels, from global to local levels (Meppem & Gill (1998), Brodhag (1999)). A recent review of results from EU research programs (Schleicher-Tappeser & Strati (1999)) in the field of sustainable regional development shows the importance of the integration of both horizontal relations (implement a collective learning process and develop new cooperation practices) and vertical relations (principle of subsidiarity), to build up common knowledge on sustainability and gain in efficiency through coordination of different levels of governance and policy support.

To tackle the horizontal relations between local actors, we created, in five areas (one per country) a group of people numbering approximately 15 to 20, including local people and persons involved in rural development (farmers, mayors of communities, members of environmental-protection NGOs, the tourist industry, etc.).

The vertical relations were addresses by the scientists acting as experts in the local groups. They carried out a sustainability assessment from a scientific point of view, that was also discussed in the local groups. Note that the rules for the scientists were to base their assessment on an analysis of sustainability objectives in political texts on the European, national and Alpine scales. The objective was to avoid producing a specific and personal point of view on sustainability by scientists. Despite the analysis of political objectives, it is clear that such a risk exists. Multi-disciplinarity and involvement of a numerous scientific team are useful complementary precautions.

5.1.3 Sustainability indicators

Concerning the problem of the implementation of sustainability, many scientists attempt to measure the level of sustainability and monitor its evolution with the help of indicators. Authors (Panell & Schilizzi (1999) have argued that sustainability indicators are a practical and reasonable way to help private and public decision-makers to orient their action toward sustainability. This explains the wide range of sustainability indicators produced in scientific literature over the last decade (OECD (1991), OECD (1995), UNCSD (1996), Rennings & Wiggering (1997), Baldock (1999)).

Indicators are often defined on the basis of a scientific definition of sustainability objectives. In the SAGRI-ALP project, we linked the definition of indicators with sustainable-agriculture objectives set by political texts. We created an indicator system **for the evaluation and convergent understanding between different people and different scales** (field level, farm level, local level) concerning sustainability in Alpine agriculture based on:

- an analysis of sustainability objectives noted in legal and political documents;
- use of this set in five areas representative of Alpine diversity;
- analysis of the ability of this set to take into consideration desires and sustainability objectives expressed by local groups of actors.

This set is reusable for an assessment of the sustainability of agriculture in other Alpine areas. But it may have to be updated:

- **if new sustainability objectives appear in new political and legislative documents;**
- **if it is used in regions not represented by the five areas in the SAGRI-ALP project, e.g. the southern Alps.**

5.1.4 Farming-system concept and modelling of scenarios

In the farming-system theory, the farm is considered an organised and finalised system. A farm system may be defined as a "series of decisions in order to reach one or many objectives using means within a set of constraints" (Sebillotte (1979); Duru & al. (1988)). This approach makes it possible to understand the choices made by farmers.

To carry out farming-system analysis, we developed functional plans of farms (Capillon & Manichon (1991)). These functional plans represent the links between different farm components (objectives of the farmer and his family, production means, land use, choices of agricultural practices, etc.), technical and economic results, and an evaluation of sustainability concerning environmental, economic and social aspects. These functional plans allow us to analyse the farmer's difficulties in implementing action for sustainability. We combined this farming-system approach with computer simulations (linear programming) to evaluate the economic (income), environmental (land use, fertilisation) and social (workload) impact and feasibility on the farm level of different scenarios targeting sustainability.

This association of farming-system analysis and linear modelling produces practical results that are useful in designing concrete plans of action:

- **the use of simulations allowed us to assess the economic impact of different scenarios;**
- **the farming-system analysis allowed us to understand the choices of farmers, which often diverge from a single economic objective (as in linear-programming models which maximise the gross margin).**

5.2 Critical review of the method

Agricultural land-use systems are "complex systems", i.e. there are strong interactions between components, feedback loops, spatial diversity, uncertainties, difficulties in forecasting changes, etc. Addressing the sustainability of this type of human economic-ecological system adds to the complexity and introduces the ethical dimension of sustainability. This implies a new methodological step to integrate the scientific data and values related to this multidimensional and social problem. We assumed that to fully take into account this complexity, an interdisciplinary approach was required.

5.2.1 The decision to organise an interdisciplinary approach

Disciplines are often barriers because they promote different cultural attitudes and viewpoints. It is useful to combine these different and often complementary points of view. To integrate these different viewpoints, participants in an interdisciplinary program must share a consensual model of the studied issues (Hyman and Wernsted (1994)). Concretely, they must agree on how to state the studied problem and on the relevant questions, the kind of data needed, the role of scientists. For the SAGRI-ALP project, this consensual agreement was progressively obtained by developing a conceptual framework (Figure 1. From the principles of sustainable development to their implementation on the local level). That required time and debates during the management-committee meetings.

The need for a common framework. **The framework ("from the principles of sustainable development to their implementation on the local level") is not just an agenda or an experimental plan. By showing the links and feedback loops, it conceptualises the issues and the scientific organisation**. It also provides a common language for all participants and avoids establishing a hierarchy between disciplines and the people involved. Concretely, the project was a succession of disciplinary tasks and interdisciplinary modelling. This cooperative effort includes not only exchanges of data and variables, but also supports common synthetic tasks such as formalising indicators and creating models and scenarios.

The disciplines involved, from economy to agronomy and sociology, are used to develop specific methods which are combined to form a consistent approach. This whole approach is original and creative because it brings together natural and social sciences, involves both scientists and local actors, integrates both local and global perspectives. The mono-disciplinary tasks are simpler and are based

upon standard and validated methods. This guaranties the feasibility and the reliability of each submodel or assessment in a consistent approach, but limits individual disciplinary progress.

5.2.2 Continuing involvement of actors

Synergy between scientists and local people was obtained thanks to the future workshop method.

- The involvement of local people was the means to test the understanding of the popular but still fuzzy concept of sustainability. The comparison with the scientific translation and the comparison between countries was innovative and could assist policy making.
- The involvement of scientists increased local awareness of global aspects of the sustainable-development issue and provided a scientifically tested assessment of local development and the environment.

Participation by citizens was probably stimulated by the possibility of simulating scenarios based on both their own values and the scientific data, as well as the possibility of debating directly with scientists on these perspectives. Promoting such interactive investigations and research is probably a good investment over the long term in view of improving governance of complex human systems.

6 CONCLUSION - INNOVATIVE RESULTS TO ASSIST IN DESIGNING ALPINE AGRICULTURE

The local level is a major issue for the implementation of sustainability, in that it is the "connection" level between global values and institutional regulations on the one hand, and the wishes, projects and actions of local actors on the other. Consequently, improving sustainability on the local level means collective change in action by all actors and requires that people share a common view on the long-term evolution of the territory. To achieve this, new ways of sharing information and making decisions have to be implemented on the local level, by bringing together local government structures with local economic and social organisations and representatives of actors. To help local people in this evolution, we propose a method **to facilitate local coordination, prospective reflection and scenario analysis**.

- Integrating global and local issues of sustainability. Associating a scientific assessment based on an analysis of sustainability objectives in political texts on the Alpine scale, and the assessment of local actors may be used to solve frequent contradictions between global and local sustainability problems. Examples are air and climate change, and some aspects of biodiversity (e.g. a species that is rare on the European level and abundant on the local level). These topics are not easily understood by local groups. The scientific assessment of sustainability and the possibility to debate its results in the local groups are an efficient contribution to integrating global issues of sustainability in local concerns.

- Deriving short term plans of action from long term perspectives. The method of prospective reflection by actors is focussed primary on the long term, but it leads to a plan of action for the short term. This makes it possible to take into account the temporal dimension of the sustainability, i.e. acting today to avoid compromising the future of later generations.

- Implementation of new governance processes on the local level. The project formulation stage followed by the implementation of action is a factor favouring the progressive establishment of the participation principle. First during project design, then its actual implementation by the local actors in three of the five regions participating in SAGRI-ALP. This favours the implementation of new governance methods that are more democratic and participative, and better suited to sustainability.

- Policy recommendations to strengthen the implementation of sustainable agriculture. They concern both general policies implemented on a large scale (Rural development regulation, market policies, etc.) and tools to enhance local participation (Leader +, innovative action, etc.). Targeting practical implementation, we address both possibilities of using current policies and general strategies.

- An operational and reproducible method on the Alpine scale. In our work, we used the "future workshops" method and a list of indicators. The different steps of the process are presented in order to be reproducible on the Alpine scale and the list of indicators will measure the level of sustainability and monitor the evolution of agriculture.

This process has been structured and organised in a methodological set of "Guidelines to formulate local plans of action for sustainable agriculture" presented in this final report, including the successive steps in the process, their objectives, as well as the tools, methods and expected results at each step. To ensure practical use of this process, our objective is to publish a handbook usable by local leaders and actors involved in rural development. This management framework will include a complete presentation of each phase of the process, including detailed step-by-step procedures, check lists, elaboration of alternative methods, work techniques (leading the local group, scientific assessment with indicators of sustainability, farm and scenario analysis), etc. This will enable easier implementation of the process and the guide will be helpful in implementing different procedures such as RDP, LEADER +, etc.

Alpine economic growth, the key function of agricultural land in the development of Alpine tourism, the quality policy already implemented by Alpine farmers, the good image of products, may place Alpine agriculture in a better situation to adapt to the new ways of producing required by the new economic and environmental constraints than many intensive agricultural zones in lower areas. Consequently, we assume that Alpine areas are good experimental sites to test the capacity of agriculture to change its relations with society and nature and to meet the challenge of sustainability.

The success of the SAGRI-ALP project confirms both this hypothesis and the interest and the effectiveness of the process used to mobilise local actors and accompany them in the elaboration of a sustainable-agriculture project. The willingness of local actors to start the implementation and demonstration phase is currently very high and it is now time to implement the plans of action in each area.

TECHNOLOGY IMPLEMENTATION PLAN

The results of SAGRI-ALP are:

- a comparative analysis of the limits of sustainability, its potential and trends in the rural areas of the Alps;
- regional guidelines with concrete indicators, objectives and plans of action to implement sustainable agriculture in the five research areas;
- final recommendations for the European Commission to implement a regionally adapted policy concerning sustainable agricultural land use in the Alps;
- an Alpine guideline to promote and build up local projects involving local people and targeting sustainable agriculture.

The results will be disseminated as follows:

To the officers of the European Commission :

- Final report including policy recommendations
- Presentation and discussion during a final meeting (planned for the 25th April 2001).

To local actors and stakeholders:

- Dissemination of the regional report 4 ("Regional guideline for sustainable agriculture"). This regional guideline has been written during the duration of the project. The last locla meeting has been used to discuss the major local issues of the project

To local actors, policy makers and stakeholders:

- **Implementation of local plans of actions in favour of sustainable agriculture and scientific evaluation of the feasibility of such experiments**. That's why we proposed to realise a demonstration project managed by local people and framed by scientists in order to give a scientific value to this work. This demonstration project has been submitted to the 5th research and technological development program in October 2000 ("demonstration of sustainable agriculture implementation in alpine mountain", acronym: IMALP, Dossier : QLRT-2000-01282). Despite a negative evaluation of independent experts ("the proposal does not qualify as a demonstration"), the willingness of local actors remain very high. We are now searching more relevant programs to implement the action plans and to assess them with scientific methodologies (i.e. LEADER +, INTERREG III).

To local leaders, activators and actors involved in rural development:

- **Edition of a management framework presenting in details the guideline to build up local action plan in favour of sustainable agriculture**. This handbook will include a complete presentation of each phase of the process, including detailed step-by-step procedures, check lists, elaboration of alternative methods, work techniques (leading the local group, scientific assessment with indicators of sustainability, farm and scenario analysis), etc. This will enable easier implementation of the process and the guide will be helpful in implementing different procedures such as RDP, LEADER +, etc. The current objective is to find an editor and financial aid to publish this handbook.

To the scientists:

- Publication of the most important results in scientific journals: a scientific synthesis is planned
- Presentation of the results at European seminars and conference: in continuation to the presentations realised during the project we proposed a paper and a communication to the world mountain symposium (30 September to 4 October 2001 ; Interlaken ; Switzerland).

After agreement of the EC the final report will be available on the web site of the coordinator: www.suacigis.com

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